AMLaP 2012 Conference
Riva del Garda, Italy

September 6-8, 2012

Welcome to AMLaP 2012

Architectures and Mechanisms for Language Processing (AMLaP) is an international conference started in 1995 with the aim of fostering interdisciplinary research and idea dissemination on how people process language. After 18 meetings, the conference has established itself as the main European venue to discuss psychological, computational, and theoretical perspectives on the cognitive architectures and mechanisms which underly any aspect of human language processing, from lexical processing, parsing and interpretation, through to discourse level mechanisms.

Submissions to the conference span all areas of empirical language study, including symbolic and connectionist computational models, corpus-based studies and statistical mechanisms, cross-linguistic studies, processing and production of morphology, syntax and semantics both within and across sentences, lexical representations, discourse comprehension, learning mechanisms, models of acquisition, neurobiology of language processing, parsing, the interpretation of prosody, and much more.

This year AMLaP is back in Italy after 16 years, under the sponsorship of the University of Trento. The event will take place in Riva del Garda, a world-renowned center for hiking, climbing and sailing, in the Alps at the Northern tip of Lake Garda. We hope you enjoy the conference and its venue.

The AMLaP 2012 Organizing Committee

Giovanna Egidi
Uri Hasson
Remo Job
Francesco Vespignani
Roberto Zamparelli

AMLaP Student Prize

As in previous editions, AMLaP will award a prize for exceptional work headed by a student. One award (500 Euro) will be given for work selected for oral presentation whose first author is a student or early-stage post-doc (3 years from PhD) and two awards (250 Euro each) will be given to the two best posters whose first author is a student or early-stage post-doc (3 years from PhD).

A panel of experts will be asked to select talks and posters, presented by a student, which exemplified the themes of the conference through clear presentation, experimental design, and relevance. The winners of the prizes will be announced at the end of the conference.

This year prizes are founded by the Fondazione Marica De Vincenzi o.n.l.u.s., a no profit organization that honors the memory of our friend and colleague Marica De Vincenzi, co-organizer of the 2nd AMLaP conference, held in Turin, Italy, in 1996.

Acknowledgements

We wish to acknowledge the financial and organizational support of the following bodies:

- Associazione Italiana di Psicologia (AIP)

- Centro Interdipartimentale Mente e Cervello (CIMeC), Università di Trento.

- Dipartimento di Scienze della Cognizione e della Formazione (DISCoF), Università di Trento.

- Facoltà di Scienze Cognitive, Università di Trento.

- Fondazione Marica De Vincenzi ONLUS.

We would like to thank all the researchers who submitted their abstracts to the conference. We received about 320 submissions from many countries (see Figure 1). The acceptance to the oral presentation was extremely selective and, sadly, many good talks had to be excluded. 35 oral talks and 201 posters were accepted. We try to give justice to the variety of themes and ideas present in the abstracts by offering four large poster sessions and ample time for informal discussion.

We also want to thank the over 360 colleagues who devoted their valuable time to reviewing the submissions, as well as the creators of the Easychair Conference System, which made this volume of submission processing feasible. Special thanks to Matthew Crocker, Martin Pickering, Barbara Hemforth and Gerry Altmann for their advice in dealing with the many facets of the organization of the conference, and to the staff of the Ufficio Congressi at the University of Trento for assistence.

Finally, we want to thank Seana Coulson (University of California San Diego), Luigi Rizzi (Università degli Studi di Siena) and Arthur Samuel (Basque Center on Cognition, Brain and Language; Ikerbasque; Stony Brook University) for accepting to be our keynote speakers at AMLAP 2012.
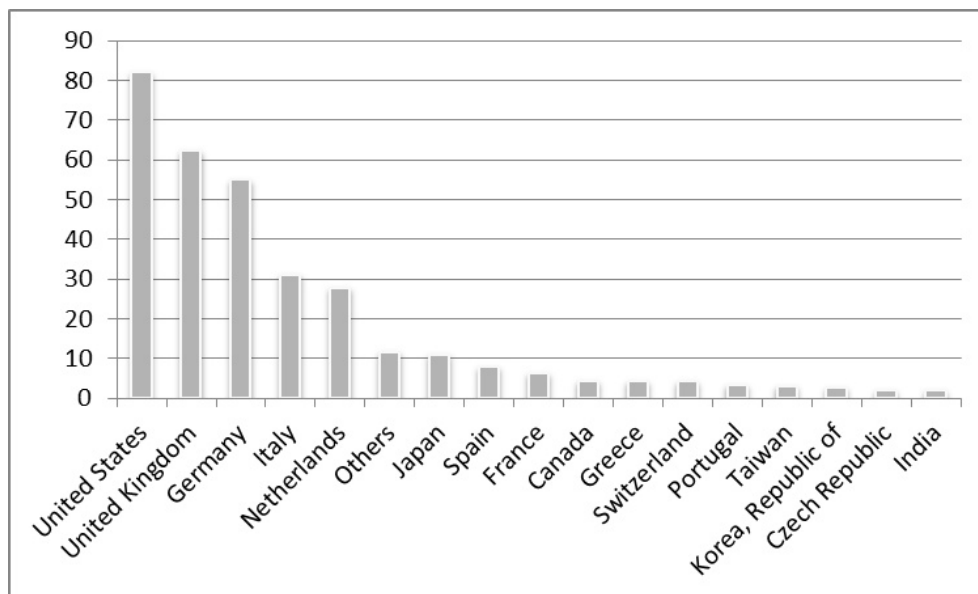

Figure 1: Submissions by Country

Errata Corrige

This electronic version of the book of abstract may differ in some respect with the printed version. In particular we are regret to inform that one poster is missing in the printed verion of this book (see poster at page 224) and six posters have been excluded from the final program of the conference since no one of the Authors was able to participate. In order to keep the same page numbers across versions a white sheet was inserted for missing abstracts. Other minor differences may arise: in case Authors find errors they are invited to communicate us at amlap2012@unitn.it

Conference Program

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Indexes

Locality and Complexity in Syntactic Theory and Language Acquisition

Luigi Rizzi

Università di Siena, Italia

Syntactic dependencies respect fundamental locality principles. One crucial concept underlying syntactic locality is intervention. For instance, Relativized Minimality (RM: Rizzi 1990) and its variants (the Minimal Link Condition, Minimal Search, etc.: Chomsky 1995, Chomsky 2000) block a local relation across an intervener which shares certain structural properties with the target of the relation. This principle explains various kinds of island phenomena: wh-islands and negative islands in A'-dependencies, and various locality effects in A- and head-dependencies. Intervention is also instrumental in identifying configurations which are harder to acquire, and more prone to language loss in pathology (Grillo 2008, Friedmann, Belletti, Rizzi 2009). Certain intervention configurations are grammatical and accessible to the adult processing system, but are harder and slower to process with respect to comparable configurations without an intervener (Gordon, Hendrick & Johnson 2004, and the reinterpretation of their results in terms of RM in Belletti & Rizzi 2012). Intervention thus seems to play a role both in grammaticality effects uncovered by theoretical and comparative linguistics, and in complexity effects observable through the experimental techniques of developmental and adult psycholinguistics. The question arises of whether a common basis can be identified underlying such apparently diverse manifestations of intervention. A promising tool to attempt a partial unification is the featural conception of Relativized Minimality (Starke 2001, Rizzi 2004), according to which an intervener affects a local dependency when it matches the specification of the target of the dependency with respect certain critical morphosyntactic features. A featural approach raises the possibility of expressing graded effects, as the featural matching between two syntactic positions may be full, partial, or null. In the talk I will explore a featural approach encompassing standard locality effects studied in formal linguistics and complexity effects uncovered in experimental research in language acquisition.

Indexical Effects and Phonetic Recalibration: Episodic Properties of the Mental Lexicon

Arthur G. Samuel

Basque Center on Cognition, Brain, and Language Ikerbasque Stony Brook University

The mental lexicon plays a central role in models of spoken word recognition, with the lexicon seen as a collection of lexical representations that include phonological, orthographic, syntactic, and semantic information. I will discuss two lines of research that implicate episodic properties of lexical representations that seem quite different in character than these properties, as they are not linguistic at all.

One research line examines constraints on lexically-guided retuning of phonetic category boundaries. Exposure to phonetic tokens that are near the boundary between two categories produces a relatively durable shift in the boundary, with the direction of the shift determined by the lexical context. The occurrence of this recalibration is subject to aspects of the carrier word's presentation that are clearly nonlinguistic, including the presence of an object in the speaker's mouth, and the visual appearance of the speaker.

A second line of work extends prior research on "indexical" effects, aspects of a word́s production that are again nonlinguistic (the voice of the speaker, whether the speaker sounds happy or sad, etc.). Some models of lexical representation have added "slots" for these speaker-related properties to each lexical entry. We show that a more explicitly episodic notion of lexical representation is needed, one that can include seemingly quite extraneous aspects of a word's presentation. These representations are more like representations of nonlinguistic, environmental sounds than has been suggested. Collectively, the data suggest that lexical entries are best thought of as what they really are: Memory representations.

Getting to the Bottom of Context Effects

Seana Coulson

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I will examine a few prominent ways in which the notion of context is understood in the language sciences, and evaluate them based on recent data from my laboratory. For example, one series of experiments contrasted the way that lexical versus discourse-level information impact the brain's real time response to words, as measured by event-related brain potentials (ERPs). Data indicate that discourse congruence can affect multiple aspects of word processing, and show how the full availability of contextual information requires time. These studies suggest context effects on word processing are perhaps not best characterized by the traditional metaphor of vertically arranged levels of processing, but rather by how quickly the relevant form of information becomes available.

Indeed, traditional models of language comprehension are argued to involve an over-attribution of the import of linguistic information, and an overly narrow view of the role of background and contextual knowledge. In contrast, the space structuring model accords background and contextual knowledge a central role in the construction of meaning. Inspired by work in cognitive semantics, the space structuring model holds that meaning is actively constructed by language users in response to their communicative goals. Linguistic information then does not convey meaning, but rather triggers various processes of meaning construction, such as the activation of frames, the establishment of mappings, and the integration or blending of information from different domains. In support of these claims, I describe a series of event-related brain potential (ERP) studies that test whether iconic co-speech gestures prompt meaning construction processes similar to those invoked by other sorts of background and local contextual information. These data suggest speakers utilize conceptual integration processes to combine linguistic information with visual-spatial and motoric information made available through gestures.

The Role of Morphological Structure in the Processing of Complex Forms: Evidence from Setswana Deverbative Nouns

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Keywords: Derivational processing; Setswana; visual word recognition; masked priming.

Current research on morphological processing focuses on the question of whether the morphological structure of a complex word like *neat-ness* plays a role in processing or whether morphological effects can be reduced to the combined effects of shared forms and meanings (e.g. Feldman, 2000). This paper contributes to this debate by investigating deverbative nouns in Setswana, a Bantu language. Setswana Class 9 derivations are not readily segmentable into an obvious stem and affix (*tsheko-seka 'court case-stand trial'*) in contrast to other noun classes such as Class 1, where the prefix *mo-* and suffix *-i* transparently indicate deverbal nouns (e.g. *moseki-seka 'the accused- stand trial'*). Moreover, Setswana has "pseudo-derived nouns", which look as if they are derived from a verb, but are in fact not morphologically or semantically related to a verb (*kgabo-gaba 'large fire-pull stomach in'*).

We present results of (i) a frequency analysis for deverbative nouns in an existing corpus of Setswana (Otlogetswe, 2010), (ii) a subjective frequency rating survey with 25 participants, (iii) a visual word-non-word lexical decision experiment with 83 participants, and (iv) a masked priming experiment with 53 participants. The findings show that frequency measures derived from the existing Setswana corpus correlate significantly with the subjective frequency ratings from the survey, suggesting that they reflect speakers' intuitions despite being based on more formal written texts. Moreover, the lexical decision experiment shows significant word-form frequency effects for both Class 1 and Class 9 derivations: the more frequently speakers encounter a word form, the faster they recognise it as a word. This suggests that stored complex word forms play a role in the processing of both noun classes under investigation. In the masked priming task, prior presentation of a morphologically related prime-form (*kitso-ITSE 'knowledge-KNOW'*) speeded recognition times for both deverbative classes significantly, compared to a baseline with unrelated primes (*bobi-ITSE 'spider web-KNOW'*). However, reaction times for the morphologically related conditions were significantly slower than the reaction times for the identity priming conditions. Such partial priming effects did not occur for pseudo derivations (*morafe-RAFA 'tribe-PILE ON'*) or for forms that only overlap in form (*moroba-ROBA 'fun-BREAK'*). This suggests that stored word forms may play a role in morphological processing, but that morphological structure affects the processing of complex word forms independently of pure form overlap. This supports models of morphological processing in which both whole-word representations and morphological structure play a role.

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Otlogetswe, T.J. (2010). *Setswana Sketch Engine Corpus*. http://www.sketchengine.co.uk/

The Tell-Tale Eye: Fixation Times Indicate Morpho-Semantic Effects in Masked Priming

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Keywords: morpho-orthographic segmentation; task effects; masked priming; eyetracking

The dominant hypothesis in the literature on visual word recognition conceives that morpheme representations are routinely accessed on the basis of morpho-orthographic information at early stages of processing (Rastle, Davis & New, 2004). This is supported by the masked priming evidence showing facilitation in both transparent (e.g., dealer-deal) and opaque (e.g., corner-corn) prime-target pairs, compared to orthographic controls (e.g., brothel-broth). However, this paradigm is extremely sensitive to task manipulation and the morpho-orthographic effect was shown to disappear when participants were asked to judge whether two letter strings are identical, rather than making a lexical decision (Duñabeitia, Kinoshita, Carreiras & Norris, 2011). This was taken to show that morpho-orthographic segmentation is not an obligatory step in visual word processing. However, since the task used by Duñabeitia et al. (2011) does not require lexical identification, it is still possible that morpho-orthographic segmentation is indeed necessary for this to take place. In the present experiment we addressed this issue by asking semantic judgements and measuring fixation times in a masked-priming paradigm.

150 Italian prime-target pairs were chosen, each of them belonging to one of three conditions: trasparent (artista-ARTE, artist-ART), opaque (retaggio-RETE, legacy-NET), and form (corallo-CORO, coral-CHOIR). In order to evaluate priming effects, these were compared to an unrelated condition, in which the targets were preceded by control words. A fixation point was presented close to the left edge of a computer screen. The prime word was shown there for 35ms, and was then substituted by the correspondent target word, along with a number appearing at the right edge of the screen. Participants were asked to understand the target word and then look at the number. Since the target screen disappeared after 700ms, the number stimulus was introduced to force readers to move their eyes away from the word as quickly as possible. Fixation times on the target word were thus employed as an index of processing time. In 15% of the stimuli, a question regarding the target word meaning was presented after the trial.

A significant facilitatory priming effect was found for both first-fixation and gaze durations in the transparent condition. No priming effect was otherwise found in either the opaque or the form condition. In other words, a morpho-semantic effect emerged, in contrast with the morpho-orthographic effect traditionally described in the masked-priming literature. The morpho-orthographic segmentation would thus not be an obligatory step in lexical access, but a phenomenon that is strongly dependent on the lexical decision task.

References

Duñabeitia, J. A., Kinoshita, S., Carreiras, M., & Norris, D. (2011). Is morpho-orthographic decomposition purely orthographic? Evidence from masked priming in the same-different task. *Language and Cognitive Processes, 26* , 509-529

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Listeners Decode Acoustic-Phonetic Cues to Morphological Structure

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Background

The acoustic-phonetic signal is rich and multidimensional. Listeners have been shown to decode many kinds of information from this signal. Detailed phonetic work shows that information about morphological structure is also encoded in the signal (Smith, Baker & Hawkins 2012). There are systematic phonetic differences between true prefixes (e.g., *dis*- in *discolour*, or *mis*- in *mistimes*) and phonemically identical pseudo-prefixed sequences embedded in monomorphemic words (e.g., *discover*, *mistakes*). Other true/pseudo-prefixes also include a phonemic change (e.g., *re*- in *refueling* [true] vs. *refusing* [pseudo]).

Methods

Our experiment tested the hypothesis that listeners are able to decode information about morphological structure from these sometimes subtle but systematic cues. We created 32 sentence pairs that were matched up to the target syllable (e.g., 'I'd be surprised if the boys *discolour* them' vs. 'I'd be surprised if the boys *discover* them'). They included phonetically subtle 'dis' and 'mis' types and phonemically different 're' types. An additional 67 fillers were also created. Pairs were recorded and cross-spliced after the target syllable (e.g. *dis*-) to create versions in which the acoustic details of the critical syllable either matched or mismatched the morphological structure of the whole word. Thirty-six native English participants were shown pairs of photographs, representing the sentence pairs. On each trial they heard one of the sentence stimuli and were asked to click on the appropriate image while their eye-movements were monitored. The procedure was repeated again a week later, with each participant hearing a new set of stimuli. To assess whether listeners would adapt to inconsistent acoustic cues, they heard only matching stimuli on one day and only mismatching stimuli on the other day – order of days was counterbalanced across subjects.

Results

Listeners were delayed in looking to target pictures when the target syllables mismatched the morphological structure of the words (p <0.001). For syllables of type 're' which had a phonemic as well as a morphological contrast, and (on average) later sentence disambiguation points than 'dis' and 'mis' type sentences, the effect was larger but looks to the target increased more slowly and there was less anticipation. Listeners were more biased to look at the true-prefix picture when they heard a true prefix and at the pseudo-prefix picture when they heard a pseudo prefix (p <0.001) additionally, there was a tendency for the true prefixes to create a stronger bias. There was also evidence that the listeners who heard all mis-matches on the first day used the acoustic information differently from those who heard matches on the first day, suggesting that they had stopped using the (now unreliable) acoustic information and were relying on other information such as the disambiguation of the sentence.

Conclusions

Our results show that listeners in fact decode cues to the morphological structure of words from the fine detail of the acoustic signal alone. This suggests that cues to morphological structure are part of the lexical representation and in some cases can cue lexical access more quickly than phonemic cues.

References

Smith, R., Baker, R., & Hawkins, S. (2012). Phonetic detail that distinguishes prefixed from pseudo-prefixed words. *Journal of Phonetics*. http://dx.doi.org/10.1016/j.wocn.2012.04.002.

When Stems Mean More than Words: The Acquisition of Morphological Structure in German 11-12 and 14-15 Year-Olds

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Lexical representation in Indo-European languages like English is assumed to be determined by meaning compositionality (e.g., Rastle, Davis, Marslen-Wilson, & Tyler, 2000). Morphologically complex words that are semantically related with their base (*successful*) are represented via the base {success}, whereas words that are semantically unrelated with the base (*successor*) must be represented as whole words {successor}.

However, this concept of lexical representation is in stark contrast to previous findings in German where morphological effects have been found regardless of meaning compositionality (e.g., Smolka, Komlósi, & Rösler, 2009). Base verbs like *stehen* ('stand') are activated to the same extent by prefixed derivations that are semantically transparent like *aufstehen* ('stand up') as they are primed by semantically opaque derivations like *verstehen* ('understand'). These findings thus suggest that a complex verb in German like *understand* is lexically represented via its base {stand}.

The present study explored the development of such lexical representations in German—when and how do they become independent of meaning compositionality? To this end, three visual priming experiments were conducted by testing ninety 11-12 year-old children, eighty 14-15 year-old children, and sixty adults. To tap into lexical processing and representation, overt priming was used (i.e. primes were consciously perceived at 500 ms SOA), and prime-target relations were manipulated between morphological, semantic, and form relatedness. Priming to a base verb like *binden* ('bind') was measured relative to matched unrelated conditions and compared between complex verbs that were (a) morphologically related and semantically transparent with respect to the base (*zubinden*, 'tie'), (b) morphologically related but semantically opaque with respect to the base (*entbinden*, 'deliver'), (c) purely semantically related with the base (*zuschnüren*, 'lace up'), or (d) purely form-related with the base (*abbilden*, 'display'). Pre-tests collected age of acquisition and age of reading (i.e., the age at which a child encounters a word in text) and confirmed that children were familiar with the complex verbs. A semantic association test confirmed that prime-target pairs in conditions (a) and (c) were rated as highly meaning related, those in conditions (b) and (d) as unrelated.

Similar to adults, children in both age groups showed neither (c) semantic nor (d) form effects, but strong morphological priming by both (a) semantically transparent and (b) opaque derivations. However, unlike with adults, the morphological facilitation was affected by meaning compositionality: Semantically related derivations induced stronger priming to the base than semantically unrelated ones. Moreover, this effect interacted with age: it was more strongly pronounced in the younger than in the older children and absent in the adult group.

While the former finding indicates that children access the base {bind} regardless of the meaning compositionality of the complex verb, the latter finding indicates that the children's system requires further exposure to morphological regularities so as to generalize morphological structure above and beyond meaning compositionality, as is the case in the adult system.

Altogether these data provide evidence that morphological regularities are acquired in morphologically rich systems like German.

References

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Exploring Representations of Event Duration in Language

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Keywords: semantic processing; temporal information; language comprehension

Previous studies have shown that durative events (*to owe money*) take longer to read than punctual events (*to lose money*) (Coll-Florit and Gennari, 2011). Similarly, in narrative comprehension, larger temporal distances between events take longer to process (Zwaan, 1996). This suggests that longer events and temporal distances recruit more semantic information during processing. However, distance effects in narratives may be due to recruiting knowledge of causal connections between events (the longer the connection, the longer the processing). Similarly, comparison across different verbs (*to owe* vs. *to lose money*) may be due to differences in causal event structure. Therefore, it remains unclear what type of information is recruited when processing long events.

To address this issue, we constructed materials like (1) in which the discourse relations and the event referred to stay the same and only the event duration interpretation varies due to minimal changes in the preceding context (plausibility didn't differ across conditions).

(1)   *Molly felt like doing some work around the house.*
         Long condition: *She had <u>three hours</u> to spare before her appointment*
         Short condition: *She had <u>an hour</u> to spare before her appointment*
         She spent all that time <u>altering her dress</u>.

In Experiment 1, we tracked participants' eye-movements while looking at objects on the screen (quadrant array) containing only one object related to the story being heard (e.g. a dress, for example (1)). Participants only heard one condition for each item (long or short). Results indicated that first fixation durations on the relevant object (dress) were longer for the long condition while hearing *her dress (p < .05).* These results were replicated (Experiment 2) with a different set of materials in which the scale of the events' duration was longer (e.g., building a house in two weeks vs. a month).

In Experiment 3, we used the same stimulus materials in a probe recognition task. After reading stories like (1) (with an additional final sentence to avoid recency), participants were presented with words (e.g. dress), and were instructed to indicate whether the word had occurred in the story. We found that participants were faster in recognizing words in the short-version of the story than in the long-version (p < .05), indicating that longer events are less accessible from memory.

These results indicate that event duration effects prevail even when the same verb and narrative structure are used in the stimuli. This suggests that the representation of an event's internal development is more complex for longer events. We argue that understanding longer events recruits experience-based knowledge of the sub-events that would likely occur, given the context, thus leading to more processing cost.

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Competition in the representation of multiple instantiations of the same object: Evidence from eye movements

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As objects in a linguistic discourse are described as moving from one location to another, or undergoing change from one state to another, language users must update their object-representations, and keep track of multiple instantiations of the same object. For example, with "The squirrel will crack the acorn. But first, it will lick the acorn," language users must maintain two distinct representations of the acorn – before and after it was cracked. With "The squirrel will sniff the acorn…," no state of change occurs, so language users only need to maintain one representation. Hindy, Altmann, Kalenik & Thompson-Schill (2012) compared sentences like these, and found greater BOLD response in LIFG (an area associated with conflict resolution; Kan & Thompson-Schill, 2004) for "crack" compared to "sniff." These results suggest that multiple instantiations of an object that has undergone a state change compete during language processing. In the current study, we used the visual world paradigm to investigate competition effects due to changes of state and changes of location (e.g., with "move the…," language users must maintain two distinct representations – before and after it moved; Altmann & Kamide, 2009). Critically, we tested whether changes of state elicited more competition than changes of location.

Participants (N = 96) heard sentence triplets like 1—3 while viewing a scene depicting a *box*, a *bowl*, some *butter*, a *woman*, and distractors. Importantly, the target egg was never depicted. The second sentence described the egg either remaining in its original location (2a), moving to a new location (2b), or moving to a new location and undergoing a state change (2c). During the final reference to "the egg," we found evidence for greater competition when the egg was associated with two instantiations (2b/c) compared to one (2a). For example, participants looked at the *box* (the original location, implied by "But first") more when the butter was put into the *bowl* (2a) compared to when the egg was moved/cracked into the *bowl* (2b/c). Conversely, participants looked at the *bowl* (new location, irrelevant given "But first") more in 2b/c than 2a. This suggests that additional instantiations of the egg increased conflict, which made the relevant representation less accessible. By contrast, we found no additional competition due to state change: eye movements did not differ between "move/crack the egg" (2b/c). This suggests that increases in the number of associated locations, rather than the type or degree of change *per se*, provides a greater source of competition in a visual-world context.

Examples
1. *Jane was happy to see there was an egg in the box.*
2. *She will (a) move some butter (b) move the egg (c) crack the egg into the bowl.*
3. *But first, she will sniff the egg.*

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Linking Cognitive Control to Revision of Garden-Path WH-Questions in Adults and Children

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Keywords: Sentence processing; WH-Questions; Language-cognition interface

Previous sentence processing research on garden-path recovery found that children fail to revise initial parsing commitments (Trueswell et al., 1999). This may result from their immature cognitive control (Novick et al., 2005), but so far there is little empirical support for this hypothesis. The present study with adults and children presents affirmative evidence by showing a tight link between cognitive control abilities measured in the Dimension Change Card Sorting Task (DCCST) and sentence revision in French garden-path WH-questions.

Thirty 6-year-olds (mean=6.8yrs) and 23 adults took part in two tasks. A Question-after-Story comprehension task presented French translations of temporarily ambiguous WH-questions like "Where did Aline explain [in the kitchen]PP that she was going to catch butterflies?" Here, listeners were expected to initially attempt WH-attachment to the main verb (MV) due to active gap filling biases and subsequently revise WH-attachment to the embedded verb (EV) due to the presence of overt PP (filled-gap) that blocks MV attachment. A globally ambiguous version without the overt PP was also presented to establish their default interpretation preference. The target questions followed cartoons that made both MV and EV attachment equally feasible.

We measured the offline response to the questions as well as response time (RT) for children and eye-tracking data for adults. The DCCST measured accuracy and RT while adults and children sorted cards according to one out of two object features (shape or color). Critically, the sorting criterion occasionally changed during the experiment to force participants to inhibit their attention to the previously relevant object feature. Our analysis used a switch cost measure, which was the difference between RT/accuracy between trials where the sorting criterion remained the same and RT/accuracy in trials where the sorting criterion changed. That is, a smaller switch cost indicates stronger cognitive control.

Adults demonstrated a clear MV interpretation preference in the ambiguous condition (95%) and surprisingly, also in the filled-gap condition (74%), despite the filled-gap revision cue. Eye-movement data revealed that upon encountering the filled-gap, only adults who provided EV interpretations redirected their fixations from the main clause location to the embedded clause location. A mixed model analysis on the interpretation data yielded a significant interaction between question type and DCCST-switch cost in RT ($p<.05$), indicating that participants with stronger cognitive control performed more revisions (35% vs. 11%).

Children also showed a strong MV attachment preference in the ambiguous (87%) and filled-gap conditions (86%). This lack of difference between the two conditions confirms children's immature revision capacity. Children's RT in the Question-after-Story task did not show any systematic relation to the interpretation data. However, a mixed model analysis on the question-answering RT showed a significant interaction between question type and DCCST-switch cost in accuracy ($p<.05$), indicating that children with stronger cognitive control spent more time in providing (incorrect) MV attachment responses. We suggest that this slower reaction time reveals their attempt at revision.

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Subjects that matter: processing correlates of Basque subject-verb agreement

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Keywords: Agreement; Person; Basque

We explored the impact of discourse representation in subject-verb agreement comprehension by focusing on the asymmetry existing between 1st and 3rd person plural forms: the composite make-up of the former – a group including a participant (speaker) and non-participants (we=I+they) – contrasts with the homogeneous non-participant composition of the latter forms (they=he+he). To investigate the sensitivity of the comprehension system to this discourse asymmetry, we used a distinctive property of Basque: the proximity plural suffix *–ok*. Unlike the fixed 3rd person interpretation of *–ek* suffixes (e.g. *japoniarr-**ek***, the Japanese$_{pl}$), *-ok* suffixes shift the interpretation of the subject from 3rd to 1st person plural (e.g. *japoniarr-**ok**,* we Japanese).

In an ERP experiment, person mismatches were created with *–ok* and *-ek* suffixes (EK/OK mismatch) manipulating the inclusion/exclusion of the speaker in the subject and in verbal person (dute$_{3pl}$/dugu$_{1pl}$), as in (1) and (2) below. The experimental design included Subject type (*-ek* vs. *-ok*) and Verb Person (1st vs. 3rd) as factors.

(1)   a. Ikastaroan japoniarr-**ek**$_{3.pl.}$ euskara ikasi <u>dute</u>$_{3.pl}$ gustora.   -EK correct
       b.*Ikastaroan japoniarr-**ek**$_{3.pl.}$ euskara ikasi <u>dugu</u>$_{1.pl}$ gustora.   -EK mismatch
(2)   a.Ikastaroan japoniarr-**ok**$_{1.pl.}$ euskara ikasi <u>dugu</u>$_{1.pl}$ gustora.   -OK correct
       b.*Ikastaroan japoniarr-**ok**$_{1.pl.}$ euskara ikasi <u>dute</u>$_{3.pl}$ gustora.   -OK mismatch

       "In class, the Japanese /we Japanese learned Basque with pleasure"

Nineteen participants took part in the study. The experimental material consisted of 160 sentences (40 per conditions) intermixed with 80 filler sentences. The stimuli were presented word-by-word, and an acceptability judgment was required after reading each sentence. Electrophysiological responses were time-locked to the reading of both the subject and the verb.

Differences between *–ok* and *-ek* already emerged while reading the subject, with *japoniarrok* (example 2) eliciting a P600 effect relative to *japoniarrek* subjects (example 1). The reading of the mismatching verb (relative to the correct form) produced different effects in *–ek* and *–ok* incongruent conditions. Both incongruent verbs elicited an N400 effect, which was significantly larger for *–ok* mismatch (2b vs. 2a) than for *–ek* mismatch (1b vs. 1a) trials (p<.001). A P600 effect was found for *–ok* mismatch verbs but not for *–ek* ones, as evidenced by the significant Subject x Person interaction (F$_{(1,18)}$= 6.55, p<.01).

These data clearly show that ERP responses to person agreement violations modulate as a function of fine-grained discourse properties of the elements involved in the dependency. The sensitivity to the dissociation between *–ok* and *-ek* subjects emerging at subject position turns out to be crucial when verb information is processed. The detection of a person mismatch following *japoniarrok* causes greater discourse-level processing difficulties, as evidenced by the larger N400 effect compared to *japoniarrek*. Moreover, assuming P600 effects to reflect processes at different levels of analysis (syntactic and semantic-pragmatic, Burkhardt, 2006; Carreiras, Salillas & Barber, 2004), the presence of such an effect for *–ok* mismatches arguably reflects discourse updating (cf. Burkhardt, 2006) operations to accommodate the non-participant representation invoked by the verb with the speaker-related one underlying the subject. We interpret these findings as suggestive of the crucial role played by discourse factors in subject-verb agreement interpretation mechanisms.

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Differentiating the Benefits and Burdens of Intervening Material in German

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Keywords: parsing, sentence complexity, working memory, locality, reading

Sentence processing has long been known to be subject to locality effects: increasing the distance between two dependent items increases processing load. However, the last decade accumulated evidence for anti-locality effects as well: intervening material may also facilitate processing (Konieczny 2000). The present study contributes novel findings from German by considering different types of intervening material: relative clauses (RCs) and adverbial phrases (AdvPs). Two self-paced reading experiments investigated sentences like (1).

(1)   *Ich glaube, dass Peter das alte Haus, (das er (AdvP) ersteigert hat) (AdvP) aufwändig renoviert hat,*
I   think   that   P.   the old house that he   bought   has   costly   renovated has
was   sehr schwierig war.
which very difficult was
'I think that Peter (AdvP) costly renovated the old house (that he bought (AdvP)), which was very difficult.'

   AdvP = *letztes Jahr mit Hilfe von Susanne* ('last year with help by Susanne')

   In Experiment 1 (106 participants, 20 sentences), the complement clause appeared in four versions: (i) containing neither the RC nor the AdvP; (ii) containing just the RC; (iii) containing the RC and the AdvP outside of the RC; (iv) containing the RC and the AdvP inside of the RC. Experiment 2 (103 participants, 20 sentences) maintained the first three conditions but replaced the last one by a condition lacking the RC but including the AdvP.

   Locality-based theories (e.g. Gibson's DLT) predict that reading times for the complement clause verb (*renoviert hat*) should increase monotonically with increasing amount of additional material between the verb and its arguments. This prediction is not borne out by our data. First, including either the RC or the AdvP makes reading times faster, thus replicating the basic anti-locality effect. Second, when the RC and AdvP are both included, the effect depends on the position of the AdvP: when the AdvP occurs inside the RC, an even somewhat stronger anti-locality effect is observed; when the AdvP follows the RC, the anti-locality effect vanishes: reading times do not differ from sentences containing neither the RC nor the AdvP.

   This reading time pattern also challenges expectation-based explanations of the anti-locality effect (Konieczny, 2000; Levy, 2008). With regard to the complement clause verb, an AdvP outside of the RC is more constraining than an AdvP within the RC. This is not compatible with the position-dependent effect of the AdvP found in our experiments: the AdvP had a facilitating effect when it occurred within the RC but not when it followed the RC.

   In summary, our data show a facilitating effect of intervening material (either RC or AdvP) for the processing of the upcoming verb. The effect is strengthened when the AdvP occurs within the RC but cancelled when the AdvP follows the RC. We will show how this pattern follows by assuming that sentence processing is subject to working-memory constraints (locality effects) and expectation-based predictions (anti-locality effects) at the same time.

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Why Giving a Kiss is More Complicated than Just Kissing: It's All in the Mapping

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Keywords: light verb constructions; structural priming; generalization task; argument structure; syntax-semantics mapping.

Processing Differences between Light Verb Constructions and Non-Light Constructions

Behavioral and neurolinguistic studies have shown that light verb constructions such as "Andrew gave Janet a kiss" are processed differently than non-light constructions such as "Andrew gave Janet a present" (Wittenberg, Jackendoff, Kuperberg, Paczynski, Snedeker, & Wiese, to appear). We consider three hypotheses about the source of this processing difference:

Hypothesis-1: Light and non-light constructions have different syntactic structures.

Hypothesis-2: They have the same syntax, leading to unusual conceptualizations of events described by light verb constructions (kissing as a transfer of a kiss involving three participants: [GIVE[ANDREW,JANET,KISS]]).

Hypothesis-3: They have the same ditransitive syntax, which in the case of a light verb construction maps onto conceptual structure in a noncanonical way, namely as a two-participant event ([KISS[ANDREW,JANET]]) instead of a three-participant event ([GIVE[ANDREW,JANET,KISS]]).

We test these hypotheses using a standard syntactic priming task (Bock & Loebell, 1990) and a new task probing conceptual structure.

Evidence from Structural Priming and a Sorting Task

Prior studies show that production priming primarily reflects surface syntax of an utterance. Thus Hypothesis-1 predicts that priming from light to non-light constructions will be absent or reduced compared to priming within non-light constructions. In the first structural priming experiment, we primed non-light picture descriptions with light or non-light double-object sentences. Both light and non-light double-object sentences elicited more double-object picture descriptions than prepositional-object sentences. Preliminary results (Experiment 2) replicate this finding for non-light targets and extends it to light targets, demonstrating symmetric priming within and across light and non-light constructions in both directions. These findings show that the light and non-light datives share a common syntactic structure ruling out Hypothesis-1. However, if structural priming is solely based on syntactic structure, they have no bearing on Hypothesis-2 and Hypothesis-3.

We used a sorting task to disentangle these hypotheses. Hypothesis-2 predicts that light verb constructions are conceptualized as three-participant events, while Hypothesis-3 predicts that they are conceptualized as two-participant events. Participants were trained to sort pictures according to the number of roles/participants in the event. In the testing phase, participants were also confronted with light verb constructions ("give a kiss"), their base verb counterparts ("to kiss"), and non-light transitive and double-object constructions. Results show that, despite being syntactically identical to double-object constructions, light verb constructions were consistently sorted as two-role events (Experiment 3). Preliminary data suggest that this is true independent of the number of entities for each semantic role (Experiment 4). These results favor Hypothesis-3, suggesting that what is driving the difference in light verb processing is truly a mapping operation at the syntax-semantics interface.

Conclusion

Taken together, our results can explain reaction times and processing patterns in light and non-light constructions and make a contribution to the research on the relationship between syntactic and conceptual structure.

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Positional Constraints on Incremental Adjective Interpretation

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Keywords: Psycholinguistics; Semantics; Visual-world eye-tracking; Adjectives

Adjectives appear in prenominal (*the **big** bee*) and predicative positions (*the bee is **big***). We provide novel evidence of incremental differences between prenominal vs. predicative dimension adjectives. Intuitions suggest *dimension adjectives* in these positions are interpreted differently (Higginbotham, 1985):
In an atrium, birds and butterflies abound. A Giant Swallowtail butterfly, dwarfed by crows, passes.

<div style="text-align:center">

(1) That is a **<u>big</u>** butterfly.=True   [prenominal]

(2) That butterfly is **<u>big</u>**.=False   [predicative]

</div>

In contexts where the object is large *within its comparison class* (butterflies), but small *within a larger natural class* (flying creatures), (1) is true: the Giant Swallowtail is large within the butterfly class. However, (2) is false: that butterfly is not large within the flying-creature class. **Prenominal dimension adjectives** rely on head nouns for the interpretation of their <u>comparison class</u> (e.g., Klein, 1980) but **predicative dimension adjectives** are <u>flexible</u>. *Color adjectives,* however, are independent of comparison class: *That is a red car*/*That car is red* isn't asymmetric, unlike (1-2).

We used eye-tracking to investigate predicative/prenominal adjectives, particularly the role of the comparison class. Participants saw four-object displays (ex.5) and heard sentences like (ex.(3-4)):

(3) Exp1/Prenominal

(a) "Click on the {orange, red} zirby" [*Unambig+color, Ambig+color*]

(b) "Click on the {tall/short} blick" [*Unambig+dimension, Ambig+dimension*].

(4) Exp2/Predicative

(a) "Click on the object that I describe. It's {orange, red} and it's a zirby" [*Unambig+color, Ambig+color]*

(b) "Click on the object that I describe. It's {tall, short} and it's a blick" [*Unambig+dimension; Ambig+dimension*].

(5) DISPLAY: tall_orange zirby, tall_red zirby, tall_orange blick, short_orange blick.

We manipulated adjective type (*color/dimension*) and ambiguity (*ambiguous/unambiguous*: presence/absence of another object with that property). Ambiguous trials included three objects with the mentioned property (three tall/orange objects), and one contrast-object (one short/red object). Unambiguous trials included one object with the mentioned property (one short/red object), and three contrast-objects (three tall/orange objects). Familiarized non-words eliminated plausibility problems. Location, color and size were counterbalanced.

Predictions are as follows: **Prenominal/Exp1**: If participants (n=16) rely on the comparison class for interpretation of *prenominal dimension* adjectives, such adjectives (e.g.*tall*) should trigger looks to contrasting class members (short object). On color trials, we expect no looks to the contrast-object. **Predicative/Exp2**: If *predicative* dimension adjectives do *not* make reference to the comparison class (resembling color), participants (n=16) should not look to contrast-objects.

Results

Prenominal: Ambiguous *dimension* adjectives in *prenominal position* triggered an *early decrease* in target-looks and an increase in contrast-looks (hearing 'tall' triggered looks to *short* blick), compared to unambiguous trials (200-400ms after adjective-onset;p<.05). Crucially, *color* did not show this pattern ('orange' didn't trigger looks to the *red* zirby).

Predicative: Ambiguous *dimension* adjectives in *predicative position* triggered looks to the target, away from contrast-objects (600-800ms after adjective-onset;p<.05). *Color* patterned similarly.

One might expect that hearing "tall" triggers looks only to "tall" object(s). But, our results show that participants used *contrasting ("short") objects* to disambiguate targets with <u>prenominal dimension adjectives</u>, but not color adjectives or predicative dimension adjectives. This fits with claims that processing of dimension and color/shape adjectives differs (Gregory et al., 2003; Grodner & Sedivy, 2011), and crucially show *that adjective processing depends on syntactic position: the comparison class plays an important role in incremental processing of adjectives in prenominal, but not in predicative, position.*

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Logical Metonymy from Type Clash to Thematic Fit

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Keywords: logical metonymy; type clash; thematic fit; similarity-based model; distributional memory.

Logical Metonymy and Type Clash

Logical metonymy (*The author began the book*) has often been explained in terms of a type-clash between an event-subcategorizing metonymic verb (*begin*) and an entity-denoting object (*book*), triggering the recovery of a covert event (<u>*reading*</u>). Experiment 3 in Traxler, Pickering and McElree (2002) is often cited as a well-known correlate of this clash, as the authors find a significant interaction between type of verb (metonymic vs. non-metonymic) and type of object (entity-denoting vs. event-denoting).

Type clashes and selectional restriction violations are widely invoked in linguistic theory, but more recent work in psycholinguistics suggests that these phenomena might be better captured via graded notions such as typicality and thematic fit. For example, some of the materials of Traxler and colleagues' seem to favor event-denoting items via a better thematic fit (***The pastor** finished/prepared the **funeral**/sandwich*).

A Similarity-Based model of Type Clash

Similarity-based frameworks such as Distributional Memory and ECU described in Lenci (2011) lend themselves particularly well to modeling the graded effect of thematic fit and expectation about upcoming arguments in sentence processing. We contrast three ECU-based models: *verb-only*, *sum* and *product*. *Verb-only* exploits expectations coming from the verb to yield the thematic fit for a filler in a given object argument position (e.g. for *sandwich* and *prepare*); the other two models do the same by combining expectations from subject and verb (e.g. for *sandwich* and *<pastor, prepare>*) by means of two different functions (*sum* and *product*)[1]. We use the models to (1) mirror the results from Traxler and colleagues; (2) contrast expectations coming from the verb and expectations coming from the composition of subject and verb, in order to evaluate whether the type-clash effect might be due to a cueing effect of the subject; (3) suggest an alternative account of logical metonymy interpretation which re-defines the binary notion of type-clash in more graded terms, i.e. as thematic fit.

The models successfully replicated the pattern of results of the psycholinguistic experiment, yielding the lowest thematic fit for metonymic verbs combined with entity-denoting objects, and a main effect of object type (entity-denoting vs. event-denoting; **sum, ***product, ***verb-only[2]), and a significant verb-object interaction (**sum, **verb-only). All models yielded a better thematic fit for event-denoting than for entity-denoting objects on the whole dataset (***sum, ***product*, ***verb-only), for metonymic verbs (***sum, **product, ***verb-only), but not for non-metonymic verbs. The pattern of results of the psycholinguistic experiment was replicated not only by models incorporating the subject (*sum* and *product*), but also by the *verb-only* model, thus suggesting the measured effect is not ascribable to an effect of subject only, but is indeed due to the verb-object interaction.

The models' success in replicating the results from the psycholinguistic experiments shows that similarity-based models are an adequate tool to model phenomena such as selectional preferences and logical metonymy, suggesting that they can both be accounted for in terms of thematic fit.

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[1] It is customary in recent compositional distributional semantic work to contrast results from both functions.

[2] ***: p<0.001; **: p<0.01; *; p<0.05

The Interference of Privilege Ground in Referential Resolution

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Keywords: Common Ground; Perspective Taking; Gradient Representations; Binary Representation

Introduction

Research into the use of perspective information on line tends to adopt a binary representation framework, where one's own and common knowledge are represented separately (Keysar et al., 2000). In contrast, Horton and Gerrig (2005) propose that common ground is an emergent property of memory processes, leading to the single complex gradient representational framework (Brown-Schmidt, 2011). According to the latter view, common ground information shared with a partner is salient to the extent that the partner provides reliable cues to common ground information.

Method

In the current mouse- and eye-tracking study, participants were asked to move objects around a 3 by 3 grid by clicking on and dragging images. At the beginning of each item, participants placed three privileged objects (not known to the speaker) in the three grid positions that the speaker cannot see. As in similar visual-world studies (Keysar et al., 2000), test items ('Move the apple to the bottom middle') occurred when there was a competitor (Privileged condition) or an irrelevant object (Baseline condition) in their privileged ground. Filler items included location-based directions ('move the object in the top left…') as well as the more standard type-based instructions ('Move the apple…') used also in test items. In a homogeneous cue condition, all instructions made reference to common ground locations. In a heterogeneous condition, location-based filler instructions made reference also to privileged ground objects. According to the single gradient framework, the privileged ground is also associated with the director and thus he is not as reliable a cue to common ground objects in the heterogeneous condition, so performance should diminish. By contrast, if participants hold a separate representation of common ground location-based reference to privileged ground slots should not affect this.

Results and Conclusion

We recorded participants' mouse trajectories and eye movements in each condition. There were main effects of Condition and Involvement and the predicted interaction. With regard to their trajectories, in the homogeneous condition there was no significant difference in the x-coordinate between Baseline and Privileged condition, while in heterogeneous condition the x-coordinate in Baseline condition was significantly larger than that in Privileged condition, showing that only in the heterogeneous condition mouse trajectories were attracted by the competitor in privileged area. As for the eye movements, in heterogeneous condition participants had smaller target advantage than that in homogeneous condition, indicating that in heterogeneous condition they got larger interference from the privileged ground. The results provided evidence that the partners' knowledge is employed based on the relative involvement of their own knowledge, and supported the complex gradient representational framework.

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Listener Modeling of Speakers in Language Comprehension

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Keywords: listener expectations; speech comprehension; speech production; event-related potentials.

Listeners are sensitive to characteristics of incoming speech, from the word level, where lexical frequency influences on-line processing, to a wider contextual scope, such that low-cloze or discourse-unacceptable words are harder to integrate into the ongoing representation. This suggests that listeners store some distributional information from prior experience. The P600 ERP component scales inversely with the ease of incorporation into the ongoing parse, such that unexpected, ungrammatical words produce larger P600s than less unexpected, ungrammatical words. Hanulíková et al. (2012) measured listeners' P600s to grammatical errors produced by native compared with accented speakers. Errors produced by native speakers elicited larger P600s than errors produced by accented speakers. One possibility is that prior experience with a specific speaker or class of speakers allows listeners to build a grammar specific to those speaker(s) and thus committed errors would be less attention-worthy. This raises two important questions. First, what types of linguistic information do listeners learn? Second, does experience affect comprehension of an individual speaker, or does it generalize to new speakers?

The present work investigated these questions in two experiments, in which listeners heard two 16-minute English passages spoken by non-native speakers. The first passage was spoken by a Turkish-accented speaker, who systematically committed one type of grammatical error (either subject-verb disagreement or incorrect pronoun case). The second passage was spoken either by the same Turkish-accented speaker or a Brazilian Portuguese-accented speaker, and contained both the trained error type and the other, untrained, error type.

In Experiment 1, subjects listened to the two passages while performing an error-detection task. Response times in the second passage were significantly faster to errors committed by the new speaker than those committed by the previously-heard speaker. However, response times to trained and untrained error types showed no differences when spoken by either speaker. Error hit rates were identical across the four conditions, suggesting that the observed reaction time difference was not due to differing intelligibility or accent features between the speakers. These results suggest that listeners modify their comprehension processes after limited experience with a particular speaker, but not at the level of specific error type. Thus, listeners do not automatically generalize across accented speakers, but do generalize across error types.

In Experiment 2, subjects performed the same task while their EEG was recorded. In the second passage, errors spoken by the new, previously-unheard speaker elicited larger P600 components than the previously-heard speaker. As before, no difference was observed between the trained and untrained error types, and there was no interaction.

Together, these experiments suggest that listeners' on-line comprehension is modified after experience with a speaker. Such modification is somewhat speaker-specific, as it is not necessarily generalized to novel-accented speakers. However, the information stored does not extend to specific facets of the speaker's grammar. Listeners are more forgiving of errors only if experience with an individual speaker (or group of speakers) demonstrates that the speaker is liable to make errors. Upon hearing a novel speaker type, listeners revert to guidance from normative grammar for comprehension. Thus, the likelihood of grammatical error production is learned from experience with an individual speaker.

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Cognitive Dynamics of Alignment in Dialogue Games

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Keywords: cooperative dialogue, decision making, alignment dynamics, eye-movement

Dialogue is often used to guide joint actions in order to achieve specific goals. Previous work in such task- oriented dialogue suggests that alignment in linguistic (e.g., Brennan and Clark, 1996) and visual (e.g., Dale et al., 2011) behaviours might be crucial to establish optimal communication, which in turn should be associated with correct decisions. In this study, we investigate how decision processes relate to alignment when communication is unidirectional, i.e., the speaker instructs the listener to perform a decision, but the listener cannot give any feedback.

In an eye-tracking dialogue game, participants (16 dyads) were engaged in a spot-the-difference task, where the speaker had to describe photo-realistic scenes (100) to a listener, who had to decide whether he/she was viewing the same scene or not. Half of the time, the scene was different by a target object, which was either displaced in the scene (left, right), or it was either depicted or not (absent, present). In order to investigate the link between decision performance and gaze alignment, we divide the dyads into two groups according to their accuracy score (high, low). We first investigated the speed-accuracy trade off by looking at how reaction time correlated with decision performance. Then, we analysed the dynamics of eye-movement alignment using cross-recurrence analysis (CRA, Dale, et, al. 2011). For each group, we first analysed the recurrence profile with lags of +/- 3.5 seconds from which we extracted the lag at which maximal recurrence occurs (i.e., how long it takes for the listener to best match the speaker in gaze). Finally, we performed a windowed analysis of recurrence to track changes over the course of the trial.

Results reveal a correlation between reaction time and performance: The longer listeners took to make a response, the more likely they were to be correct. This indicates that the listener needs to accumulate enough information to make an accurate decision. Interestingly, when looking at recurrence of gaze, we found that low performing dyads have a higher recurrence than high performing dyads; but high dyads display maximal recurrence at positive lags, i.e., speaker leading, while low dyads have maximal recurrence closer to 0, i.e., synchrony between speaker and listener. This pattern suggests that low-performing listeners tend to map quickly the information delivered by the speaker, but they fail to capture details from the linguistic input. High-performing listeners, instead, wait for linguistic information to cumulate, and use it to maximize their decision process. This result is confirmed when looking at the trend of recurrence over the trial, where low dyads reach maximal recurrence more quickly than high dyads, who instead display a steady increase over the course of the trial.

Overall, our data suggest that optimal decisions do not always imply optimal alignments, especially when dialog is not enacted as a bidirectional process. In this case, task partners must find an optimal balance of complementary behaviours to achieve the task.

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Finishing each other's . . .
Responding to incomplete contributions in dialogue

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Keywords: Compound contributions; predictability; dialogue; text chat

Introduction and Method

A distinguishing feature of dialogue is that contributions can be fragmentary or incomplete. Such incomplete utterances may be later completed by another interlocutor (Purver et al, 2009). These cross-person *compound contributions* (CCs) are a paradigmatic feature of dialogue and have been hypothesised to be more likely in predictable contexts (Lerner, 1991) but the contributions of different sources of predictability has not been systematically investigated. We present an experiment which is, to the best of our knowledge, the first to ever systematically attempt to induce continuations in an ongoing dialogue.

Using the DiET chat tool, we artificially truncate genuine contributions in ongoing text-based dialogues providing other participants with the opportunity to provide completions. This intervention is introduced systematically, in real time with the truncation point manipulated to vary the lexical and syntactic predictability of what comes next using an entropy calculation. Pragmatic predictability – whether the intervened turn contributed to an ongoing topic under discussion or not, and whether the turn could have been considered complete at the truncation point – was subsequently annotated by the authors.

Results and Discussion

The results look at what type of response (if any) participants produce to the apparently incomplete turn. They show that what is critical to the likelihood of one's interlocutor supplying a *continuation* is the accessibility of common ground. While people are sensitive to syntactic predictability, this alone is insufficient to prompt a completion. Participants make use of syntactic predictability only if the context is sufficiently constrained. Though people do respect syntactic constraints when producing continuations, truncation at different syntactic points in the sentence does not cause any difference in difficulty in producing them. *Clarification requests*, in contrast, are more likely, and more likely to be formulated as continuations, when the syntactic category of the upcoming material is more predictable; this suggests that while the grammar is a mutually available resource, it is not used in the same way by all interlocutors, with syntax able to be exploited to localise the source of a potential misunderstanding.

Another of the main findings is that people are sensitive to potential turn endings. These may be syntactic but they are not necessarily so. Some cases which appear to be syntactically incomplete can be responded to as if they are complete, provided that the continuation is highly predictable. If there are indeed cases which are interpreted as complete when they are not – as if the hearer is supplying the missing material internally, but does not necessarily produce it, this has implications for any grammatical or dialogue model. Incomplete syntactic strings must be not only successfully analysed, but also assigned potentially complete semantic representations.

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Predicting Upcoming Meaning Involves Specific Contents and Domain-General Mechanisms

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Keywords: prediction; semantics; eye-tracking.

In sentence comprehension, readers and listeners often anticipate upcoming information (e.g., Altmann & Kamide, 1999). We investigated two aspects of this process, namely 1) what is pre-activated when anticipating an upcoming word (the *contents* of predictions), and 2) which cognitive *mechanisms* are involved.

The contents of predictions at the level of meaning could be restricted to functional semantic attributes (e.g., edibility; Altmann & Kamide, 1999). However, when words are processed other types of information can also be activated, such as object shape representations. It is unknown whether this type of information is already activated when upcoming words are predicted. Forty-five adult participants listened to predictable words in sentence contexts (e.g., "In 1969 Neil Armstrong was the first man to set foot on the moon.") while looking at visual displays of four objects. Their eye movements were recorded. There were three conditions: target present (e.g., a moon and three distractor objects that were unrelated to the predictable word in terms of semantics, shape, and phonology), shape competitor (e.g., a tomato and three unrelated distractors), and distractors only (e.g., rice and three other unrelated objects). Across lists, the same pictures and sentences were used in the different conditions. We found that participants already showed a significant bias for the target object (moon) over unrelated distractors several seconds before the target was mentioned, demonstrating that they were predicting. Importantly, there was also a smaller but significant shape competitor (tomato) preference starting at about a second before critical word onset, consistent with predictions involving the referent's shape.

The mechanisms of predictions could be specific to language tasks, or language could use processing principles that are also used in other domains of cognition. We investigated whether performance in non-linguistic prediction is related to prediction in language processing, taking an individual differences approach. In addition to the language processing task, the participants performed a simple cueing task (after Posner, Nissen, & Ogden, 1978). They pressed one of two buttons (left/right) to indicate the location of an X symbol on the screen. On half of the trials, the X was preceded by a neutral cue (+). On the other half, an arrow cue pointing left (<) or right (>) indicated the upcoming X's location with 80% validity (i.e., the arrow cue was correct 80% of the time). The SOA between cue and target was 500 ms. Prediction was quantified as the mean response latency difference between the neutral and valid condition. This measure correlated positively with individual participants' anticipatory target and shape competitor preference (r = .27; r = .45), and was a significant predictor of anticipatory looks in linear mixed-effects regression models of the data. Participants who showed more facilitation from the arrow cues predicted to a higher degree in the linguistic task. This suggests that prediction in language processing may use mechanisms that are also used in other domains of cognition.

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Predicting the Next Word: Data and Model from a Speeded Cloze Task

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A word's predictability is a critical variable in language comprehension research, influencing both eye fixation durations in reading (e.g., Ehrlich & Rayner, 1981) and N400 amplitudes (e.g., Kutas & Hillyard, 1984). Predictability is usually assessed via the cloze task, in which subjects read a sentence fragment and write the word that they think is most likely to come next. The predictability of a word, in a given context, is determined by the proportion of subjects who provide that word.

In an attempt to better understand the meaning of the cloze probability variable, we investigated the process by which subjects choose a likely or plausible continuation of a sentence. Subjects in a modified cloze task (N = 33) read sentences one word at a time in RSVP format, and at some point in the sentence were prompted to speak the next word. We used fragments that had been previously normed using a standard paper-and-pencil cloze task. Subjects were given 3 seconds to respond. We recorded not only the word that the subject produced, but also the response time (RT) to begin speaking. Each subject completed 380 critical trials.

Subjects produced a response within 3 seconds on over 90% of trials, resulting in over 11,000 data points. Of the fragments that were highly constraining in off-line norms, eliciting a single dominant response, over 90% elicited the same dominant response in the present study. Overall, the items were fairly uniformly distributed across the full range of constraint, from completely constraining (all subjects produced the same word) to completely unconstraining (each subject produced a unique response).

The first critical finding was that RT decreased linearly with the probability of a subject's response. Mean RT was several hundred milliseconds faster for the highest-probability responses (i.e., those made by the majority of subjects) compared to the lowest-probability responses (i.e., unique responses). In addition, there was a similarly large effect of the item's level of constraint, as lower-probability responses were faster when the item elicited a high-probability modal response than when the item was unconstraining.

We simulated the critical findings with a simple counter model of lexical selection, which we call the *Cloze Race* model. Multiple lexical items race toward a response criterion. Words vary in their probability of moving toward criterion at each time step; this probability may be seen as reflecting the word's degree of activation based on context. The effects of response probability and item constraint on RT emerge from this model without additional assumptions.

Based on these data and their simulation with the Cloze Race model, we suggest that variation in cloze responses to a given item reflects the stochasticity inherent in performing the cloze task, rather than true inter-subject differences. We also suggest that cloze responses may be viewed as reflecting, at least in part, patterns of lexical activation by context, rather than an explicit process of prediction. Finally, we discuss implications for the interpretation of lexical predictability effects in comprehension.

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Language-specific processing of speech and non-speech

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Keywords: language-comprehension; cross-linguistic studies; cross-language speech processing

Introduction

Adult listeners perceive speech in a way that is optimized to their native language. It is an open question of which levels of processing adapt to the demands of the native language. While it is generally assumed that language experience does not alter auditory processing, there is evidence for language-specific sensitivities to acoustic information (e.g., Iverson, Kuhl, Akahane-Yamada, Diesch, Tohkura, Kettermann & Siebert, 2003), and for language-specific representation at the neural level (e.g., Zhang, Kuhl, Imada, Kotani & Tohkura, 2005). The present study investigated to what extent language-specific sensitivities operate at pre-attentive auditory levels and at higher levels of phonetic categorization. We compared the discrimination of acoustic transforms between English and Japanese listeners using behavioral and MEG measures.

Approach

When listening to speech, Japanese listeners show language-specific sensitivities to the acoustic dimensions which differentiate English /r/ from /l/ (e.g., Miyawaki, Strange, Verbrugge, Liberman, Jenkins & Fujimura, 1975). When presented with the same acoustic variation in non-speech contexts, however, Japanese listeners show a pattern of discrimination not different from English. The present study used stimuli that parametrically varied this speech/non-speech difference, to see how far a stimulus must be from speech in order for cross-language differences to disappear. The experimental stimuli were a series of continua that mimicked the acoustic cues differentiating English /r/-/l/. The different continua disrupted, to varying degrees, the naturalness and perceptual coherence of the stimuli. A series of behavioral experiments examined listener's identification and discrimination sensitivity for all the continua. In addition, an MEG experiment recorded listeners' mismatch responses (MMF) to four stimulus series, which showed different degrees of language-specific processing in the behavioral experiments.

Results

The behavioral results demonstrated strong cross-language differences for the stimuli that sounded most like speech, no significant cross-language differences for the stimuli that were least like speech, and moderate cross-language differences for a middle range of stimuli that were not categorized accurately as /r/ and /l/ and sometimes did not sound like speech. The presence of cross-language differences in the latter stimuli demonstrates that they were not caused by phonological categorization, but they may be speech specific.

The MEG results show cross-language differences in the processing of all four transforms. Stimuli that defied phonetic categorization showed language-dependent patterns of processing at a low pre-attentive level. This suggests that language-specialization affects the processing of acoustic variation for both speech and non-speech.

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Rapid Integration of Intonational and Contextual Information When Processing the Focus Particle *auch*

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Keywords: discourse processing, intonation, focus, focus particles

Focus particles such as German *auch* 'also' associate with one element of the sentence and evoke an alternative set to this element. Intonation indicates with which element *auch* associates. If stressed, *auch* associates with the initial constituent. For example in 1), stressed *auch* indicates that somebody else eats a cherry in addition to the witch. In contrast, when *auch* is unstressed and the object stressed (2), *auch* expresses that the witch eats other things in addition to a cherry.

1) Die Zauberin isst AUCH immer wieder eine Kirsche.
   The witch ALSO eats a cherry again (in addition to somebody else)

2) Die Zauberin isst auch immer wieder eine KIRSCHE.
   The witch also eats a CHERRY again (in addition to something else).

It is unclear whether and when listeners infer the different alternative sets evoked by stressed and unstressed *auch*. Previous research on the processing of focus has found both rapid (Eberhard et al., 1995) and delayed (Paterson et al., 1999) effects.
In a self-paced listening study, we put sentences such as 1) and 2) in two different preceding contexts, neutral (A: Did you hear what is happening?) or strongly biasing towards the object noun (B: The witch is eating a banana. Do you know what else she is eating?). We found prolonged listening times one word after *auch* when prosodic and contextual information were conflicting (context B + sentence 1), suggesting that listeners start integrating contextual and prosodic information rapidly when *auch* is encountered.

This study did not, however, test directly whether and when listeners infer alternative sets. In a visual world experiment, participants saw a target picture (the witch eating a cherry and a banana) and competitor pictures with other people eating when listening to these sentences (1, 2) in contexts A and B. As the first noun always identified the target picture unambiguously, this picture received the majority of looks in all conditions. Strikingly, however, when there was no conflicting contextual information (context A), there were more looks to the competitor pictures from the onset of *auch* on when *auch* was stressed than when it was not stressed. This indicates that in a neutral context, listeners start looking for alternative sets to the subject as soon as they hear stressed, but not unstressed *auch*, at least when such alternatives are visually available.

Our results corroborate previous studies showing rapid processing of focus information. They are difficult to reconcile with minimalist models of discourse processing stating that comprehenders do not rapidly draw inferences that are not necessary for local comprehension processes.

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The limited power of sound symbolism

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In defiance of the assumed design principle of language of arbitrariness between sign and signified, many languages use ideophones, which are depictive words for sensory imagery. The form-meaning mappings in ideophones have been variably hypothesized to be language-specific, universal, or a mixture of both. We test the claim of universality, and in particular, the claim that ideophones "do the work of representation by phonetic means" (Tedlock, 1999). In support of this claim, recent research shows that naive listeners can consistently map certain sounds to certain meanings in nonce words, leading to claims that such mappings may underlie the evolution of language (Ramachandran & Hubbard, 2001).

Given the theoretical weight ascribed to sound-symbolism in language, it is important to know whether ideophones could live up to this promise. The "recognizability" of these mappings may be due to both segmental and suprasegmental properties of the stimuli. While the segmental properties tend to be singled out, prosodic aspects have not been investigated yet. To critically evaluate the power of lexicalised sound-symbolism in ideophones, we recorded over 200 ideophones from five semantic categories (Sound, Motion, Texture, Visual Appearance, and Shape) and from five languages (Japanese, Korean, Semai, Siwu, Ewe, representing four language families).

Ideophones were presented to Dutch listeners as a natural recording and in three edited forms produced by a Dutch diphone synthesizer. A rich resynthesis made use of the original utterances phoneme durations, as well as pitch and intensity contours. One resynthesis used these suprasegmental properties with different segments (prosody-only), the last used the same diphones but with standard segment durations and a simple falling contour (phones-only).

To test how well these forms represent their meaning, Dutch listeners were asked to choose between the correct and another ideophone's translation. Results showed that participants performed above chance, but performance depended on both category and stimulus version (no interaction). Performance did not differ between the original recordings and the rich resynthesis (both 57% correct), and was better in these two conditions than in the phones-only and prosody-only condition (both 53.5% correct). This suggests that it is the combination of phones and prosody that cue the meaning. As for the different semantic categories, sound ideophones transmitted their meaning better (61% correct) than ideophones from the other four categories (around 54% correct for Shape, Visual Appearance, Texture, and Motion; these were significantly above chance, but not different from each other).

The overall modest performance indicates that previous reports of 95% correct sound-meaning mappings (Ramachandran & Hubbard, 2001) can only be achieved in isolated domains, and may be partly due to the prosodic implementation (e.g., saying "kiki" with long closure durations for the /k/s, to give the impression of something sharp) rather than inherent sound-meaning mappings associated with certain phones. As such, lexicalised sound-symbolism appears to be of limited universal validity, and therefore seems a weak basis for language evolution.

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The Time-Course of Dimension-Based Statistical Learning

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Keywords: speech perception; perceptual learning, statistical learning

Abstract

Speech processing requires sensitivity to long-term regularities of the native language, yet demands listeners to flexibly adapt to perturbations that arise from talker idiosyncrasies such as nonnative accent. The present paper follows up on the findings of Idemaru & Holt (2011), who discovered a particular way listeners deal with talker idiosyncracies, dimension-based statistical learning of correlations between acoustic dimensions that define a given speech segment. While engaged in a word recognition task guided by a perceptually unambiguous voice-onset time (VOT) acoustics to signal *beer, pier, deer* or *tear*, listeners were exposed incidentally to an artificial "accent" deviating from English norms in its correlation of the pitch onset of the following vowel (F0) to VOT. Whereas in English high F0 correlates with long VOT, indicating voicelessness, Idemaru & Holt's (2011) stimuli introduced the inverse correlation where high F0 correlated with short VOT, indicating voicedness. Test stimuli with ambiguous VOT in-between /t/ and /d/ or /p/ and /b/ and differing in F0 were interspersed throughout the experiment among training stimuli with unambiguous VOT values typical of /t/ and /p/ on the one hand and /d/ and /b/ on the other. Listeners were shown to adapt to this inverse correlation by discarding or down-weighting F0 as a cue to voicing.

The present study examines the timecourse of this learning by means of asking 40 native English speakers to click on pictures of potential referents (a mug of beer, a pier, a tear, a deer) of the words they hear. In the course of 20-minute experiment, listeners heard a total of 124 training stimuli ("accented" *beer, pier, deer* and *tear*). The VOT-ambiguous test stimuli were presented after 4, 8, 16, 32, and 64 presentations of training stimuli to monitor the use of F0 as a cue to voicing. Eye-gaze to the pictures during the test trials were analyzed and we found a very early effect of training: after just four training trials, the difference between high F0 and low F0 words significantly decreased compared to a pretest (cf. also Vroomen et al. 2007) for the categorization of *beer, pier* and *deer*, according to a mixed-effects growth curve analysis. These results suggest very rapid nature of perceptual learning. However, for the categorization of *beer*, this effect disappeared after 60 training trials, suggesting a potential tension between short-term and long-term representations. Furthermore, analysis of eyegaze in response to training stimuli, in which VOT varied as well as F0, showed that after training there was increased looks to *deer* with higher VOT within the category of long VOTs and increased looks to *pier* and *tear* with lower VOT within the category of short VOTs in some training stages. This suggests temporary re-evaluation of these small, within-category VOT differences. Although this re-learning was limited to a specific region of VOT, the results overall suggest a very rapid perceptual learning affecting the use of both the primary and secondary cues to voicing.

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Can we Tell what we Say when we Hear ourselves Saying Something Else?

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A defining assumption of standard models of speech production is that verbal utterances are guided by robust and well-specified message intentions, which are translated into an utterance via a series of linguistically defined processes. The utterance is then monitored by comparing feedback from auditory, proprioceptive and inner, phonological, loops with the original intention (e.g. Levelt, 1983; 1989). This way, it is assumed, speech errors and other dysfluencies which are thought to arise at some stage during the translation processes can be detected and repaired. We present results that challenge this standard hierarchical model and that point towards a fundamentally interactive and dynamic relationship between speech and monitoring.

We have developed a novel technical platform that allows us to selectively manipulate speakers' auditory feedback in real time. 78 participants (42 female) took part in the study. Seated in front of a computer screen, participants performed a 250 word, computerized Stroop test while hearing themselves speaking solely through a sound isolated headset. In the default mode, their speech was relayed unaltered. During the test, four of the trials were manipulated in the following way. We covertly inserted a previously recorded word of the participant's own speech at the exact same time as they were uttering another word, phonetically similar but semantically distinct. Simultaneously, we blocked out the feedback of their actual speech, effectively creating a situation where they say one word but hear themselves, in their own voice, say another word. For instance, they may utter the word 'grey' while receiving feedback indicating that they are saying the word 'green'. To investigate how these manipulations are experienced, the question "what did you say?" was shown on the screen directly following manipulated trials; when this question was answered, the test resumed.

Manipulations were experienced as self-produced in roughly 60% of all manipulated trials, as was revealed by the participant's responses to the manipulated feedback. These results demonstrate how we as speakers sometimes use the auditory feedback of our own voice not only to perform error-monitoring or to regulate phonetic or extra-linguistic factors of our speech. Rather, more generally, we seem to engage this feedback in an incessant on-line interpretive process, or 'auto-comprehension', which actually substantiates and consolidates the very meaning of self-produced speech. We believe this finding has wide implications for models of speech production and self-monitoring, as well as for the investigation of the agency of the spoken word.

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The Role of Verb Bias in Structural Priming: Evidence from Children and Adults

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Conceptualising the relationship between verbs and syntactic structure is central to our understanding of language. In adults, the syntactic preferences of verbs have a significant impact on how listeners interpret language (e.g. Trueswell & Kim, 1998) and on what speakers produce (e.g. Pickering & Branigan, 1998), indicating that we must posit a close integration between syntactic structure and the verb lexicon in adult representations. Yet, how this relationship develops in children is less clear. One school of thought suggests that children's early knowledge of syntactic structure is restricted to knowledge of how individual verbs behave, with generalisation across verbs occurring later (e.g. Tomasello, 2000). Another suggests that young children have broadly adultlike knowledge of syntactic structure that generalises across verbs from early on (e.g. Valian, 1986). A third possibility is that children first build abstract representations, and build the links between the structures and verbs later (Thothathiri & Snedeker, 2006).

The current study used a priming paradigm to explore whether children and adults show the same sensitivity to verb syntactic preferences. We primed children (3-4 and 5-6 year olds) and adults with verbs that occur more often in double object datives (*give, send*) and verbs that occur more often in prepositional datives (*send, bring*). We adapted Rowland, Chang, Ambridge, Pine, & Lieven's (in press) dialogue task. Children and adults heard and produced double object dative (DOD; *Dora gave Boots a rabbit*) and prepositional dative primes (PD; *Dora gave a rabbit to Boots*) before producing targets with four verbs varying in structure bias (*give*, *show*, *bring* and *send*). The participants heard the same verb in the prime and target (e.g. *gave-gave*), and also a different verb (e.g. *gave-sent*).

The results showed that:

a. All age groups showed significant structural priming effects, supporting the idea that 3 year olds have already built abstract representations of syntactic structure.

b. All age groups produced more double object datives with DOD-biased verbs than with PD-biased verbs, indicating that even 3-year olds are sensitive to the syntactic preferences of these verbs.

However, the results also showed that:

c. Adults, not children, showed increased priming effects when the prime and target shared a verb (the lexical boost)

d. Children showed an increased priming effect when there was a mismatch between the prime verb's syntactic preference (e.g. *give*) and its structure (e.g. PD; prime surprisal).

Overall, the results suggest that 3 year olds have already built syntactic representations and established links between these representations and some verbs. However, they also suggest that lexical effects on structural priming are different for children and adults, indicating that children's syntactic representations are more tied to particular verbs than those of adults. We argue that the results are best explained in terms of the Dual-Path model of syntactic development and processing. This conceptualises both syntax acquisition and structural priming in terms of an error-driven implicit learning mechanism, but posits a separate mechanism to explain lexical boost effects on structural priming (Chang, Dell, & Bock, 2006).

Individual Differences in Verbal Working Memory Predict Co-Speech Gesture

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Keywords: gesture; language production; individual differences; working memory

Speakers gesture even in the absence of an audience; thus, researchers have proposed that gesture may be an intrinsic part of the language production process. There are at least two ways that gesture may aid production. First, gesturing may lighten the verbal working memory (VWM) load, as speakers are better able to remember verbal items when they gesture during intervening speech than when they do not (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001; Ping & Goldin-Meadow, 2010). Second, gesturing may aid lexical retrieval, as gestures are time-locked to associated words (Morrell-Samuels & Krauss, 1992), and speakers become more disfluent when not allowed to gesture (Krauss, 1998). These theories predict that speakers with lower VWM or reduced lexical access should produce more gestures.

In the current study, 50 speakers (18 male) completed an individual differences battery that included measures of VWM and lexical access (vocabulary and verbal fluency (VF)). To elicit gesture, each speaker described five short cartoon clips immediately after viewing, and descriptions were video recorded. Two coders judged whether a gesture was produced in each description (ICC(3,2) = .94) and the number of gestures produced in each description was counted by both coders (ICC(3,2) = .98). The likelihood of a gesture being produced was modeled using a logistic mixed-effect regression model. The gesture count data was analyzed using a zero-inflated mixed-effect Poisson regression model. Gender and composite scores of VWM, vocabulary, and VF were included as fixed-effect predictors in both analyses, and speaker and video clip intercepts were included as random effects. Composite measures were roughly normally distributed and not significantly correlated. In both analyses, decreased VWM was associated with more gestures ($p < .01$). Vocabulary, VF, and gender did not predict gesturing (ps > .15).

These results support the hypothesis that gesture serves to lighten the load on VWM (Goldin-Meadow et al., 2001; Ping & Goldin-Meadow, 2010), as speakers with lower VWM gestured more often; however, the results are not consistent with the hypothesis that gesture aids lexical retrieval. Thus, gesturing may free up VWM resources that are recruited during speaking by helping speakers organize their thoughts for speech, or by shifting the load to other cognitive systems (Goldin-Meadow et al., 2001).

This study is the first to show that gesturing is linked to individual variation in cognitive resources. Thus, these results begin to elucidate why people gesture when they speak, and why some speakers gesture more than others.

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The influence of gaze direction on the comprehension of speech and gesture in triadic communication

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Keywords: co-speech iconic gesture, eye gaze, recipient status; communicative intent; multi-party communication.

Human face-to-face communication is a multi-modal activity. Recent research has shown that, during comprehension, recipients integrate information from speech with that contained in co-speech gestures (e.g., Kelly et al., 2010). The current studies take this research one step further by investigating the influence of another modality, namely eye gaze, on speech and gesture comprehension, to advance our understanding of language processing in more situated contexts. In spite of the large body of literature on processing of eye gaze, very few studies have investigated its processing in the context of communication (but see, e.g., Staudte & Crocker, 2011 for an exception). In two studies we simulated a triadic communication context in which a speaker alternated their gaze between our participant and another (alleged) participant. Participants thus viewed speech-only or speech + gesture utterances either in the role of addressee (direct gaze) or in the role of unaddressed recipient (averted gaze).

In Study 1, participants (N = 32) viewed video-clips of a speaker producing speech-only (e.g. "she trained the horse") or speech+gesture utterances conveying complementary information (e.g. "she trained the horse"+WHIPPING gesture). Participants were asked to judge whether a word displayed on screen after each video-clip matched what the speaker said or not. In half of the cases, the word matched a previously uttered word, requiring a "yes" answer. In all other cases, the word matched the meaning of the gesture the actor had performed, thus requiring a

'no' answer. Longer responses to gesture-related trials showed that unaddressed recipients did indeed comprehend speakers' gestures differently to addressees indicating that they might focus more attention on gestures than addressees do, due to not having to split their attention between gesture and gaze.

Study 2 used the same triadic set-up as Study 1. Instead of explicitly focusing participants onto the speech modality (in Study 1 participants judged what was said), it investigated the influence of eye gaze on the speaker's overall message. Participants viewed speech-only or speech+gesture utterances conveying similar object-related information. Each video-clip was followed by two images of objects, one of which the speaker had referred to in the preceding clip (e.g. "she likes the piano" +PLAYING PIANO gesture; pictures: piano - spoon). Participants' (N=32) task was to choose the object that best matched the speaker's message. Reaction times showed that unaddressed recipients responded significantly slower than addressees for speech-only utterances. However, perceiving the same speech accompanied by gestures sped up their responses to a level identical to that of addressees.

These findings show that shifts in speaker's eye gaze in a triadic communication setting modulate comprehension of speech and gesture. Unaddressed recipients appear to devote greater attention to gesture, and in cases where speech comprehension suffers due to not being addressed, gesture comprehension remains intact and enhances the comprehension of a speaker's message. This provides first insights into language processing in a multimodal context integrating the influence of three different modalities during comprehension.

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Syntactic Alignment is Mediated by Social Perception and Conflict Management

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Keywords: syntactic priming; sentence production; sociolinguistic perception; adaptation

Background

Syntactic priming in production refers to the increased probability of reusing a structure in a target that was previously experienced while processing a prime (Bock, 1986). Psycholinguistic research has characterized syntactic priming as a fully automatic process (Pickering & Garrod, 2004) and has identified a variety of structural factors related to the prime and target that predict the strength of priming in production (see Chang, Dell & Bock, 2006; Reitter, Keller & Moore, 2011). At the same time, research in social psychology has attributed syntactic priming to social factors, e.g., imitating as a means of managing interpersonal distance (Balcetis & Dale, 2005).

Here, we explore the relation between these two sets of factors, which have to date been studied under rather different paradigms. Using a psycholinguistic paradigm, we test whether syntactic priming is influenced by speaker accent, actual and perceived ideological similarity between participants and speakers, and participants' conflict management styles.

Predictions

We predict (1) priming will be greater when (a) listening to a native speaker, and more so when that speaker sounds White rather than African American and (b) when participants perceive themselves as similar to the speaker; and (2) participants who handle conflict by compromising rather than insisting their view is right will be more likely to imitate the speaker's syntactic choices (assuming that choosing between syntactic alternatives is a type of conflict resolution).

Method

Participants (n=242) recruited through Amazon's Mechanical Turk were paid $2 to participate in a 10-15 minute web-based cumulative syntactic priming experiment.

Phase 1: Participants listened to a political monologue containing either 10 DO or PO primes. Between subjects, we manipulated speaker accent (Standard White English, African American Standard English, or strongly Mandarin-accented English) and the speaker's political orientation (monologue conveyed either a conservative or liberal stance on government spending).

Phase 2: Participants described ten line drawings (generously provided by Bob Slevc, and tested in previous priming studies), four of which were designed to elicit descriptions containing DO or PO structures.

Phase 3: Participants answered questions about themselves (demographic background, political affiliations, conflict management style, similarity to speaker) and about their social evaluations of the speaker from Phase1 (Zahn & Hopper, 1985).

Results

Mixed logit regression (with maximum random effect structure; predictors scaled) revealed that the priming effect was larger for PO primes than for DO primes (β=.84, p<.01), corroborating the known inverse frequency effect whereby less frequent structures prime more than higher frequency structures. Testing the accent prediction (1a), participants showed greater priming after listening to the White English speaker (β=-1.14, p<.001), and less priming after listening to the non-native speaker (β=-.95, p<.01), with responses to the Black English speaker falling in between; but this pattern was only found for DO primes. A marginally significant effect of perceived similarity (prediction 1b) was found (β=.99, p=.065). Further, self-rated compromisers showed significantly greater priming (prediction 2), but only for PO primes and particularly when listening to the two native accented speakers (β=.76, p<.02).

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Using codeswitching to examine the link between production and comprehension

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Keywords: bilingual language processing; codeswitching; grammatical gender.

Researchers continue to debate the extent to which exposure to distributional patterns in production affects comprehension. Here, we examine this issue by examining grammatical gender in Spanish-English codeswitching, i.e. the fluid alternation between languages in bilingual speech. Speakers use gender to facilitate target noun identification in informative contexts, i.e. when competing candidates differ in gender (Lew-Williams & Fernald, 2007). Although grammatical gender is absent in English, the determiner – noun juncture is a frequently codeswitched construction, e.g. ***el candy*** "the candy." Of interest to the production-comprehension link, researchers have observed a production asymmetry such that the masculine gender is overwhelmingly used regardless of the gender of the Spanish translation equivalent, e.g. ***el candy***, Sp. ***el*$_{masc}$ *caramelo*$_{masc}$** and ***el candle***, Sp. ***la*$_{fem}$ *vela*$_{fem}$.** Alternatively, feminine marked codeswitches are infrequent and restrictively used with feminine translation equivalents, e.g. *la candle* but **la candy*.

Using the visual world paradigm, we investigate whether this production asymmetry is reflected in comprehension. 25 Spanish (L1) - English (L2) bilinguals (mean English AoA 9.2 years) participated in three experimental blocks: Spanish, single noun codeswitching, and multi-word codeswitching. Participants' eye movements were recorded while viewing a 2-picture display of concrete nouns. In the first two blocks, participants heard a simple carrier phrase, e.g. *Encuentra el/la _____* "Find the$_{masc/fem}$ _____." The multi-word codeswitching block presented target items embedded in variable codeswitched sentences, e.g. *The man **dijo que** el garlic was in the kitchen* "The man said that the garlic was in the kitchen." In the Spanish block, distractors were either same or different gender as the target item. In the codeswitching blocks, experimental pairs were English nouns with different gender Spanish translation equivalents. Experimental pairs were also phonological competitors, e.g. *candy* and *candle* overlap in the first syllable. This manipulation tests whether the masculine as the default article would result in delayed processing due to phonological competition (Allopenna et al., 1998).

We analyzed the difference between total proportion of fixations to target and distractor items by conducting paired-t tests in 100 msec time regions from article onset through 1000 msec to estimate a divergence time region. For the Spanish block, a control group (N = 24) confirmed that monolinguals exhibit facilitatory effects for different gender trials (different gender, Region 300; same gender, Region 500). Bilinguals exhibited faster looks towards different gender trials only for feminine conditions (different gender, Region 400; same gender, Region 500). For the single noun codeswitching block, bilinguals continued to show anticipatory effects solely for feminine conditions (Region 400 for feminine v. Region 700 for masculine). The same pattern was found in the multi-word codeswitching block but at a different timescale (Region 600 for feminine v. Region 800 for masculine). Our results point towards experience-driven changes to processing in comprehension. We discuss the findings in relation to the dynamic nature of gender processing suggesting that bilinguals' reliance upon masculine as an informative cue has shifted due to exposure to the production asymmetry in codeswitching.

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Bilingualism and Executive Functions: ERP Evidence and Source Reconstruction of Conflict Processing in a Stroop Task

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Keywords: Bilingualism; Stroop task; cognitive control; active inhibition; N200; N400; ACC

Executive functions are necessary for the coordination and control of cognitive operations to reach specific goals. In the present study, we investigated whether the increased capacity of bilinguals to manage inhibition due to frequent code switching has an effect on conflict detection and resolution. Different models of bilingual language processing discuss how selection and inhibition of languages is carried out. Among them, the Inhibitory Control (IC) model by Green (1998) postulates a level of general inhibitory control implied in language selection and inhibition as well as in non-linguistic domains. To examine the capacity to resist interference, the classic Stroop task (Stroop, 1935) constitutes a critical test as two competing processes, i.e. a highly automatic linguistic process (reading) and a controlled process (colour naming), are simultaneously involved. To investigate the neuronal correlates of Stroop interferences, an event-related potential (ERP) experiment was designed. Twenty highly proficient successive French-German bilingual adults performed a manual version of the Stroop task in their first (L1) and second (L2) languages. In addition, 20 French monolingual adults were tested in their L1. In addition to the usual congruent, incongruent and neutral experimental conditions, a negative priming condition was included. Negative priming trials are incongruent trials whose print colour equals the colour word in the preceding incongruent trial. Therefore, inhibition applied on the colour word of the previous trial has to be overcome in order to respond to the print colour in the negative priming trial. Descriptively, whereas behavioural data showed shorter response times in bilinguals, no advantage of bilingualism was observed on the Stroop effect size. ERP data revealed a larger negative deflection in the negative priming compared to the congruent condition in the time window 200-300 ms (N200 effect) at centro-parietal electrodes, but only for monolinguals. This early negativity is thought to reflect overcoming of inhibition. Moreover, the negative priming condition was associated with a centro-parietal N400 effect of similar size for bi- and monolinguals. The N400 effect is discussed to reflect conflict detection or resolution. Analysis on the activity of neuronal sources replicated the anterior cingulate cortex (ACC) as a main neuronal generator of the Stroop effect. The ACC source waveforms showed a numerical difference between the negative priming and the congruent condition occurring slightly later for monolinguals (550-650 ms) than for bilinguals (500-600 ms). Further analyses on the two languages of bilinguals showed reduced behavioural and neurophysiological Stroop interference in L2 compared to L1 (reduced N400 effect in L2). These findings support the "temporal delay assumption" formulated by Dijkstra & Van Heuven (2002). Taken together, the present data reinforce the idea that multiple language use improves efficacy in resolving cognitive conflict. The results of the present study lend support to psycholinguistic models postulating a higher-order level of top-down inhibitory control involved in bilingual language processing. Moreover, our data convey information on the temporal decomposition of cognitive conflict processing. A bilingual advantage can be found not only for current inhibition but also for the flexibility necessary in overcoming of inhibition.

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Bilingualism Trains Specific Brain Circuits Involved in the Rapid Reconfiguration of Behavior: Evidence from Rapid Instructed Task Learning

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Keywords: Bilingualism; fMRI; Executive functions; Rapidly instructed task learning; Basal ganglia

Introduction

Bilinguals outperform monolinguals on a variety of higher-level, non-linguistic cognitive tasks (e.g., Bialystok, Craik, & Luk, 2012). This improved cognitive performance must somehow result from their experience in managing and switching between two languages. Because this transfer of skills implies that linguistic abilities share some common neural infrastructure with general executive functions, the study of the bilingual mind provides a unique window for understanding how language depends on the general architecture of brain.

Here, we present the results of a neuroimaging study comparing bilinguals and monolinguals performing a task that requires the immediate reconfiguration of behavior according to new rules. While previous investigation have focused on specific aspects of executive functions, our study focused on the mechanisms that allow rapid reconfiguration of complex behaviors. We suspected that, because bilinguals need to swiftly change syntactic and morphological rules when switching languages, they would show a behavioral advantage in this type of non-linguistic rule application paradigm.

Specifically, we compared the performance of 16 monolinguals (mean age 21.1 ± 4.3 years) and 15 early bilinguals (mean age 22.0 ± 4.8 years, fluent in both languages before the age of 7) in a rapidly instructed task-learning paradigm. In this paradigm, participants perform different "tasks" at every trial. Each trial is divided into two phases, an "encoding" phase where participants are given the task instructions, and an "execution" phase where the instructions are applied to a target stimulus. Separate response times were collected for these two phases, and the instructions could be entirely novel or have been practiced in advance. To minimize the role of language in this paradigm, all the instructions were combinations of mathematical rules, all the stimuli were pairs of numbers in the range 1-9, and all the instructions were given in an artificial symbolic notation. For example, the instructions for a particular task could be "Multiply x by *2*; Add 1 to *y*; sum the two results" and the stimuli could be the pair "*x* = 8, *y* = 2". Functional images (TR = 2,000ms, TE = 21ms, 44 axial slices, 2.75x2.75x3.2 voxels) were acquired while participants performed the tasks, and analyzed with SPM8.

Results

Behavioral results confirmed our prediction that bilinguals were faster than monolinguals at executing entirely novel instructions. More specifically, bilinguals were as fast at executing new instructions as they were at executing instructions that had been practiced before. In contrast, monolinguals took significantly longer at executing new rules than practiced ones.

An analysis of the neuroimaging data showed that bilinguals had greater basal ganglia activation than monolinguals when executing new instructions. This is consistent with previous research showing that this circuit plays an important, general-purpose role in executive function by controlling which signals gain access to prefrontal cortex (e.g., Stocco, Lebiere, & Anderson, 2010).

In summary, our results suggest that bilingual practice increases the ability to recruit the basal ganglia, and this ultimately results in greater cognitive flexibility and greater proficiency at implementing new complex behaviors. This transfer effect also implies that the application of language-specific rules (which is particularly trained in bilinguals) also depends on brain regions (like the basal ganglia) that play a general role in executive functions.

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Cross-Modal Effects on Novel Word Consolidation

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Keywords: word learning; memory consolidation; modality

In line with two-stage models of memory, it has been proposed that memory traces for newly learned words are initially dependent on medial temporal structures and acquire neocortical, more lexical representations during the first night's sleep after training (Davis & Gaskell, 2009). Only after sleep-dependent consolidation are novel words fully integrated into the lexicon and are therefore able to enter into lexical competition with phonologically overlapping existing words. This effect, observable as a slowing down of responses to existing words with a novel competitor, has been demonstrated using various tasks including lexical decision, pause detection, semantic judgement, and word-spotting.

We investigated the time course of lexicalisation of novel words learned in the visual and auditory modality. Subjects were familiarised with novel words either in a visual task (letter monitoring) or an auditory task (phoneme monitoring), and subsequently performed an auditory pause-detection task on existing words that overlapped with the learned novel words. Results indicated that, as in previous work, words learned auditorily enter into competition with existing words after one night's sleep, but not immediately after familiarisation. However, competition effects for novel words learned from print emerged only after a week. The presence of a competition effect from visually learned words task indicates that at least after a week, novel words had acquired abstract representations that were able to influence recognition of existing words independently of their modality.

We discuss possible explanations for the delay in cross-modal lexicalisation. Since we observed a delayed, but nonetheless significant competition effect in participants who received written input, we argue that learning novel words from print does not preclude cross-modal lexicalisation. Furthermore, previous work has demonstrated competition effects after a single night in a visual within-modality paradigm (Bowers et al.; 2005). This strongly suggests that it is the cross-modal design rather than the input modality per se that caused the delay in lexicalisation in our cross-modal condition. Either a longer consolidation period, reactivation during the second session, or a combination of both may be necessary for cross-modal lexicalisation to take place. We therefore hypothesise that the formation of a truly abstract, modality-independent lexical representation is characterised by a longer and possibly more complex time course than has previously been assumed.

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Vocabulary Learning in Children: Effects of Semantic Training on Memory Consolidation

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Although the acquisition of a novel spoken form is often rapid, previous research with adults and children suggests that integration of novel and existing phonological knowledge (measured by engagement in lexical competition) requires a consolidation period associated with sleep (Dumay& Gaskell, 2007; Henderson, Weighall, Brown & Gaskell, in press).

Mostprevious research has studied phonological learning of fictitious nonwords (e.g., dolpheg) in the absence of meaning and may not reflect naturalistic word learning which includes semantic information. Evidence for the role of semantics in word learning with adults is mixed. Dumay, Feng& Gaskell, (2004) found semantic training led to an increased *delay* in lexical integration compared to phonological learning alone. In contrast, Leach & Samuel (2007), found immediate integration following semantic training. The influence of semantic training on the time course of lexical integration in children has not previously been examined. However, McKague, Pratt and Johnston (2001) found semantic training improved recall with 6-7 year olds.

Here the possibility that children may show faster consolidation of novel spoken words when semantic training is provided was investigated using real unfamiliar words. Ninety-seven children aged 5-9 years learned 14 unfamiliar science words with semantic training (semantic group) or phonological/orthographic training (nosemantic group). Effects of exposure on explicit memory (cued recall) and lexical competition (pause detection) were measured immediately (0-hrs) and 24-hrs after training and 1-week later. In the pause detection task the speed with which listeners detect silent pauses inserted into words provides an on-line indicator of lexical activity as latencies are thought to be affected by processing resource availability generally being faster the fewer alternative completions that are compatible with the input (Mattys& Clark, 2002).

Both groups were slower to detect pauses in familiar competitor words ("hippopotamus") relative to control words 24-hours after training on a real (but unfamiliar) competitors ("hippocampus") but not immediately, indicating that the newly learned word effectively engaged in lexical competition supporting the view that a period of offline consolidation is required for lexical integration irrespective of training condition. Furthermore, both groups explicitly recalled significantly more words 24 hours after training, relative to 0-hrs. However, the semantic group showed superior recall to the no-semantic group after 1-week, suggesting that semantic training may lead to more durable phonological representations that are more easily retrieved.

We provide the first evidence that semantic trainingduring spoken word learning does not affect the time course of lexical integration inchildren (as measured by engagement in lexical competition). However, semantic training may result in more stable lexical representations longer term.

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Cortical Dynamics of Spreading Activation and Lexical Competition during Naming Investigated with MEG

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Keywords: MEG; naming; semantic interference

Introduction

Selecting a word for production is assumed to involve a spreading-activation and a lexical-competition mechanism (e.g., Levelt, Roelofs, & Meyer, 1999). The activation of the target concept spreads to other nodes in the lexical network. Activated nodes then compete for selection. To investigate these mechanisms, picture-word interference is often used, in which speakers name pictures while ignoring distractor words. Usually, pictures paired with semantically related distractors (pictured leg, distractor 'arm') are named more slowly than pictures paired with unrelated distractors (distractor 'desk'). This semantic effect is interpreted as evidence for lexical competition. Recently, the neural basis of this effect has been investigated with ERPs. However, ERPs only capture evoked activity, while providing no information about non-phase-locked (induced) activity.

To examine how induced and evoked activity may relate to distractor effects in picture naming, we conducted a picture-word interference study employing MEG. The distractors were either the name of the picture (congruent condition), from the same semantic category (semantic condition), or unrelated to the picture (unrelated condition). We examined event-related fields (ERFs) and time-frequency representations (TFRs), and neural sources were estimated. The contrasts of interest were the semantic (semantic vs. unrelated) and the Stroop-like (semantic vs. congruent) effects.

Results

The response times (RTs) were 911 ms for the semantic, 894 ms for the unrelated, and 830 ms for the congruent condition. The semantic (semantic > unrelated) and Stroop-like (semantic > congruent) effects were observed. The ERFs showed a peak around 450 ms, with the ordering of peak amplitudes being unrelated > semantic > congruent, different from the ordering of the RTs. These evoked effects were localised to superior temporal areas. The TFRs showed power increase between 450-650 ms in a frequency band of 6-10 Hz, with the condition ordering being semantic > unrelated > congruent, corresponding to the ordering of RTs. The power effects were localised to frontal brain areas associated with top-down control.

Discussion

The distractor effects in the ERFs are interpreted as mutual semantic priming between the distractor and the picture, reflecting the spreading activation mechanism. The smaller the semantic distance between distractor and picture, the larger the priming, and the smaller the ERF amplitude. The effects in the TFRs suggest that the oscillations, localised to frontal areas, reflect top-down influences on the selection of linguistic information. The larger the competition between distractor and picture name, the larger the top-down control needed, reflected in the TFR power. The time course of the effects suggests that top-down control in frontal brain areas is triggered by increased competition during word planning.

Our study presents estimated neural sources of evoked and induced activity associated with distractor effects in picture-word interference. We suggest that the evoked activity reflects spreading activation in the lexical network and the induced activity reflects lexical competition.

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Phonological Neighborhood in Speech Production Revisited

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Keywords: speech production; phonological similarity; neighborhood density; lexical access; mental lexicon.

Phonological neighborhood density (PND) refers to the number of words that differ from a given word by a single phoneme. Previous studies on PND in speech production have reported conflicting results (inhibition and facilitation), notably within and across languages. It is of importance to clarify the role of phonological similarity in speaking and to establish how such similarity influences access to the lexical network. To this aim, we conducted a large-scale picture naming experiment in Spanish. In two sessions, 30 participants were asked to name 533 object pictures as fast and as accurately as possible. The data (N = 31,980 trials) were analyzed using mixed linear regression models performed at the single trial level. To control for possible confounds, several variables known to affect naming performance were included in the analysis (e.g., age of acquisition, name agreement, onset density, first syllable frequency, etc.). Our results showed that increasing PND had a detrimental effect on naming latencies. Moreover, several re-analyses of published data sets provided further evidence on an inhibitory effect of PND on naming latencies. In addition, we highlight that the effects of PND surface differently depending on the task and performance measure at hand. We argue that when naming speed is tested, latencies are influenced by competitive processes involving similar sounding words. On the contrary, in accuracy tasks phonological similarity plays a facilitative and protective role. We conclude that the lexical network underlying speech production should not be described solely on the basis of static representational properties such as phonological similarity. The dynamics of the retrieval process have an influential impact on how these properties surface in speech performance.

Cohort effects in the visual world paradigm are mediated by visual/perceptual representations activated by spoken words, not phonological codes activated by displayed pictures

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We present a theoretical perspective on the vision-language interface in which visual representations are automatically activated for spoken words and utterances, whereas phonological coding of pictures and scenes is under strategic control. This view predicts that (1) linguistically mediated fixations are driven by visual/perceptual representations evoked by a spoken word and (2) implicit naming of objects or pictures will only occur in visual world studies when name retrieval facilitates task performance. We argue that results that have been interpreted as evidence for implicit naming are in fact fully consistent with the visual/perceptual hypothesis.

To directly test the visual/perceptual and naming hypotheses, we developed a set of 14 pictures with synonymous names (e.g., *couch/sofa)* and cohorts associated with each name (*cow* and *soda*, respectively). Norms established that (1) when shown the picture and a name, both names were rated as equally good and (2) when shown the picture and asked to generate a name, one name was strongly dominant. The visual/perceptual hypothesis predicts that dominance will affect fixations only when aspects of the experimental task encourage the participant to retrieve the picture's name.

In Experiment 1, we modified the standard setup of a four-picture spoken word recognition study in the visual world paradigm by masking a picture to create memory demands, which are known to promote linguistic encoding. Four pictures were displayed in a grid, and one of the pictures was highlighted by a red square. After 1.5 seconds, the highlighted picture was covered with a semi-opaque mask. The position of the mask was randomized, and trials were counterbalanced for whether the target was the masked picture. Additional filler trials controlled for any contingencies. In the test trials, the target was one of the two cohorts, while the synonym picture was masked. There were significantly more looks to the masked picture (e.g. *couch/sofa*) when the target word was a cohort of the dominant synonym name (*cow*) than when the target word was a cohort of the subordinate synonym name (*soda*). This result suggests that participants retrieved a name associated with the masked synonym picture. Thus, robust name typicality effects emerge under conditions in which memory demands encourage linguistic encoding.

Experiment 2 presented the same stimuli with the same preview, but no pictures were masked. The visual/perceptual hypothesis predicts that name typicality effects should be eliminated under these conditions (which are typical for visual world experiments). The results supported this prediction: We found strong cohort effects, with a similar proportion of looks to the synonym picture regardless of whether the target was a cohort of the dominant or subordinate name.

Taken together, these results strongly support the visual/perceptual mapping hypothesis, and they suggest that the activation of phonological codes is strategic, adopted only to accommodate to memory demands. The results are incompatible with the hypothesis that implicit naming drives eye movements in the visual world paradigm.

The Effect of L1 Exposure on Spanish Attrition: An Eye-tracking Study

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Previous research has shown L1 attrition to be restricted to structures at the interfaces between syntax and other cognitive domains, such as semantics or pragmatics, but not to occur with context-independent structures (*Interface Hypothesis*, Sorace & Filiaci 2006). This is supported by studies exploring cross-linguistic influence effects in interface structures, such as the production and/or interpretation of null versus overt pronominal subjects, in different bilingual groups with different language combinations, such as early bilinguals (Paradis & Navarro, 2003), late bilinguals (Rothman, 2009), and L1 attriters (Tsimpli et al., 2004). The current hypothesis is that individual L1 attrition affects only the ability to process interface structures but not knowledge representations themselves (Sorace, 2011).

Here, we investigate attrition using both off-line and on-line measures, comparing a syntax-pragmatics interface phenomenon (pronominal subjects in Spanish) with a "context-independent" phenomenon (the Spanish personal preposition *a,* also known as Differential Object Marking, DOM). In Spanish, the distribution of null and overt subject pronouns is pragmatically constrained, whereas the presence of the preposition just depends on the animacy and specificity of the direct object. Participants included a group of attrited speakers of L1 Spanish who had been living in the UK for a minimum of 5 years, and a group of Spanish monolinguals. Using a naturalness judgment task and eye tracking while reading, participants were presented with anaphora in which number cues matched or mismatched predicted antecedent preferences (i.e. empty *pro*: subject preference; overt pronoun: object preference):

Subject match: La madre se despidió de las niñas cuando ella/*pro* salía por la puerta.
                (the mother said goodbye[sing.] to the girls when she/*pro* left[sing.] by the door)

Object match: Las madres se despidieron de la niña cuando ella/*pro* salía por la puerta.
                (the mothers said goodbye[plural] to the girl when she/*pro* left[sing.] by the door)

The DOM study also used a mismatch paradigm, crossing preposition presence (*al* vs. *el*) with animacy (e.g. María vio el/al niño/barco en el puerto, *Maria saw (prep) the boy/boat in the harbour*), where the animate object requires the prepositional form *al*. Offline ratings revealed equal mismatch sensitivity for both groups with both structures. However, eye-tracking measures showed that monolinguals were reliably more sensitive than attriters to the pronoun mismatch, while both groups showed equal on-line sensitivity to the DOM mismatch, which reveals that attrition affects interface structures, but not more context-independent structures.

Second, we investigated the effects of recent (re)exposure to L1 input on attrition. A second group of attriters carried out the same experiment after having been exposed exclusively to Spanish in a monolingual Spanish-speaking environment for a minimum of a week. Their eye-tracking results patterned with the monolingual group. This novel manipulation shows that attrition effects decrease as a result of L1 exposure, and that bilinguals are sensitive to input changes. Taken together, the findings suggest that attrition is due to processing difficulties rather than to a permanent change in speakers' L1 grammatical representations.

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Inflectional Morphology in Native and Non-Native Comprehension: A Cross-Modal Priming Study on German Participles

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Keywords: Morphology; Participles; Comprehension; Bilingualism

Abstract

Priming techniques have been argued to provide a window into different levels of processing of inflected words, with masked priming supposedly tapping into visual word-form-level and cross-modal priming into modality-independent central lexical-level representations. Priming techniques have also been used to study inflectional processing in non-native (L2) comprehension; the interpretation of the results from these studies is, however, controversial. Some have argued that word forms such as '*walked*' are morphologically decomposed in L1 but not in L2 comprehension (Silva & Clahsen, 2008); others have claimed that L1 and L2 processing of inflected words employs the same mechanisms (Feldman, Kostic, Basnight-Brown, Filipovic Durdevic, & Pastizzo, 2009). For non-native speakers, it is also not clear whether the two levels of processing are equally (in)sensitive to morphological structure.

The current study examines German (past) participle inflection. A previous masked priming study (Neubauer & Clahsen, 2009) reported stem-priming effects for regular '*t*'-participles in L1 German but not in highly proficient Polish L2 learners of German. Does this mean that L2 learners do not decompose regularly inflected words, at either the word-form- or the central lexical level?

To address this question, we performed a cross-modal priming experiment with 72 L1 German speakers (mean age: 37.7) and 30 highly proficient L2 learners of German with Russian as L1 (mean age: 27.2). Participants listened to one of three experimental primes, immediately followed by corresponding first-person-singular forms presented as visual targets, which had to be read out aloud. Stem-priming effects were determined using both unrelated and identity conditions as baselines.

	PRIMES	TARGETS
(1) -*t* participles:	*gedruckt* 'printed'	*drucke*
(2) -*n* participles with stem change:	*geliehen* 'borrowed'	*leihe*
(3) -*n* participles, without stem change:	*gewaschen* 'washed'	*wasche*

The results revealed different priming patterns in the L1 and L2, confirmed by a significant Condition-by-Group interaction. The L1 group showed full priming for (1), i.e. the same amount of facilitation for morphologically related prime-target pairs as in the identity condition, and reduced, but still significant, partial priming for (2) and (3). The L2 group showed partial priming for (1) and (2), no priming for (3).

For the L1 group, these results from cross-modal priming are parallel to those from masked priming in that –*t* but not –*n* participles yielded full stem-priming effects. For the L2 group, however, masked and cross-modal priming yielded different results, particularly for regular (-*t*) participles, for which a significant priming effect was found in the cross-modal experiment only.

We interpret these results in terms of different levels of representation for morphologically complex words. The significant (masked and cross-modal) stem-priming effects for native speakers indicate that they decompose inflected words into their morphological constituents at both the word-form level and the level of lexical representations. The absence of masked-priming, paired with reduced cross-modal priming suggests that whilst L2 learners do not employ morpho-orthographic segmentation at the word-form level, their central lexical-level representations seem to encode morphological relatedness similarly to native speakers.

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Bilingual Segmentation: Effect of Context Language in Basque/Spanish Bilinguals

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Keywords: segmentation; frequency; bilingualism.

What cues do humans use to segment words and phrases out of speech? Gervain (2007) argues that one cue involves the relative distribution of functors and content words in natural languages. Functors are closed-class elements that occur very frequently in natural languages and constant markers that help categorizing content words and extracting regularities in artificial grammars. They tend to appear at the edges of syntactic phrases. Their location varies cross-linguistically: phrase-initially in V(erb)-O(bject) languages, phrase-finally in O(bject)-V(erb) languages.

Gervain et al. (submitted) find differences in the segmentation preferences of an ambiguous artificial language by adult speakers of several languages: Japanese and Basque speakers (OV languages) choose more often than French and Italian speakers (VO languages) a segmentation pattern in where frequent syllables are the final elements of hexasyllabic units. The frequent-final preference of the Basque group, who are bilinguals (L2Spanish, VO) open the ground for inquiring whether OV-VO bilinguals deploy only the segmentation strategy determined by their L1, or whether they can deploy both.

We explore the segmentation preferences of Basque-Spanish bilinguals to determine whether OV-VO bilinguals: (a) use the segmentation strategies of the two languages they command and use frequently, or (b) prefer the segmentation strategy characteristic of their L1. To this end, we used the artificial language designed by Gervain (2007), characterized by strict alternation of frequent (a,b,c) and infrequent (X,Y,Z) syllables. The input was ambiguous, i.e., it could be segmented as consisting of either frequent-final segments (XbYcZaXbYc…) or frequent-initial segments (aXbYcZaXbY…). As in Gervain (2007) and Gervain et al. (submitted), the experiment consisted of a 17min familiarization in the ambiguous language followed by a test phase, in which participants heard pairs of hexasyllabic sequences—one member of the pair being frequent-final, the other frequent-initial—and had to choose which sequence sounded more like the familiarization stream. Participants were L1Basque-L2Spanish bilinguals, sorted into two groups depending on the context language, i.e., the language in which they were addressed and received the experiments' instructions (Spanish/Basque). Language of the instructions has been claimed to be a relevant factor for bilingual performance, affecting the relative activation of the bilingual's languages.

Results revealed that the context language significantly influenced the performance of the L1Basque bilinguals: the group given instructions in Basque produced a significantly greater number of frequent-final responses (77.65%) than the group given instructions in Spanish (66.82%) (p=0.046). Hence, L1Basque bilinguals' segmentation preferences are modulated by the context language. This suggests that bilinguals deploy two segmentation strategies and are able to switch between these two as required by the input.

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Perceptual Integration of Talker and Language Characteristics in Bilingual Speech

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Keywords: indexical information; bilingual speech processing; Garner task.

Previous research has established that phonetic and indexical information are perceptually integrated rather than segregated, and that speech perception is a talker-contingent process (e.g. Mullenix & Pisoni, 1990). In the case of bilingual speech processing, a critical dimension of indexical information is language identification (which language is being spoken?) because phonetic identification is largely language-dependent (especially for conflicting phoneme categories across two languages). The present research examines the interaction of these two indexical dimensions, talker and language, in bilingual speech processing.

Recent research has indicated that talker identification depends on language familiarity (e.g. Levi, Winters, & Pisoni, 2007), and therefore that talker and language information may be perceptually integrated (i.e. talker information is conveyed in a language-specific manner). Alternatively, there could be sufficient language-independent talker information (e.g. pitch, rate, and source-filter characteristics) for language and talker identification to be perceptually segregated (i.e. talker information is conveyed in a language-independent manner). To test these possibilities, we investigated talker and language identification in the speech of Mandarin-English bilinguals.

Using a speeded classification procedure (Garner, 1974), we manipulated variability in the talker's gender (male vs. female) and in the language being spoken (Mandarin vs. English). The stimuli consisted of short, meaningful sentences obtained from two Mandarin-English bilinguals. The task of English-speaking participants with no knowledge of Mandarin was to classify each sentence on one of two indexical dimensions, gender or language being spoken. Three stimulus sets for each dimension were presented. In the control set, the relevant dimension varied randomly but the irrelevant dimension was held constant. In the orthogonal set, both dimensions varied randomly. In the correlated set, a property of one dimension was paired with a property of the other dimension. Importantly, slower responses to the orthogonal set versus the control set would indicate that gender and language are processed dependently.

Results showed no significant differences in accuracy between stimulus dimensions and sets (all close to ceiling). The response time data showed that listeners were overall faster in classifying stimuli on the gender than on the language dimension. Most importantly, there was a significant interference effect, with faster response times in the constant than in the orthogonal stimulus set, indicating that gender and language are processed in an integral manner. This mutual interference effect did not interact with stimulus dimension, revealing that, although the processing between gender and language is dependent, the size of the interference effect is symmetrical. This effect was replicated using a different talker pair.

To conclude, the present results demonstrate the perceptual integration of talker and language characteristics in bilingual speech. Listeners are not able to ignore variation in the gender dimension while processing the language dimension, and vice versa. This suggests that talker-specificity (at least at the level of gender identity) is not fully segregated from language-specificity. Currently, follow-up studies investigate this talker-language dependency for talkers of the same gender and for Mandarin-English bilingual listeners.

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Language Switching in Unbalanced Bilinguals: The Role of Stimulus Valence and Predictability on Asymmetric Switch Costs

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Keywords: Language Switching; stimulus valence; word production; switch costs; predictability; bilingualism.

Introduction

The issue of control in language production is often investigated by exploring how bilingual people select which language to use in a given context. One largely exploited paradigm is based on asking people to read a sequence of stimuli using either one or the other of two languages (L1 and L2) and measuring the cost of switching between them. Two main research lines can be individuated in this domain. In one, lexical decision has been used with trial-by-trial changes in language occurring in alternated runs, according to a fixed sequence (e.g., Thomas & Allport, 2000). In these cases participants were asked to give a manual response and the switching between languages could be predicted in advance. Also, in many cases words were univalent stimuli, given that in most cases a sequence of letters is a word either in one or in the other language. These studies have reported large switch costs that were comparable for L1 and L2. In the other research line, naming has been used and the trial-by-trial changes in language are unpredictable, with a language cue (e.g., coloured rectangle) appearing at the same time as the target stimulus (e.g., Meuter & Allport, 1999). The stimuli are typically numerals or pictures, which are bivalent stimuli (i.e. they can be named in either of the two languages). These studies have reported asymmetrical switch costs were the cost to switching to L1 is larger than the cost to switching to L2. Aim of the present study is reconciling these two research lines and further investigating the nature of the asymmetric cost by manipulating both language predictability stimuli valence.

Method

Two experiments are reported that examine the costs obtained when switching between languages while naming (1) Arabic numerals (bivalent) and (two) number words (univalent) in separate blocks. In one experiment (N = 40), the language switches were predictable according to a fixed AABB sequence. In the other experiment (N = 36), switches were unpredictable with language indicated by the color of a rectangle within which the stimuli were inscribed.

Both experiments were performed by two groups of participants. One group was composed by students at Trent University (CA) who had English as L1 and French as L2; the other group was composed by students at the University of Padova, who had English as L2 and Italian as L1.

Results

In both experiments a significant switch cost was observed both for Arabic numerals (bivalent stimuli) and for number words (univalent stimuli), though it was larger for the numerals. The switch cost asymmetry (larger switch costs for L1 than for L2) was present for Arabic numbers and number words, both in the case of predictable and unpredictable switches and both for participants with English as L1 and L2. Therefore, the cost and asymmetry although much larger in the case of Arabic numbers were still observed irrespective of stimulus valence, switch predictability and language set.

Conclusion

Overall, the pattern suggests that the absence of a switch cost asymmetry in previous work is due to the choice of language task. An asymmetry is observed when the task requires selecting a phonological code., This further constrains the locus of the control system in bilingual language production.

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The Multimodal Meaning of Speed in Language
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Keywords: Lexical Semantics; Embodiment; Simulation

The retrieval of semantic information in language is thought to involve the shared activation of resources used in perception and action. Experiments have been performed that show how comprehending action or motion language, for example, can interact with physical action (e.g. Glenberg & Kaschak, 2002) or motion perception (Kaschak, Madden, Therriault, Yaxley, Aveyard, Blanchard & Zwaan, 2005). The present research investigates a new semantic domain, speed, and shows how language can be embodied for words referring to different speeds. Speed is an interesting novel domain to investigate because it requires integration of spatial and temporal information and therefore might be thought of as more abstract than other dimensions already explored (e.g., manner of motion). In particular, we hypothesise that because processing speed requires integration of different information, language referring to speed may equally affect processing of speed information in different modalities.

In both experiments a lexical decision task was used with verbs denoting fast or slow motion (e.g. amble, dash), filler words (e.g. globe) and non-words (e.g. tades). To establish how fast and slow verbs are processed without any concurrent perceptual stimuli, we previously ran a baseline lexical decision task, in which all items were presented alone. The results of this experiment suggest that there is no difference in response times between fast and slow words in a neutral context. For the following two experiments, we use as our dependent variable the difference between response times to an item in each experiment and the response times to items in the 'simple' experiment. This allows us measure the extent of any interference/facilitation effect and additionally serves to remove the effects of any lexical variables such as word frequency. In Experiment 1, participants viewed a dynamic visual display that moved at a fast or slow speed before being presented with each item. The visual display contained lines moving outwards from the centre of the screen, creating a sense of motion. Results showed a significant interaction between speed of verb and speed of visual display: response times to verbs were fastest when the speed of the verb matched the speed of the visual stimulus. Experiment 2 combined the same lexical decision task with an auditory stimulus. Before the item appeared on screen, participants listened to fast or slow beeps through headphones. The beeps travelled from left to right ear with a gap between each beep of either 50ms (fast) or 1000ms (slow). Results again showed an interaction between the two forms of speed, but a different pattern to Experiment 1 was observed. Response times to the fast and slow verbs were similar after listening to fast beeps, whereas response times were faster to fast verbs than to slow verbs after listening to slow beeps.

These results indicate that first; speed in language is simulated and interacts with speed in other modalities. Second, results show a different pattern when speeded auditory stimuli is used than when speeded visual stimuli is used. This suggests that information recruited from different modalities may differ in nature and/or temporal pattern.

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Action Sentences and Body-Specific Representations

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Keywords: embodied cognition; action language; body-specificity

Introduction

Embodied accounts of language are supported by research demonstrating body-specificity in language comprehension. When reading manual action verbs like "to grasp", left-handers activate premotor areas controlling the left hand, and right-handers activate premotor areas controlling the right hand (Willems, Hagoort, & Casasanto, 2010). By default, comprehenders represent actions named by verbs as they themselves would perform them.

We investigated how body-specificity interacts with perspective taking in language. We expected that, reading about manual actions described in the first person (e.g., *I am cutting the tomato*), left- and right-handers would represent the actions differently, consistent with performing the actions with different dominant hands. When reading about actions in the third person (e.g., *He is cutting the tomato*), it is possible that left- and right-handers still represent the actions differently, attributing their own handedness to the referent of "he." Alternatively, left- and right-handers might represent third-person actions similarly, attributing right-handedness to the referent of "he," since most potential referents are right-handed.

Methods and Results

Experiment 1 used a sentence-picture matching task to demonstrate body-specificity in first-person action sentences. Participants read sentences describing first-person actions, then viewed photographs showing an action carried out by either a left or a right hand. All photographs depicted the action from an egocentric perspective. Results showed a significant interaction between dominant hand of participant and the hand performing the action in the photograph: right-handers were slower to match sentences to photographs showing right-handed actions, and left-handers were slower to match sentences to photographs showing left-handed actions. No interaction was observed when sentence and photograph did not match, indicating that the interaction was not simply a result of viewing left-/ right-handed images.

Experiment 2 manipulated linguistic perspective in right- and left-handers in a forced-choice task. Participants read a first- or third-person action sentence, and then chose between two photographs: one photograph showed a right hand performing the action, and the other photograph showed a left hand performing the action. The perspective of the photographs (egocentric/ allocentric) was also manipulated. We found a significant interaction between handedness and pronoun: all participants preferred body-specific representation on both first- and third-person sentences; however this body-specific preference was significantly weaker for third-person sentences than first-person sentences.

Discussion

These studies extend research on body-specificity in language comprehension by demonstrating that comprehenders interpret action sentences as they themselves would perform the action. This pattern holds even when the agent of the sentence is explicitly not the comprehender, and, in the case of left-handed participants, is unlikely to perform the action in the same manner as the comprehender.

However, the tendency for body-specific interpretations is significantly reduced in third- versus first-person action sentences: motor representations of manual actions are malleable, and are affected by the verb's grammatical person. Linguistic context can moderate, but not override, our default body-specific interpretation of action language.

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Walking the Walk and Talking the Talk, and Perceptually Simulating Both While Reading

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Keywords: Eye-tracking; reading; perceptual simulation;

Previous research shows that the semantic content of dialogue descriptions affects reading times on embedded quotes. Yao and Scheepers (2011) showed that readers were faster to read direct quotes when the preceding context implied a fast-talking character, an effect attributed to perceptual simulation of talker speed. Subsequently, Stites, Luke, and Christianson (Accepted) manipulated a character's action speed independently from their speaking rate (e.g., *John ran/walked into the room and said quickly/slowly, "I finally found my car keys"*) to determine if these two cues have separable effects on direct speech simulation. Readers spent less time reading direct (but not indirect) quotes explicitly described as being said quickly compared to slowly, whereas action speed had no effect. Furthermore, semantically "fast" adverbs were read faster than semantically "slow" adverbs, controlling for length and frequency.

However, Stites et al. (Accepted) leaves the open question of whether adverb speed affects quote reading times because it directly describes speech rate, or because it was always closer to the quote than the verb was. In the current stimuli, the adverb describing speech rate is farther away from the direct quote than the verb (e.g., *John said quickly/slowly as he ran/walked into the room, "I finally found my car keys"*). The current results replicate Stites et al.'s findings that readers use adverb content to modulate direct quote reading times: go-past and total times are significantly shorter on quotes said quickly compared to slowly, with no effect of action speed. Thus, readers use the adverb describing the quote to guide simulation of talker speed, regardless of its physical distance from the direct quote. Additionally, "fast" adverbs were again read faster than "slow" adverbs, an important replication, as Stites et al. were the first to show this effect.

Additionally, selective go-past durations on the prepositional phrase describing the action (*into the room*) were shorter following fast relative to slow actions, with no effect of adverb speed. To our knowledge, we are the first to show that perceptual simulation of a non-vocal action can modulate eye movements. This effect was not present in Stites et al. (Accepted) when the action occurred before the speech act was introduced, suggesting that the verb "said" cues the upcoming speech, causing readers to prepare to generate voice-related representations. This preparation for perceptual simulation could make readers more likely to create any perceptually-driven representations, including character movement rate. The dissociation between the effects of character speaking and movement rate suggests that readers generate perceptual representations that are sensitive enough to affect reading times on only the phrases to which they directly correspond, rather than generally affecting eye-movement speed over the remainder of the sentence.

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Spatial Coding of Object Typical Size: Evidence for a SNARC-like Effect

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Keywords: SNARC Effect; Object Size; Polarity Coding Account.

Introduction

The SNARC effect refers to the finding that left-to-right readers tend to react faster to small numbers when a left response is required and to larger numbers when a right response is required. This phenomenon suggests that numbers are spatially represented on a mental number line, which is oriented from left to right. The SNARC effect is usually attributed to the automatic activation of spatial representations of number magnitudes, which interact with response position codes (Dehaene, Bossini, & Giraux, 1993).

The present study aimed at investigating whether the typical size of objects, as with number magnitude, is automatically represented, and whether this representation is spatial in nature.

Method

Participants performed either a magnitude comparison task (Experiments 1 and 3) or a semantic decision task (Experiments 2 and 4). Target stimuli were either pictures (Experiments 1 and 2) or words (Experiments 3 and 4) referring to typically large or small animals or inanimate objects.

In the magnitude comparison task, participants were required to judge whether a centrally-presented target was smaller or larger than a reference stimulus, by pressing a left- or right-side key.

In the semantic decision task, participants had to classify the target as belonging to either the category of living or non-living entities, by pressing the left- or right-side key.

Results

Results demonstrated that, regardless of task type and stimulus format (picture or word), left responses were faster when the target represented animals or inanimate objects of small size (e.g., a bee or a key), whereas right responses were faster in the case of typically large animals or objects (e.g., an elephant or a house).

Conclusions

The present results indicate that the information about the object typical size is automatically activated, even if it is irrelevant to the task. These results suggest that the typical size of objects is spatially coded, as has been proposed to occur for number magnitudes (Dehaene *et al.,* 1993). In this representation, small objects are on the left and large objects are on the right.

These results are also consistent with the polarity coding account (e.g., Proctor & Cho, 2006). According to this account, opposite concepts (like small–large and left–right) constitute categorical dimensions. Within these dimensions, each of the opposite concepts is associated with a specific polarity (e.g., small and left being negative while large and right being positive). In agreement with this proposal, the effect observed in the present study may be verbal in nature, rather than visuo-spatial, that is, it may be driven by the congruency between the polar codes of stimuli and responses.

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The Role of Emotion in Abstract Word Processing

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Keywords: Abstract Words; Embodiment;Emotion; Dual Coding Theory;Semantic Processing

While embodied sensory experience may be an obvious source of information for concrete concepts like apple, what information might support our representation of abstract concepts like truth?

In comparison to concrete words, abstract words are learned later, read slower, and are not remembered as well. Dual Coding Theory (Paivio, 2007) suggests these effects are a result of less information available for abstract concepts. It proposes that concrete words are represented using both embodied sensorimotor experience and linguistic associations, while only language can support representations of abstract words. However, processing differences between concrete and abstract words may result from qualitatively different forms of embodied information.

Recognising a preponderance of emotional content in abstract words,it was recently proposed that emotion serves as experiential information that is especially crucial in representing abstract concepts, just as sensorimotor information is important for concrete concepts (Kousta et al., 2011). This is supported by the finding that emotional abstract words are acquired earlier in development than non-emotional abstract words, suggesting that emotion may bootstrap abstract concept acquisition. However, there is currently limited behavioural evidence for this link between emotion and abstract words.

The present experiment implements a behavioural paradigm that has previously been used to investigate depth of processing and memory. In this paradigm, participants are given a series of target words and asked an elaboration question about each word, which requires processing of the word on a deep semantic level or a shallow level. Such experiments consistently found that participants remember target words best when they were elaborated with deep questions, rather than shallow questions. However, little attention has been paid to whether the type of deep question affects recall.

This present experiment investigates whether emotional processing indeed underlies the representation of abstract concepts more than concrete concepts, using the above paradigm with matched sets of 30 abstract and 30 concrete target words that were elaborated with one of three types of questions: (1) Deep-Feel: "How does this make you feel?" (2) Deep-Where: "Where might you find this?"(3) Shallow-Count: "How many letters are in this word?" A wide range of lexical variables were controlled for, including frequency, length, age of acquisition, familiarity, and imageability. Afterwards, participants were asked to freely recall the target words.

The key finding is that, looking at only deeply elaborated words, there is an interaction between concreteness and question type [$F(1,72)=4.575$, $p=0.036$], such that "Deep-Feel" elaboration facilitates recall of abstract words, whereas "Deep-Where" elaboration facilitates recall of concrete words. As a manipulation check, words with deep elaboration were indeed recalled more than those with "Shallow-Count" elaboration [$t(71)=-13.579$, $p<0.001$].

Thus, emotion appears to play a significant role in the processing of abstract words.As concrete concepts can be grounded in our external sensorimotor experience, abstract concepts can be grounded in our internal affective states.

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The Processing of Emotional Sentences by Young and Older Adults: A Visual World Eye-movement Study

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Keywords: sentence processing; visual world; emotional priming; facial expressions.

An intriguing result from research on emotion processing is that emotional content in one modality (e.g., language) can prime emotion processing in another modality (e.g., vision). For instance, responses involving emotional words can be primed by (a) emotionally-valenced pictures (Spruyt et al. 02), (b) facial expressions (Aguado et al. 07), and even (c) smells (Li et al. 07) and (d) sounds (Sollberger et al. 2003), suggesting rapid interactions between emotional language and nonlinguistic emotional material. However, research has so far almost exclusively focused on emotionally-valenced *words*. Thus there is a need to investigate how emotional content is processed in enriched settings, i.e. sentences in visual context. Using the visual world paradigm, and facial expressions as primes, we studied how (with which time course) valenced facial primes affect the processing of emotionally-valenced sentences in German. A concurrent aim was to examine age differences in emotional priming since there is evidence that emotion perception changes with age. Broadly speaking, younger people show a negativity bias (i.e., a preference for negative over positive stimuli), which reverses as people grow older.

In our experiment, young (N=32, Mean age=23) and older (N=32, Mean age=64) participants viewed an emotional prime face (happy, sad) for 3000 ms. This was followed by two opposite-valence target event-depictions (positive and negative; IAPS database). After a 1500 ms picture-preview, participants listened to a sentence referring to one of the depicted events. The initial sentence part was valence- and reference-neutral (e.g., [*I believe* [*that* (NP1….)]]). Disambiguation occurred from the subject of the embedded sentence (NP1) onwards. This setup yielded a 2(group: young /old) x 2(prime: negative/positive) x 2(sentence: negative/positive) x 2(picture: negative/positive) design. If emotional priming occurs rapidly also in situated sentence processing, people should prefer to look at the picture which is emotionally congruent with the prime face before NP1 (face-picture congruence). Later, while processing the embedded sentence, people should look at the appropriate picture (the picture the sentence is about) but there should be facilitation (i.e. more looks) if the prime face was (vs. wasn't) congruent with the sentence. If the two age groups process emotional content differently, as might be expected from existing findings on emotion perception, we should see more pronounced facilitation with negative valence primes for the younger and with positive valence primes for the older adults.

Before NP1, we observed a significant face-picture congruence effect in the young group, and a preference for the negative picture. Neither of these (nor other) effects emerged in the older group. After NP1 until sentence end, we found significant facilitation in the younger group but only with negative stimuli (i.e., when face, sentence and picture were negative), while the older group showed facilitation only with positive stimuli.

These findings demonstrate for the first time emotional priming from facial expressions to sentence processing. Emotional priming occurred from the early stages and throughout sentence processing. Interestingly, our group manipulation also revealed the expected differences in sensitivity to processing emotional stimuli between younger and older populations.

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Asymmetries in cross-linguistic emotion recognition

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Keywords: Emotion recognition; cross-linguistic; speech perception.

This study investigates the occurrence of asymmetries in cross-linguistic recognition of emotion in speech. Theories on emotion recognition do not predict any asymmetries in the cross-linguistic recognition of emotion: if a particular emotion expressed by e.g. a Korean speaker is difficult to interpret for a Dutch listener, the same emotion expressed by a Dutch speaker should be equally difficult for a Korean listener. This study investigates whether that is indeed the case. Previous studies have established that certain emotions are more accurately recognized cross-linguistically than others, and that language-typological similarity facilitates cross-linguistic emotion recognition, but were unsuitable for assessing asymmetrical recognition patterns.

To investigate asymmetries in cross-lingual emotion recognition, here, a fully crossed design is used, with speakers as well as listeners from two typologically unrelated languages, Dutch and Korean. Additionally, listeners of American English, typologically close to Dutch but not Korean, were tested. This design differs from previous studies, that have either used a *one-to-many* design (presenting emotional expressions from a single language to listeners from more than one native language group) or a *many-to-one* design (presenting emotional expressions from more than one language to listeners from a single native language group). The *many-to-many* (two-to-three) design in the present study enables the investigation of asymmetries that neither the one-to-many nor the many-to-one design allows for.

A large number of emotions (eight) was used, balanced in valence (positive-negative) and arousal (active-passive), including basic and non-basic emotions, recorded by a large number of speakers. Stimuli consisted of posed emotional expressions in a single *nonsense* phrase that was phonologically legal in Dutch, Korean, and English, recorded by eight Dutch and eight Korean professional actors, and selected on the basis of prior perception studies with Dutch and Korean listeners.

28 Dutch, 24 Korean, and 26 American participants heard all Dutch and Korean stimuli, blocked by language. Dutch and American listeners did not know any Korean, and Korean and American listeners did not know any Dutch. Participants indicated for each stimulus which emotion it expressed by mouse clicking on one of the eight emotions or on "neutral".

First, results are in line with previous findings, with effects of language distance, basic vs. non-basic emotions, and valence as expected. Importantly, there were strong asymmetries across languages and listener groups that cannot be explained along those previously described dimensions. Some emotions were expressed more effectively in one language than in another (e.g., all groups, including Dutch listeners, recognized fear better when expressed by Korean than by Dutch speakers). Further, some emotions were recognized more effectively by one group than by the others (e.g., Korean listeners recognized sadness better than the other groups, regardless of the language of the speaker).

Existing theories cannot explain those asymmetries. Previous research, using the one-to-many or many-to-one design, has not captured such asymmetries. The present results thus point to the importance of the many-to-many design for gaining further insights into cross-linguistic emotion recognition, and calls for the extension of theories of cross-linguistic emotion recognition in order to incorporate asymmetrical perception patterns.

Mood and conflict in discourse

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Keywords: Discourse; Pragmatics; Emotion; ERP

Research has shown that mood can influence language comprehension at various levels. However, little is known about how it affects discourse comprehension. While a few studies showed facilitation of mood-congruent contents (Egidi & Nusbaum, 2012), we explored how mood affects discourse processing with non-valenced contents.

Discourse processing involves dynamically creating a situation model, during which readers have to strike a balance between possibly conflicting general world-knowledge and what's being asserted specifically in the discourse, without being pulled into strong memory attractors that are currently irrelevant. Based on recent literature that negative affect sensitizes attention to conflict (van Steenbergen, 2010), we hypothesize that mood can influence how readers deal with the conflicts between general world-knowledge and the specific discourse.

To test this, we first created a sentence fragment (*with light on one can see ...*) that strongly cues familiar world-knowledge, supporting (s+) or disapproving (s-) the following critical word CW (more/less). Next, we embedded these sentences in a wider discourse whose meaning ultimately did (d+)/didn't (d-) support CW. Conflict potentially arises whenever CW is partially or not supported by predictions based on general world-knowledge and specific discourse. 240 such stimuli were created, matched between conditions and pretested with plausibility ratings. All stories described situations that could happen in the real world.

[d+s+]: [Discourse about driving at night]. *With light one sees <u>more</u> …*
[d-s-]: [Discourse about driving at night]. *With light one sees <u>less</u> …*
[d-s+]: [Discourse about stargazing at night]. *With light one sees <u>more</u> …*
[d+s-]: [Discourse about stargazing at night]. *With light one sees <u>less</u> …*

24 subjects participated in a 2-session EEG experiment (positive/negative-valence film-clips, one week apart). Within a session, they rated their initial mood first (baseline) and then did 5 consecutive blocks, each containing one clip, 30 stories, and end-of-block mood rating.

Mood ratings confirmed that our film-clips induced reliable mood differences. In both moods, we found N400 effects (300-500 ms, posterior) for [d-s-] relative to [d+s+] only. We also observed clear sustained late positivities 'LP' (500-900 ms, anterior) for [d-s-,d-s+,d+s-] relative to [d+s+], only after negative mood induction. Comparing moods directly, the LPs were larger after negative mood induction in [d-s-,d-s+,d+s-], and smaller after positive mood induction in [d+s+].

Assuming N400 reflects ease of conceptual memory retrieval, our findings suggest that as long as some aspect of the materials supported CW [d+s+,d-s+,d+s-], access to the concept behind it was easy, and not modulated by mood. We take LP to index some aspect of conflict-related processing, e.g., revising predictions (Otten & Van Berkum, 2008), updating discourse model with new info (Burkhardt, 2007), and/or continued processing of irresolvable conflict (Kuperberg, 2007). Critically, LP is sensitive to mood: Negative mood caused readers to attend more strongly to conflicting aspects of language, with difficulty to disengage (Bar, 2009).

Thus, mood influences conflict handling during discourse processing. Contributing to the language and emotion literature: Mood not only affects the processing of negative-valenced content in language, but also negativity at a more abstract processing level.

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Emotion and Frequency Share an Early Temporal Epoch in Word Processing: Evidence from a PRP Study

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Recent studies have shown an interaction between Frequency and Emotion in words presented in isolation (e.g., Kuchine et al., 2007; Scott, O'Donnell, Leuthold & Sereno, 2009) and, more recently, during normal reading (Scott et al., 2012).While all emotion words are read or responded to faster than their neutral counterparts at low frequency, only negative – not positive – words have an advantage at high frequency. Posited explanations for this include desensitization ('the boy who cried wolf' hypothesis: Scott et al., 2012) and a 2-stage theory of perceptual defence (e.g., Pratto & John, 1991), but one thing agreed upon by all authors is that the interactions indicate both variables influence processing within the same temporal period. In this study the psychological refractory period (PRP) was used to examine whether this common stage of processing reflects early or late stages of perception.

In the PRP task, participants respond to two stimuli in quick succession. Response times (RTs) increase as the stimulus onset asynchrony (SOA) decreases. This is attributed to a resource bottleneck that prevents one or more stages of processing from being carried out simultaneously for both stimuli. By manipulating the difficulty of the second task, we can examine whether the locus of difficulty reflects early (pre-bottleneck) or later (response selection) processing based on whether the RT difference is diminished at short SOAs (an underadditive effect: pre-bottleneck locus) or remains constant across SOAs (an additive effect: response selection or later).

This paradigm has been used to examine the locus of frequency effects; McCann et al. (2000) reported an additive effect of frequency, suggesting word recognition was attentionally demanding. However, Cleland et al. (2006) found an underadditive effect of frequency, suggesting that frequency-sensitive processing could proceed while attention was engaged with another task. Ruthruff et al. (2008) provided some reconciliation of these findings by demonstrating that skilled readers showed an underadditive effect whereas less skilled readers showed an additive effect; in other words, the automaticity of word reading, and the locus of frequency effects, varied with reading skill.

In the current study, participants made a pitch decision to a tone (task 1), quickly followed by a lexical decision to a visually presented word. Words could be high frequency or low frequency, and either positive, negative or neutral in emotional content. As SOA increased, RTs to task 2 decreased. We replicated the Frequency x Emotion interaction described above only at the long SOA, suggesting that frequency and emotion share a common, early, stage of word processing.

Furthermore, we found evidence that individual differences influenced the automaticity with which the emotional content of words was processed. In particular, participants high in state negativity (measured on the PANAS scale) demonstrated an underadditive interaction of emotion by SOA (a finding not present in participants with lower negative PANAS scores). This suggests that the automaticity with which a word is processed may be influenced by mood. We hypothesise that such state negativity confers a processing privilege to negative words which counteracts the desensitization or defensive minimization present in normal readers.

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Prediction during Language Processing is a Piece of Cake – but only for Skilled Producers

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Keywords: Prediction; Production Vocabulary; Language-mediated Visual Search; Toddlers.

Background

Adults orient towards an image of a cake upon hearing sentences such as "The boy will eat the cake" even before hearing the word *cake*, i.e., soon after they hear the verb EAT (Kamide et al., 2003). This finding has been taken to suggest that verb processing includes prediction of nouns that qualify as arguments for these verbs. Upon hearing the verb EAT, adults and young children (three- to ten-year-olds; Borovsky et al., in press) anticipate upcoming linguistic input in keeping with this verb's selectional restrictions and use this to orient towards images of thematically appropriate arguments.

Research Questions

Against this background we ask two questions. First, we ask whether *two-year-olds* similarly anticipate nouns that are in keeping with a verb's semantic selectional restrictions (i.e., anticipate edible nouns upon hearing EAT) and use this to orient towards images of thematically appropriate nouns. Second and more importantly, we ask whether toddlers' skill in predicting upcoming linguistic input is correlated with their language production skills (Chang et al., 2006; Pickering & Garrod, 2007).

Method

Two-year-olds were presented with images of two objects, e.g., a cake and a bird, and heard sentences containing either semantically constraining verbs such as "The boy eats the big cake" or sentences containing semantically non-constraining verbs such as "The boy sees the big cake". We then examined children's eye-movements towards the target image, i.e., cake, following the onset of the verb but prior to the onset of the target label.

Results

Children oriented towards the image of the target image, i.e., cake, even before they heard the corresponding noun, but only in the context of semantically constraining verbs (eat) but not following semantically non-constraining verbs (see). Furthermore, we found that children's production skills, i.e., their production vocabulary size significantly correlated with their prediction skills – children with larger production vocabularies were better at anticipating upcoming linguistic input to orient towards thematically appropriate arguments. This correlation remained significant even when any influence of children's comprehension vocabulary size was residualised from the influence of their production vocabulary size on prediction.

Discussion

With regard to the two questions posed by this research, we show first that even two-year-olds are able to use information extracted from the verb to predict lexical items that are semantically more suited to acting as the arguments of these verbs. Second, our data support an important role for production-based mechanisms in language comprehension (Chang et al., 2006; Pickering & Garrod, 2007). Importantly, this finding suggests that there is a component to children's prediction ability that is specifically tied to their production skills and not to their comprehension skills (as suggested by the correlation with residualised production scores). This might be taken to suggest that prediction using production is not a general feature of language comprehension but may be more specific to the learning of production representations (cf. Chang et al., 2006).

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Syntactic Surprisal Affects Word Durations: Support for UID

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Keywords: Uniform Information Density; Surprisal; Spoken Language

The uniform information density (UID, Levy and Jaeger, 2007) hypothesis suggests that people generally distribute information uniformly across across a text or utterance. Information density is thereby defined as the rate of surprisal across a text or utterance. Supporting evidence for the UID hypothesis comes for example from the effect of syllable predictability on phoneme durations (Aylett and Turk, 2006), the lower likelihood of the presence of the relativizer "that" in object relative clauses when the ORC is very predictable (Levy and Jaeger, 2007) or the reduction of "have", "be" etc. in predictable contexts (Frank and Jaeger, 2008). But there's also counter-evidence from compound particle length in Dutch (Kuperman et al., 2007).

This study investigates whether there is a general correlation between syntactic surprisal and spoken word durations. The AMI meeting corpus contains a record of 100 hours of meetings of up to five speakers and is annotated with orthographically correct transcriptions and exact word durations. We ran a linear mixed effects regression model with the observed word durations as a response variable and syntactic surprisal based on the Roark parser (Roark et al., 2009) as a predictor of interest. We also included as baseline predictors the word duration estimates from the state-of-the-art text-to-speech system MARY, word frequencies estimated from written resources (Gigaword and Penn Treebank) and spoken resources (AMI corpus, 10-fold cross).

Additionally, we calculated 3-gram and 4-gram surprisal trained on these resources. In order to avoid issues of collinearity between syntactic surprisal and any of the other predictors, we residualize syntactic surprisal against the other predictors. All reported results refer to mixed effects models with random intercepts for speakers and random slopes for TTS duration estimates and syntactic surprisal. (Models with more random slopes fail to converge.) Non-words like "hm-m" were excluded from the analysis. The resulting model contained ca. 770000 data points.

Besides a positive significant effect of TTS durations and a significant negative effect of frequencies, we find that surprisal as calculated using the syntactic parser is a significant positive predictor of spoken word lengths and is a better predictor of word durations than any of the ngram surprisal measures. The effect is also large enough to be audible: for example, the duration of the word "thing" with the lowest syntactic surprisal estimate in the corpus would be estimated to be 104ms shorter than the word's highest syntactic surprisal occurrence, everything else being equal. In comparison, the maximal difference in duration related to the gigaword 4-gram surprisal predictor would be 35ms. Our analysis provides further support for UID and indicates that humans have very fine-grained control over the interaction of syntax and word articulation.

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Representing That *You* Are Naming Interferes with *My* Naming

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Keywords: language production; joint task; forward models; covert simulation.

Another's actions can interfere with execution of one's own actions in joint tasks, possibly because action and perception representations share a similar format (Knoblich, Butterfill, & Sebanz, 2011). Pickering and Garrod (in press) proposed that speakers compute forward models for both their own (during production) and others' (during comprehension) upcoming utterances. This predicts that speakers in a simultaneous naming task will experience interference from the representation of their partners' utterances.

Twelve pairs of participants named pictures in two adjacent rooms. They could not hear each other, but they were told they would "work together" and they would see exactly the same stimuli. A trial began with an instruction screen: participants saw both their and their partner's name, followed by either "red", "blue", or "no" (e.g., "John: red, Mary: blue"). Then a red and a blue picture appeared. Participants responded by naming the picture presented in the assigned colour first and the other picture second; they remained silent if the instruction was "no".

On a trial-by-trial basis, we varied whether their partner gave the same response (SAME), a different response (i.e., naming the pictures in the reversed order; DIFFERENT) or no response (NO). Picture pairs were either semantically related (e.g., apple – banana) or unrelated (e.g., apple – blouse). LME-models with participants and items as random factors were fitted to naming latencies and accuracy data. The effect of Partner's task was assessed with two planned contrasts (NO response vs. response; SAME vs. DIFFERENT).

Semantically related pairs were named more slowly than semantically unrelated ones (B = 16ms, SE = 5, t = 3.27). Therefore participants began planning the second name before articulation onset. They were faster in the NO (M = 865ms) than in the SAME (M = 881ms) or the DIFFERENT (M = 877ms) conditions (B = 15ms, SE = 5, t = 2.94), which did not differ from each other (t<1). In addition, participants made more errors in the NO than in the other two conditions (log-odds B = 0.36, SE = 0.14, t = 2.61). Importantly, they also made fewer errors in the SAME than in the DIFFERENT condition (log-odds B = -0.26, SE = 0.10, t = -2.53). None of these effects interacted with semantic relatedness (t<1).

We argue that speakers represent *that* their partner is about to speak. They do so by computing a (generic) forward model, which interferes with the forward-model representation of their own utterance. Error analyses tentatively indicate that more detailed forward models (perhaps specifying linear order) of the partner's utterance might be formed as well; this seems to cause occasional selection of the wrong model. Overall, our findings are consistent with the hypothesis that others' utterances are modeled via production processes (Pickering & Garrod, in press).

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The Picture – Word Interference Paradigm: Polarity of the Effects

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Abstract

Semantic interference effects obtained by means of the picture-word interference paradigm refer to longer latency in naming a target picture in presence of a semantically related distracter compared to a control condition. Models give different explanations about the effect observed. The competition hypothesis describes these effects as a process of competition for selection between items semantically related (Levelt, Roelofs and Mayer, 1999). According to this theory, the interference effects reflect a mechanism of access to the lexicon. On the other hand, the response exclusion hypothesis describes the interference as a post-lexical effect, reflecting a mechanism of exclusion of production-ready representations from the one channel output buffer. This hypothesis is supported by studies which, manipulating semantic distance between materials, have found facilitation effects in presence of within-category close distracters compared to within-category far distracters (Mahon, Costa, Peterson, Vargas and Caramazza, 2007) and studies in which interference effects were found in a delayed version of the paradigm (Janssen, Schirm, Mahon and Caramazza, 2008).

In two picture-word interference experiments the polarity of the effects has been investigated. The role of synonyms (synonymous distracters vs non related distracters) was tested in the production of nouns (experiment 1; corda-fune vs corda-rana, in English cord-rope vs cord-frog) and verbs (experiment 2; sbucciare-pelare vs sbucciare-cullare, in English to skin-to pare vs to skin-to rock) in two different temporal conditions: the immediate condition (SOA=0) in which target and distracter appeared simultaneously on the screen and participants had to name the picture immediately and a delayed condition (SOA=1000) in which the distracter followed of 1000 milliseconds the presentation of the target and the naming task started after the onset of the distracter.

The results of the experiments revealed a facilitation effect in presence of synonyms distracters in the immediate condition, whereas no effects have been observed in the delayed condition. Models of language production can explain only a part of the data opening a discussion on lexical production processes.

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Vocabulary spurt and word-class composition:
Further evidence for a model of plateaus and linearity in early vocabulary growth

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Background & Aim

A lot of research on child language development has long assumed that there is a vocabulary spurt, namely a rapid increase in word acquisition rate, at around 18 months of age (e.g., Nelson, 1973). However, there is a continuing debate as to whether or not the increase rate is discrete. Some researchers argue that a discrete change in the rate reflects a qualitative shift in underlying mechanisms such as the acquisition of naming insight (Dore, 1978) and advanced categorization (Gopnik & Meltzoff, 1987); others argue that statistical analyses with logistic and quadratic fitting (Ganger & Brent, 2004) or with a Gaussian distribution in word difficulty (McMurray, 2007) indicate no discrete change in the rate, and therefore no qualitative shift in the mechanisms. More recently, detailed day-by-day analyses of longitudinal data have shown that plateaus, namely large time gaps (i.e., 7 or more days) during which children produce no new words, occur frequently during the pre-spurt period (Minami et al., 2012). Interestingly, a curve with plateaus removed is better explained by a linear-regression model with fewer fitting errors, indicating that a spurt can be modeled from a combination of plateaus and linear vocabulary growth. According to this linearity-based model, a spurt is not a discrete change, but an apparent change in the rate that is caused by the decrease in frequency of plateaus. Here we provide further evidence for the linearity-based model. Given the previous view that the spurt is due to a rapid increase in acquired nouns (Nelson, 1973), we investigate the relation between word-class composition concerning nouns and the word acquisition rate that can be estimated by the linearity-based model.

Methods

We collected longitudinal data from 17 Japanese-speaking children, whose mothers employed a web diary that we constructed for this project to report the acquisition date, pronunciation, and meaning of newly learned words that their children produced from 10 to 24 months. According to Caselli et al.'s (1999) word-class definition, the acquired words were classified into five word classes: nouns (excluding proper nouns and names of people/places), social words (including routines and games, sound effects, and names of people), predicates (verbs and adjectives), closed words, and other words. Next, we estimated the word acquisition rate in each child using plateau-removed linear fitting. To clarify developmental changes in the rate-composition relation, the word-class composition was analyzed in 20-word units with a 10-word sliding way.

Results & Discussion

The results indicated that the linear no-plateau rates correlated significantly with the word-class composition (i.e., number of nouns and social words) only in words 1-20 ($r_{noun} = .78$, $r_{social\ word} = -.73$, ps $<.001$). No significant correlation was found in other vocabulary ranges. Clearly, the word-class composition in the first 20 words can predict the linear no-plateau rate, indicating that children who include more nouns (and fewer social words) in the first 20 words produce new words linearly at a higher rate except the period of plateaus. The strong link between the earliest word-class composition and the linear no-plateau rate suggests that an internal mechanism that affects the rate exists from the earliest stage of lexical development, providing further evidence for the linearity-based model that a spurt reflects no qualitative shift in the mechanism.

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Producing inflected word forms: An ERP study on the English past-tense

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Studies of language comprehension have revealed that regular and irregular inflectional morphology can be dissociated in event-related potentials (ERPs) suggesting different underlying processing mechanisms for these forms (e.g. Newman, Ullman, Pancheva, Wligura, & Neville, 2007). Specifically, ERP studies of inflectional morphology across different languages (German, Italian, Catalan) have consistently reported an anterior negativity (300-800ms) in response to reading/hearing incorrectly regularized word forms (give – 'gived') when compared to reading/hearing correctly regularized word forms (walk – walked; e.g. Rodriguez-Fornells, Clahsen, Lleo, Zaake, & Münte, 2001). In addition, some studies also report a centro-parietal positivity (800-1200 ms) in response to processing incorrectly regularized words (e.g. Lück, Hahne, & Clahsen, 2006). In contrast, irregularizations (peep – 'pept') are reported to elicit an N400-like negativity when compared to correctly inflected irregular words (e.g. Weyerts, Penke, Dohrn, Clahsen, & Münte, 1997).

Studies exploring inflectional morphology during language production by means of ERPs are still rare (but see e.g. Koester & Schiller, 2008) since ERP data are easily contaminated by muscle movements elicited during articulation. Here, a 'silent production' paradigm that asks participants to silently produce responses before uttering them aloud can help. The current study uses such a paradigm to examine the neural correlates of producing inflected word forms, in the English past tense. ERPs were time-locked to the cue for silent production of either the past-tense or the 3rd person present-tense form (control condition). Participants are then cued for an overt response to check for accuracy. This paradigm thus captures the processes carried out in natural language production prior to vocalization while minimizing articulatory muscle contamination.

We investigated ERP correlates of inflectional morphology production in native speakers of English, comparing adults and 12 year-old children. Based on evidence from language comprehension and behavioural language production studies we expect a dissociation of regular and irregular past-tense production (e.g. walked vs. fell) but no such dissociation for 3rd person present-tense production (e.g. walks vs. falls) in adults. We expect the 12 year olds to show a similar effect if their production is adult-like.

Adult results revealed a fronto-centrally distributed negativity for regular when compared to irregular past tense forms between 300 and 450ms post silent production cue onset. Results from 12-year olds were comparable; however the negativity lasted 100ms longer and was right frontally distributed. Moreover, the negativity was followed by a late positivity (650-800ms). No ERP differences were found in either group for the 3rd person present-tense control condition.

We attribute the early negativity for regular past-tense forms to enhanced processing costs during the application of the '-ed' rule in both adults and children. The additional positivity observed in 12-year olds suggests increased processing demands in children relative to adults when producing regular past-tense forms.

These data nicely complement findings from language comprehension studies (e.g. Lück et al., 2006) and show that this ERP paradigm is suitable to investigate language production in both adults and children.

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Stress assignment in reading Italian pseudowords

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Keywords: stress assignment, pseudoword reading, stress neighborhood, articulation planning

The present study investigated stress assignment in reading aloud Italian pseudowords. In order to read a polysyllabic stimulus in Italian, stress assignment is obligatory. However, stress position is unpredictable by rule. There are two main stress patterns with asymmetrical distribution: 80% of words bear penultimate stress and 18% of words antepenultimate stress. In pseudoword reading two issues arise: i) How do readers assign stress to pseudowords? ii) How does stress assignment affect pseudoword naming times? The second issue has never been addressed before. For the first one, two main alternatives have been proposed: (a) Readers follow the distributional bias in their language and assign the most common stress pattern to pseudowords (Colombo, 1992); (b) Readers rely on distributional information, such as stress neighborhood – the proportion and number of words sharing orthographic ending and stress pattern – which is a good predictor of stress (Burani & Arduino, 2004).

We report four reading experiments, where we addressed the issue of how readers assign stress to pseudowords (Exp. 1 & 2), whether or not and how stress assignment affects pseudoword naming times (Exp. 3 & 4).In Experiment 1 we created three-syllabic pseudowords by manipulating their stress neighborhood: Half stimuli had a final sequence associated with penultimate (dominant) stress words (e.g., -oro in *riSTOro:* comfort) and the other half a final sequence associated with antepenultimate stress words (e.g., -ola in *PENtola:* pot). Experiment 2 was a replication of Experiment 1, but with a new set of stimuli controlled for syllabic structure. The same stimuli were used in Experiment 3. For Experiment 4 we created two new sets of four-syllabic pseudowords. In Experiments 1 and 2, participants were asked to read pseudowords aloud. In Experiments 3 and 4 we instructed the participants to assign either the penultimate or the antepenultimate stress to each of the pseudowords of the same block, so that each stimulus received both penultimate and antepenultimate stress

The results showed that, in assigning stress to pseudowords, participants do not rely on stress dominance, since no bias toward the penultimate (dominant) stress was found. In contrast, stress assignment is driven by stress neighborhood, but only when this orthographic/phonological information is widely represented in the lexicon (Exp. 1 & 2). The results of Experiments 3 and 4 showed that participants are faster in reading pseudowords with antepenultimate than penultimate stress and this effect was not driven by distributional information. Our study shows that Italian readers use orthographic/phonological distributional information in stress assignment, but this information does not affect naming speed. Naming time may be affected by stress position at the level of articulation planning, because the size of the unit that has to be articulated (in order to include the stressed syllable) varies according to stress position.

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Prosody and Interactivity guide on-line use of Common Ground

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Keywords: Common ground; perspective-taking; eye-tracking; prosody.

According to a dominant theoretical position, common ground (CG) is formed through interactive feedback (Clark & Schaefer, 1989); on an alternative, CG is formed automatically (Horton, 2007). Further, whether CG influences on-line language processing is unresolved, possibly due to methodological inconsistencies in whether CG was established interactively (Hanna, Tanenhaus, & Trueswell, 2003; Brown-Schmidt, 2012), or not (Barr, 2008). However, a central claim of the interactive view—that CG representations afford sophisticated linguistic exchanges—is untested. The present research manipulates interactivity while testing whether CG inferences are sophisticated by examining the interplay between utterance intonation and CG.

METHOD: 48 eye-tracked participants completed a partially-scripted dialog task in which participant and confederate viewed a 4x3 grid from opposite perspectives. Each square contained an animal wearing an accessory. Four animals were visible to both partners (*common ground*), four to the participant (*participant-privileged*), and four to the confederate (*confederate-privileged*). The task was to identify whether adjacent squares matched. Critical scenes contained two "critical" CG animals of the same type with different accessories, both with a participant-privileged (PG) animal above (e.g., COW WITH A HAT$_{[PG]}$ above BEAR WITH A TIE$_{[CG]}$, and PIG WITH A PURSE$_{[PG]}$ above BEAR WITH A FLOWER$_{[CG]}$).

The confederate periodically asked three scripted questions: Question#1 (setup) asked about a critical PG animal, bringing it (e.g., the PIG WITH A PURSE$_{[PG]}$) into linguistic CG, or an unrelated control. Question#2 was a filler. Question#3 (critical) was temporarily ambiguous between the two critical CG animals:

Quest#1: *What's in the top middle?* <u>Participant</u>: *Pig wearing a purse.*
Quest#2: *What's below the horse wearing a hat?* <u>Participant</u>: *Pig wearing a flower.*
Quest#3 <u>*What's above the bear*</u> *wearing a tie?* <u>Participant</u>: *Cow wearing a hat.*

When the confederate, in Q#1, had already asked about the PIG WITH PURSE$_{[PG]}$ (above the BEAR WITH FLOWER$_{[CG]}$), upon hearing "*What's above the <u>bear…</u>*" in Q#3, listeners should gaze at the other bear (WITH TIE)$_{[CG]}$, because they already know the speaker knows what is above the BEAR WITH FLOWER$_{[CG]}$ (Brown-Schmidt, 2012). To test for sophisticated (Clark & Schaefer, 1989) vs. simple CG representations (Horton, 2007), we contrasted standard WH-questions with rising WH-questions that indicated uncertainty. If CG-representations are nuanced, rising WHs should reduce fixations to the unmentioned PG animal.

RESULTS: During interpretation of the temporarily ambiguous Question#3 (*What's above the bear…*)*,* the preference to fixate the unmentioned PG animal [COW WITH A HAT$_{[PG]}$] vs. mentioned PG animal [PIG WITH A PURSE$_{[PG]}$] was analyzed with mixed-models. When Q#1 asked about a critical PG animal (vs. unrelated control), participants fixated the target significantly more (*t*=3.28), demonstrating sensitivity to linguistic context. Further, support for sophisticated representations was observed—but only in interactive conversations—rising-contour Q#3s reduced fixations to the PG animal (*t*=2.28). Crucially, both effects were significantly stronger in interactive conversation vs. a condition with pre-recorded stimuli (*t's*>2.9).

CONCLUSIONS: These findings allow two novel conclusions: <u>First</u>, CG more strongly affects language processing in interactive conversation. <u>Second</u>, CG inferences were sensitive to intonation, suggesting a complex interplay between utterance form and common ground.

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Evidence for Different Mechanisms for Processing Pitch in Speech and Music

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Keywords: prosody; music perception

Abstract

There is a growing literature exploring shared mechanisms between music and language (see Patel, 2008 for a thorough overview). This paper explores the hypothesis that the auditory system may support different mechanisms for processing pitch in speech vs. music. Results from two imitation experiments suggest that there are divergent mechanisms involved, and furthermore that top-down processes may mediate how these mechanisms are engaged.

In Experiment 1, 21 participants performed three experimental tasks: a *speech* task, a speech-derived *tones* task, and a *musical* task. For the *speech* task, eight carrier sentences were each produced in eight naturally-occurring intonational contours of English. These 64 stimuli were presented in a pseudorandom order, and participants were instructed to imitate both the lexical content and "the way it was said." Instructions avoided direct mention of matching pitch.

In the *tones* task, stimuli were synthesized as steady-tone sequences matching the pitch and rhythm of the speech stimuli, with a method inspired by Patel, Peretz, Tramo, & Labreque (1998). Specifically, a pitch value was identified for each syllable in the speech stimuli, namely pitch peaks or valleys for pitch-accented syllables, and mean pitch values for others. Simple sine tones (fundamental plus the next three harmonics) were synthesized from these values, and tone durations were matched precisely to the durations of the corresponding syllables. Participants in the *tones* task were instructed to imitate the melody, using the syllable "nah."

Subjects' task for the *musical* task was the same as for the *tones*, except that pitch values were adjusted in order to fit into well-formed musical intervals. This adjustment was minimal, such that the resulting tunes maintained both the pitch range and pitch contour of the matching speech and tone stimuli, but with intervals that fit within a Western even-tempered major- or minor-key scale.

Finally, participants performed the commercially-available Advanced Measures of Musical Audiation (AMMA; Gordon, 1989), a purely receptive task, which we assume taps general abilities to perceive and encode musical melodies.

Production pitches from participants and target pitches from the stimuli were extracted automatically via the Praat software, using hand-labeled syllable boundaries. Accuracy was assessed by comparing by-speaker normalizations of the productions and targets. The adequacy of this method is supported by a correlation of $r = 0.79$ between these normalized productions and targets in the speech condition, which matched the overall impression that participants were fairly accurate in this condition. That is, the relatively high accuracy overall in the speech condition as assessed by our automated pitch-extraction methods matched our subjective impressions that subjects were quite accurate in this task, suggesting that these automatic, reproducible methods for extracting pitches were adequate for capturing a global measure of pitch accuracy.

Results from both experiments were analyzed with mixed-effects models. In Experiment 1, participants were most accurate in the speech task, and least accurate on the non-musical tones task (p's < .05). More importantly, the measure of musical ability (AMMA) was positively related to performance on the musical task, as expected, but unrelated to performance on the other tasks. This suggests that different perceptual mechanisms were engaged with the different stimulus types.

Experiment 2 included only the *tones* task (and the AMMA), but added a between-subjects manipulation of instructions. 26 participants (12 male) were instructed that the stimuli were taken from speech, while 25 participants (11 male) were instructed that the stimuli were musical tunes. The results showed a significant interaction ($p < .05$) of instruction type by AMMA score. This result suggests that top-down expectations can modulate how perceptual mechanisms are engaged.

These two results provide evidence of dissociation between pitch processing in music and speech. Pitch accuracy in the imitation tasks is differentially related to musical ability, depending on the type of stimulus (Experiment 1) and the top-down expectations of participants (Experiment 2). This is a novel demonstration of dissociation at the level of pitch processing, employing novel methods for eliciting and automatically analyzing pitch productions, and sheds further light on the differences in cognitive mechanisms that process musical and linguistic melodies.

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Prosodic Balance in Different Elicitation Techniques

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Keywords: Prosodic balance; relative clause attachment ambiguities.

Research on prosody production showed that several factors affect boundary placement, amongst them syntactic structure, semantic relatedness, and prosody-inherent factors like balance (i.e. phrases of comparable size). Recently, a primacy of meaning over balance was postulated (Breen, Watson & Gibson , 2010). Moreover, it was discussed whether attention affects prosody (Speer, Warren & Schafer, 2011).

The present study investigated the interplay of meaning and balance employing different elicitation techniques. We tested whether balance, defined by the number of pitch accents per phrase, plays a more crucial role when participants are not explicitly instructed to disambiguate, and whether comprehension is modulated by balance. We examined relative-clause-attachment constructions, where a modifier is attached to one of two available matrix NPs. While a boundary preceding the modifier corresponds to a high-attachment-reading, a boundary between the NPs corresponds to a low-attachment-reading.

In our first two experiments, participants read gender-disambiguated structures without obtaining specific instructions. Balance was either neutral (3 accents, Exp. 1), or biased towards low (B) or high (C) attachment (4 accents, Exp. 2). Exps. 3+4 involved globally ambiguous structures in each of these prosodic variants. In Exp. 3, a combined production-perception task, readers disambiguated sentences according to their preferences and subsequently indicated their interpretations. In Exp. 4, readers were explicitly given the sentence's meaning before their productions. Utterances were analyzed with respect to duration and F0 range (differences between minima and maxima).

Exp. 1
A.   Er sah die Pflégerin des Géigers, die/der áufatmete.
        He saw the caretaker-FEM *(N1)* the violinist-MASC *(N2)* who-FEM/MASC respired.
        "He saw the caretaker of the violist who respired."
Exp. 2
B.   Er sah die bedächtige Pflégerin # des Géigers, die/der áufatmete.
        He saw the deliberate caretakerFEM the violinistMASC, who FEM/MASC respired.
C.   Er sah die Pflégerin des Géigers, # die/der ábermals áufatmete.
        He saw the caretakerFEM the violinistMASC, who FEM/MASC repeatedly respired.
Exps. 3-4
D.   Er sah die (bedächtige) Pflégerin der Géigerin, die (abermals) áufatmete.
        He saw the (deliberate) caretakerFEM the violinistFEM whoFEM (repeatedly) respired.

Across studies, participants realized disambiguation prosodically, as reflected by a durational increase of the pre-boundary noun (low attachment: N1; high attachment: N2). Moreover, balance affected production in Exps.2-4: A prosodic bias towards high attachment was reflected by an additional F0 increase on N2, and a shorter duration of N1, corresponding to a pre-RC break. Prosodic balance also affected interpretation: in Exp.3, participants preferred a low-attachment interpretation (62,7% for a prosodic bias towards low attachment, 67,5% for the neutral variants), which was significantly weakened when balance biased towards high attachment (57,5%). Finally, we did not observe any effects of attention: Realizations in Exp.4 did not differ significantly from Exp.3.

In sum, besides disambiguation, balance affected both the production and the interpretation of relative-clause-attachment ambiguities. These effects conflict with a purely meaning-driven account, but might be explained by assuming a greater flexibility for modifiers compared to previously analyzed constructions involving arguments. The absent instruction effects are in accord with Situationally Independent Prosody (Speer et al., 2011), postulating that grammatical constraints govern prosodic phrasing, which are not modulated by attention.

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The Effects of Intonational Phrase Boundaries on Prominence

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Speakers accentuate words in a variety of ways. Words that are new to a conversation, for example, are said more prominently than words that have already been mentioned. This prominence is characterized in part by longer word durations and higher F0 (Fowler and Housum, 1987). However, if speakers are producing prominence as a cue to focus for listeners, the acoustic cues might differ in different contexts. In particular, words that precede intonational phrase boundaries often undergo acoustic changes that are similar to those of acoustic prominence linked to discourse. Recent research suggests that the context of prosodic targets may have an effect on its acoustic correlates (Shue et al., 2008). In this study, we investigated whether speakers change the acoustic realization of focused words when they occur in potentially acoustically ambiguous locations (i.e. preceding an intonational phrase boundary).

In this study, 20 participants were presented with a 2x3 array of 6 figures for each trial. They saw two successive movements, which they described while their speech was recorded. We manipulated whether the target word, the second moving object, was new. We also manipulated the length of the descriptor necessary to refer to the target object. This was done in order to vary the likelihood that the participant would make a boundary immediately after the target word (see Example 1). There were four conditions: new/boundary, new/no boundary, given/boundary, and given/no boundary.

We analyzed word duration, average pitch, and the shape of the pitch contour. Analyses were conducted using multilevel models. We found that the presence of a boundary had a large effect on word duration (p<.0001), while newness had a smaller effect (p<.05). Additionally, for pitch there was an interaction between boundary and newness in the first half of the word (p<.05), but not in the second half. Critically, these effects seemed to be super-additive: new/boundary words had an overall higher pitch than those in other conditions. These data suggest that in contexts in which F0 and duration changes might be attributed to an intonational boundary, speakers amplify the acoustic cues associated with prominence.

Example:

Boundary: Move the circle with the **hearts** under the rectangle.
No Boundary: Move the **hearts** under the rectangle.

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Computation and Cancellation of Scalar Implicatures: ERP Evidence

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Keywords: ERP, Pragmatics, Semantics, Scalar Implicatures

The degree of automaticity and effort required for computing scalar implicatures (SI) are under debate (see Bott et al., 2012). While findings indicate that SIs are costly to compute (e.g., Breheny et al., 2006; Bott et al., 2012), it is unclear what kinds of processes underlie the computation of different SIs. In the theoretical literature (Horn, 1989, Chierchia, 2004) examples like (1) are explained as Exclusive-or, a derived interpretation that either 'pictures' or 'videos' are permitted, but not both. Another possible reading in these contexts is "free-choice" interference (Fox, 2007). In contrast, (2) triggers an inclusive reading due to the downward monotone predicate 'forbidden'.

We investigated the brain responses (ERPs) indexing both SI computation and potential cancellation processes in German. 16 participants read sentences such as (1) and (2) followed either by (3) or (4) (2*2 design). The first sentence suggests either Inclusive-or (2) or Exclusive-or and a potential "free-choice" interference (1). The second sentence further challenged this implicature, and participants had to determine the validity of the second sentence after reading it. In a pre-test, 44 participants judged the context (1) more valid when combined with (4) than (3) and context (2) more valid when combined with (3) than (4) (all reported p's<.05) supporting Exclusive and Inclusive interpretations. However, it is unclear whether this meaning is derived directly or whether it is computed by canceling the implicature, a question we addressed with ERPs.

Our analyses examined the ERPs for the regions indicated by squared brackets (1-4). (2) revealed a global negativity (300-500ms) in comparison to (1) suggesting additional processing costs for computing Inclusive-or. One interpretation is that the meaning is derived via a cancellation of the Exclusive reading. (3) showed an increased centro-parietal positivity (400-800ms) when following (1) versus (2), suggesting an updating process of the former assumed model. (4) showed an increased centro-parietal negativity (400-600ms) following (2) in comparison to (1). This suggests a further semantic processing load when Inclusive-or from the first sentence does not match with the statement of the second sentence (All reported p's<.05.).

This study highlights the online computation of SIs in which Inclusive-or is derived via a cancellation process e.g. Levinson (2000). Brain responses also highlighted the fact that the SIs computed in the first sentence carry their pragmatic meaning in the context and therefore resulting in either the reanalysis (positivity) or a negativity when confronted with incongruent information in the second sentence. Additionally, the centro-parietal difference suggests exclusive reading for condition (1).

1. Es ist erlaubt Fotos [**oder**] Videos von der Botschaft zu machen. (***Exclusive-*or; "free-choice" interference**)
*It is permitted to take pictures **or** videos of the embassy.*
2. Es ist verboten Fotos [**oder**] Videos[...] (***Inclusive-*or**)
*It is forbidden to take pictures **or** videos[...]*
3. Ben darf[**sowohl Fotos**] als auch Videos von der Botschaft machen.
*Ben is allowed to take **both pictures** and videos of the embassy.*
4. Ben darf[**nur Fotos**][...]
*Ben is allowed to take **only pictures**[...]*

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Embedded implicatures: Do they exist?

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Sentence (1a) can be understood as (1b). Such cases of local exhaustification (LE) are often referred to as embedded implicatures, as it seems that the effect of adding a quantity implicature occurs at an embedded site.

(1a) Every dieter who ate fruit for breakfast lost weight.

(1b) Every dieter who ate fruit and no rich food for breakfast lost weight.

How is this enriched reading derived? When enrichments as in (1) appear in a downward entailing ("less than three") or non-monotonic ("exactly three") environment, there is no straightforward way of accounting for readings like (1b) by standard Gricean reasoning. Gricean accounts claim that LE is a secondary operation, which is often marked by focal stress (Geurts 2011). On the other hand, syntactic (Chiercia, Fox & Spector2008) and pragmatic localist accounts allow for routine LE inferences to take place. One key difference between them is that syntactic but not pragmatic localists assume that LE is represented at the level of syntactic representation.

Experimental work on LE using verification tasks has led to contradictory results. Differences in the visual displays appear to play an important role in accounting for this discrepancy. Participants might be steered towards a particular interpretation by properties of the picture. To avoid this problem, we adopted an act-out paradigm in which 70 participants are presented with a neutral starting scene, here represented as 11111 11111 11111 11111(4 sets of 5 boxes; "1" means that the box contains a ball, "0" means that the box is empty). They hear a sentence like "I would like **exactly** 2 sets/**less than** 3 sets to have a ball in its boxes 2 and 4". The "exactly 2" sentence creates a non-monotonic condition while "less than 3" creates a downward-entailing condition. If LE is an available reading, some participants will give the response like 01010 01010 11111 11111. Results show no difference between non-monotonic and downward-entailing conditions in global or LE response rate, which suggest that "global" responses could come from a hedge strategy satisfying both "literal" and "LE" interpretations. Although the majority gave a literal (11111 11111 10101 10101) or global implicature response (01010 01010 10101 10101), LE responses did occur significantly more than wrong responses. Surprisingly, responses in which no action was undertaken (11111 11111 11111 11111) – "Error" responses – were equally prevalent. However, "Error" rates correlated negatively with non-literal responses (p=0.044).

In a follow-up verification study, we asked another 40 participants to rate all types of readings on a 1-7 scale. Results show no difference in the mean rating for situations that correspond to LE and Error readings (p=1) but a significant difference between LE and wrong responses (p<0.05). Overall, our experiments showed that a significant percentage of participants gave LE responses in non-monotonic or downward-entailing environments. However, whether LE responses come from genuine LE interpretations requires further research. LE responses and acceptance might be caused by the same mechanism which caused Error responses: participants interpreted "exactly N" as meaning "at least N": there are (exactly) 2 sets that have a ball in its boxes 2 and 4.

Figure3: global response

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Free choice inferences are not processed like scalar implicatures

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Linguistic inferences can broadly be broken down into three types: entailments, implicatures and presuppositions. This typology is mostly based on traditional linguistic means, such as introspective judgments about phrases occurring in different constructions and in different conversational contexts. More recently, the processing properties of these inferences have also been studied. For example, recent work shows that *scalar implicatures* can be costly to derive (e.g., Bott, Bailey & Grodner, 2012). In this paper we consider the processing of another type of inference, *free choice permission*, a phenomenon by which conjunctive inferences are unexpectedly added to disjunctive sentences. For instance, a sentence such as "Mary is allowed to eat an ice-cream or a cake" is often understood as granting permission both for eating an ice-cream *and* for eating a cake, yet this interpretation isn't included in the standard, Boolean meaning of the disjunction (in which only one or other of the disjuncts needs to be true for the sentence to be true).

Recent arguments from the theoretical linguistics literature suggest that formal models used to derive scalar implicatures can be adapted to account for free choice inferences (see, e.g., Schultz, 2005). In most cases, the idea is to treat free choice inferences as second order scalar implicatures, or complex scalar implicatures. We present three experiments that test a processing implementation of this account.

If free choice inferences are processed as complex scalar implicatures, processing results for free choice inferences should pattern with those of scalar implicatures. Specifically, in contexts in which scalar implicatures are processed more slowly than their literal equivalents, free choice inferences should also be processed more slowly than their literal equivalents. In Experiments 1 and 2, we show that free choice interpretations are derived at the same speed, if not more quickly, than the literal (Boolean) disjunctive interpretations, in contrast to recent work indicating that scalar implicatures are costly to derive in similar contexts. In Experiment 3 we demonstrate an interaction between scalar implicatures and free choice inferences, such that scalar implicatures are derived more slowly than their literal controls but free choice inferences are derived more quickly. Overall, our data suggests that free choice inferences are not processed as complex scalar implicatures, contrary to arguments coming from the theoretical linguistics literature.

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Long-before-short in Head-final Languages that Agree

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Keywords: language production-sentence production-word order-Heavy NP Shift-agreement

This study explores how word order is affected by processing constraints; particularly, how phrases are sequentially arranged relative to their phonological length. Hawkins (2004) argues that speakers try to minimize the average distance between the immediate constituents of a phrase (Mi(nimize)D(istance) principle), so that VO languages will prefer short-before-long constituent sequences, while OV languages will prefer long-before-short sequences. These preferences have been shown to hold both in VO languages and in two OV languages, Japanese and Korean. However, Hawkins does not make clear predictions about the role rich verbal agreement might play in word order planning of free word order languages.

Using the same paradigm as in Yamashita and Chang (2001), we explore the effects verb agreement has on the long-before-short preference during word order planning in Basque, an OV language with rich verb agreement, where VP constituents can be either preverbal or postverbal, unlike Japanese and Korean. Twenty-four Basque speakers were presented a series of phrases, and asked to arrange them in sentences. The length of subject-NPs vs. direct-object-NPs of transitive sentences (Experiment 1: S vs. DO) and of direct-object-NPs and indirect-object-NPs of ditransitive sentences (Experiment 2: DO vs. IO) was manipulated. When the constituents had en equal length, speakers showed a general preference for a canonical word order (Experiment 1: canonical S-DO: 96.4% vs. DO-S: 3.6%; Experiment 2: canonical IO-DO: 58.8% vs IO-DO: 41.2%). Importantly, the likelihood of producing a non-canonical structure was significantly higher when the DO was longer than the S (Experiment 1) or the IO (Experiment 2). Crucially, long-before-short order was more frequent in verb-medial than in verb-final sequences. Our results do not accommodate with precision to the MiD metrics as proposed by Hawkins: MiD predicts that in Basque long-before-short constituent placing would attain a better I(mmediate)C(onstituent)-to-word-ratio in verb-final than in verb-medial sequences and, in consequence, the more efficient verb-final structure should be preferred. However, our results could be accounted for if agreement is taken as an argument prediction device. Long-before-short verb-medial structure preference conforms to the spirit of the MiD: agreement with the postponed constituent provides sufficient information to build up phrase structure without having to access the last constituent. Verb-medial and -final structures would then have the same IC-to-word-ratio. Moreover, long-before-short verb-medial preference allows a more efficient processing: agreement is faster and decreases short-term memory load by reducing the number of constituents to be produced before the verb (Ueno & Polinsky, 2009).

These results highlight the role played by agreement in the satisfaction of processing demands, and show that speakers of rich agreement and free word order languages like Basque employ the strategy to favor shorter over longer dependencies, following general principles to speed up phrase identification.

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Is quantifier scope resolved automatically during reading?

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Keywords: quantifier scope; scope conflict; underspecification; reading times; incremental picture verification

Sanford & Sturt (2002 TCS) argue that scope remains underspecified until the situation forces disambiguation (but see Conroy's 2008 dissertation , Filik et al. 2004 PB). We report a combined self-paced reading/verification experiment where readers regularly disambiguated doubly-quantified sentences early despite being encouraged to delay interpretation.

Scope conflict (SC) is expected if the configuration of quantifiers favors one reading, but their inherent properties favor another. (1a) exemplifies SC within a DP: the inverse-linking construction supports inverse scope, but *alle* (all) prefers narrow scope. In (1b) with *jeder* (every) both factors point towards wide scope for *every* thus there should be no difficulty, although the sentence is still ambiguous. (2a/b) illustrate the same contrast, but here quantifiers are co-arguments of the verb.

If scope interpretation is automatic, SC with *all* should arise in (2) at the second quantifier and in (1) at the DP (if scope resolution is immediate) or at the sentence boundary (if the predicate is needed). However, if scope is regularly underspecified, only disambiguation should force scope resolution.

To compare these positions, 40 participants read 60 items (+80 fillers, 40 false) and then decided whether the sentence matched a scope-disambiguating picture. To delay scope interpretation, they were instructed to accept the picture if it was at all consistent with the sentence. We monitored for SC during reading, ie. long before the disambiguation.

Sentences (1a/b) and (2a/b) were paired with two disambiguating card-displays in a 2*2*2-(*quantifier* x *construction* x *disambiguation*) design. Linear pictures had the same object on all three cards, but card2 contained an additional object, cf. (4a). Inverse pictures (4b) had three different objects. Again, card2 provided the disambiguation. To control for lexical *all*/*every* differences we included (3a/b) together with card-displays showing the same object on all three cards. Card1 was the same across all (8+2) conditions.

We found a strong preference for inverse scope. Acceptance for the linear reading was 17.2% (LME:no reliable differences;p's>.2). Offline tests showed that linear interpretation was still more acceptable in (1a/b)-(2a/b) than in unambiguous inverse-scope controls (LME:p<.01). The inverse conditions were accepted 77.5% in (2a), 90.4% in (2b), 81.2% in (1a) and 91.3% in (1b). As expected, the inverse reading was less compatible with *all* than with *every* (p<.01), but (1) and (2) had the same distribution of readings (p's≥.23) and didn't differ in judgment times (p's≥.22).

Reading times revealed SC in (2a/b): *all* was read more slowly than *every* ($t_{1/2}>2.5$;$p_{1/2}<.05$). In contrast, there was no *all*/*every* difference in (1) and (3) (interaction:$F_{1/2}>6.2$;$p_{1/2}<.05$). The lack of *all*/*every* difference in (3) shows that the difficulty in (2) is not due to lexical factors, but to scope conflict. The lack of difference in (1) suggests that SC only shows up in larger domains that include a predicate.

Taken together, these findings indicate early automatic scope resolution. The results will be contrasted with an eyetracking experiment where the picture materials did not require scope disambiguation.

Sample materials

(1)	Genau ein/ Tier/ auf/	**a)** allen/ Karten/	**b)**jeder/ Karte/ ist/ ein Affe.
	Exactly one animal on	**a)** all cards	**b)** every card is a monkey.
(2)	Genau ein/ Affe/ ist/ auf/	**a)** allen/ Karten/	**b)** jeder/ Karte/ zu/ finden.
	Exactly one monkey is on	**a)** all cards	**b)** every card to find.
(3)	Auf/	**a)** allen/ Karten/	**b)** jeder/ Karte/ ist ein Affe.
	On	**a)** all cards	**b)** every card is a monkey.

$\forall\exists_{=1}$ card display	$\exists_{=1}\forall$ card display
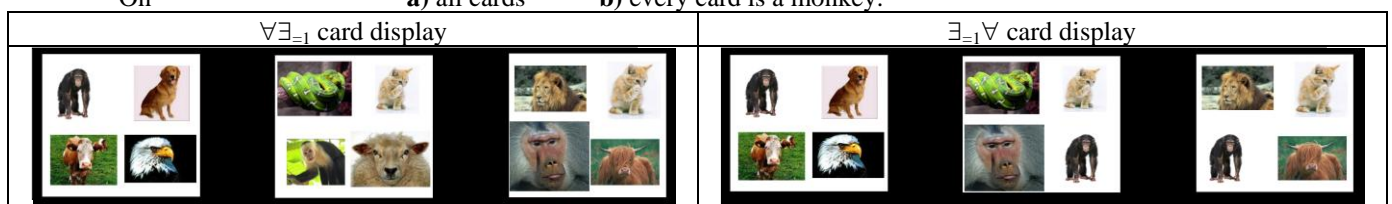
The neural computation of scalar implicature

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Keywords: scalar implicature; ERP; pragmatics.

The last decade has seen an explosion of research on scalar implicatures (the inference that, e.g., "some" indicates "some but not all"), focusing on the timing of implicatures and the contexts in which they are calculated. However, little is known about their neural computation. Prior studies have shown that the calculation of implicatures influences the processing of subsequent words. If the implicature renders a word infelicitous (some people have lungs) it elicits a larger N400 than if it is consistent with the implicature (some people have pets) (Nieuwland, Ditman & Kuperberg, 2010; but see Novek & Posada, 2003). While this confirms that implicatures are can be calculated within 1200-1500ms of the scalar trigger (some), it provides little direct information about the neural systems involved in calculating the implicature. The present study addresses this question using EEG.

Previous research demonstrates that scalar implicatures are rarely calculated in the antecedents of conditionals (Chierchia, Fox & Spector, 2011). Thus, the word some is more likely to trigger scalar implicature in (1) than in (2):

(1)   Addison ate some of the cookies before breakfast this morning, and the rest are on the counter.
(2)   If Addison ate some of the cookies before breakfast this morning, then the rest are on the counter.

14 participants read 30 sentences like (1) and 30 like (2). Because processing of declarative and conditional sentences differ in numerous ways, an additional 18 participants completed a control experiment in which some was replaced with only some, lexically forcing the "some but not all" interpretation.

To determine whether the conditional/declarative manipulation influenced implicature calculation, we analyzed the ERPs to the phrase the rest, which is infelicitous unless the inference is made that "some" means "not all". Indeed, a sustained right frontal positivity (300-1000ms) was observed at the rest in (2) relative to (1), and this difference was eliminated in the control experiment, where the upper-bound was semantically required, resulting in a significant 2x2 interaction.

The key analysis was at some of, which should trigger scalar implicature calculation in (1) but not (2). The phrase some of was associated with a large, sustained frontal positivity (400ms-1000+ms) in (1) relative to (2), a difference which was diminished in the control experiment, resulting in a significant 2x2 interaction (Figure 1). Because of the novelty of these findings, the study was replicated using different equipment (Neuroscan Synamps2 vs. EGI). The critical interactions replicated.

We suggest that this positivity characterizes scalar implicature processing, and perhaps implicature processing in general. Its sustained nature is consistent with previous empirical findings suggesting scalar implicature processing is slow and costly (Bott & Noveck, 2004; Huang & Snedeker, 2009). Alternatively, it may represent the creation of a discourse context requiring an upper bound. These and other possibilities are discussed.

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Local coherence interference in online sentence comprehension

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Keywords: Anticipation; Local coherences; Sentence processing.

Local coherence interference stems from word strings that support an alternative syntactic parse that cannot be integrated with the global syntactic context. For example, the underlined words in "The coach smiled at the player tossed a Frisbee" support an active clause that cannot be linked with "at." Tabor et al. (2004) showed that reading times on "tossed" were slowed (e.g., relative to "thrown," which does not support a local coherence). These results are problematic for theories that assume that parsing is immediately constrained by the syntactic context.

In the current study, we addressed two critical questions related to these findings: first, is local coherence interference a lexical effect, stemming from lexical-level ambiguities (e.g., main verb/passive participle ambiguity of "tossed;" see Gibson, 2006)? Second, do local coherences influence online semantic/comprehension processes?

Methods. We tested for effects of local coherences on anticipatory eye movements (Altmann & Kamide, 1999) in the visual world paradigm. Kamide et al. (2003) showed that listeners hearing (1) while viewing the example scene anticipatorily fixated (during "ride the") motorbike more than carousel, based on the subject and verb constraints. In the current study, we used similar scenes, but modified their sentences to include non-, subject, and object relative clause sentences (1–3). Critically, (2) contained a local coherence ("the girl will ride the…;" underlined), formed by the adjacent noun in the relative clause and main verb.

Predictions. In 1–3, motorbike was the predictable direct object of the main clause subject and verb. If local coherences influence online semantic/comprehension processes, we predicted listeners would be most likely to fixate the competitor carousel in (2), in which carousel was a predictable direct object of the local coherence.

Results. During "ride the," proportions of fixations to carousel patterned as follows: (2) > (3) = (1).

Conclusions. These results provide evidence that local coherences rapidly influence *anticipatory* eye movements (for related results, see Konieczny et al., 2009). Critically, these results suggest that local coherence effects are not due to (biases related to) lexically ambiguous words, and they build on previous findings showing lexical interference effects in anticipation (e.g., listeners hearing "Toby will arrest the..." anticipatorily fixated a context-incompatible *policeman* based on "local" verb fit; Kukona et al., 2011). We are conducting a second experiment using subject relative clauses with post-nonimal phrases ("The man who likes the girl [from Leeds]/[very much] will ride..."): we predict less interference given adverbs ("verb much"), which block the local coherence. We discuss these findings in relation to dynamical, self-organizing and Good-enough theories of sentence processing.

Examples

Visual scene: *man*, (young) *girl, motorbike, carousel, beer, & sweets*
(1) "The man will ride the motorbike." (non-relative clause)
(2) "The man who likes the girl will ride the motorbike." (subject relative clause)
(3) "The man who the girl likes will ride the motorbike." (object relative clause)

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Online detection and repair of comparative illusions: evidence from self-paced reading

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Keywords: grammatical illusions; comparatives; shallow processing; self-paced reading

Introduction

"Comparative illusions" (e.g., *More people have been to Berlin than I have*) are typically accepted by speakers, in spite of the ill-formed comparison (*number of people in the set of Berlin-goers > ??number of people in the set of Berlin-going me*). Comprehenders seem not to notice the problem, a fact that has been offered as evidence for superficial heuristics or "shallow processing" in sentence comprehension (Townsend & Bever, 2001; Sanford & Sturt, 2002; Ferreira, Ferraro and Bailey, 2002). But if we engage in shallow processing, it is surprising that illusion rates (measured by acceptability judgments) are sensitive to subtle semantic properties of the predicate, namely whether the event described is "repeatable" or not (e.g. *eat his first cupcake* vs. *eat in the lunchroom*) (Wellwood et al 2009). This finding suggests we do process the illusion's meaning.

In a self-paced reading task, we investigated how illusions are processed online, asking: (a) Is there any evidence for online detection/repair in reading times? If so, (b) do *all* illusions cause processing difficulty, or only those consciously detected (as indicated by offline ratings)? Under a shallow processing account, illusions should either be no different from controls, or cause slowdown only when consciously detected.

Experiment 1

24 participants read and provided acceptability judgments (on a seven-point scale) for 48 items. We manipulated predicate repeatability to see whether lower ratings for non-repeatable illusions corresponded to different patterns in reading times, e.g.: *more judges {retired to Florida | vacationed in Florida}*. Illusion conditions had definite singular NPs (*than the/my/our* NP *did*), while controls had bare plural NPs (*than* NPs *did*). Participants paraphrased 1/3 of the items out loud. The illusion had a significant effect on reading times and ratings: illusions were rated lower, and read more slowly at the critical region, than controls. Non-repeatable illusions were rated less acceptable than repeatable illusions – in line with Wellwood et al (2009) – and in the area *following* the critical region, they were read marginally more slowly.

Experiment 2

We next tested whether slowdown would persist when the illusion condition contained plural NPs (e.g., *than my* NPs *did*), since plurality makes illusions maximally acceptable (Wellwood et al, 2009). The conditions and procedure were similar to Experiment 1, except the participants (n = 40) *repeated* items out loud to facilitate shallow processing. Again, illusions were rated less acceptable than controls, and resulted in slowed reading times at the critical region. As before, reading times late in the sentence were also marginally slower for non-repeatable illusions than repeatable illusions.

Discussion

The results here indicate that **comparative illusions do not arise because of shallow processing**. *Participants experienced processing difficulty at the critical region as they read illusions, regardless of whether they consciously detected the anomaly*. This slowdown persisted even for highly illusory items, and with tasks that should facilitate shallow processing. This suggests that the problem is detected; however, when context permits it, we can repair the illusion by shifting to event comparison – as suggested by Wellwood et al (2009).

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Priming of Get- and Be-passives in English

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Keywords: English passive; get; be; syntax; priming

Previous sentence production research demonstrated ubiquitous passive-voice priming effect in English transitive sentence production. Recent research with adults suggested that priming of voice in English is sensitive to the repetition of notional verbs from prime to target (Myachykov, 2007). Alleged interchangeability of auxiliaries *be* and *get* as well as optional truncation by omitting an agentive by-phrase (*e.g., Bob <u>was</u> hit [by Mary]* vs. *Bob <u>got</u> hit [by Mary]*) have long been viewed as signs of the two existing passive variants subserving a single structural representation (e.g., Chomsky, 1981). Recent data appear to confirm this view by showing that voice priming in English speaking 4-year olds is relatively immune to both auxiliary repetition (*be* and *get*) and by-phrase inclusion (Messenger, 2010; Messenger, et al., 2011). However, recent corpus analyses including our own suggest that by-phrases are less frequent in get- than in be-passives (Guoliang & Lei, 2010; Myachykov, et al., this volume) and that the two forms may cluster differently in relation to notional verb semantics (e.g., Medina, 2009; Myachykov, et al., this volume). One explanation for these differences is that, compared to the semantically shallow *be* in be-passives, *get* is not a "true" auxiliary – it operates as a lexical rather than an auxiliary verb, projecting its own semantics (e.g., Haegeman, 1985; Hübler, 1998). If so, at least in adult performance, one could expect specific modulations within the general voice priming effect from both auxiliary repetition and by-phrase inclusion.

Here, we report the results of a study that tested the independence of get- and be-passive structural representations in adult native English speakers. In a standard syntactic priming setup (cf. Bock, 1986), participants read aloud single-sentence passive primes and then produced single-sentence descriptions of pictured (transitive) target events. Two priming factors were orthogonally manipulated: (1) Passive auxiliary (*be* or *get*) and (2) by-phrase inclusion (full passive or truncated passive). The design did not include an active voice priming condition as the effectiveness of the latter (in relation to passive primes) had been demonstrated before. We used binary logistic Generalized Estimating Equations for separate analyses of proportions of be- and get-passive responses as well as the likelihood of overtly mentioning the agent via by-phrase inclusion relative to the total number of valid responses.

The analyses showed that there were more be-passive responses after full-passive primes than after truncated-passive primes. Since a comparable main effect was absent in get-passive responses, this suggests that by-phrase inclusion supports the use of *be-* but not of *get*-passives (in line with the corpus findings). Most importantly, our analyses revealed an auxiliary-repetition main effect (e.g., more get-passive responses after get-passive primes). Finally, there were no clear effects of the experimental factors on the likelihood of by-phrase inclusion although full-passive responses were more likely overall.

Our findings, therefore, suggest that, although the same syntactic representation may underlie be- and get-passives in early development, these forms become associated with distinct non-interchangeable construction types susceptible to lexically-specific auxiliary priming effects in adult native speakers.

Predicting Speech Production: Facilitation But No Inhibition?

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Keywords: facilitation; inhibition; picture naming ;sentential priming; speech production

Topic

Although picture-naming studies have contributed significantly to understandings of speech production, particularly of item-specific effects such as age-of-acquisition, the findings of studies of context-specific effects (i.e., where context is manipulated via the use of distractor items) have been less conclusive. This has led to widespread recognition that the nature of information-flow through the speech production system is vulnerable to subtle variations in task, to the extent that similar paradigms can produce apparently contradictory findings (e.g.,Madebach et al., 2011).

Experimental design

In order to investigate how the speech production system most typically responds to effects of context, we employed a sentential priming paradigm in which the role of the "distractor" item was assumed by a high-cloze-probability sentence-stem, as opposed to the more commonly employed distractor-word or -picture. This created a dialogue-like context, in which the speaker was also a listener. Each target picture name was associated with cloze-sentence stems for which it acted as the high-predictability cloze item: pre-testing was conducted to ensure that all pictures had high-name agreement and all sentence-stems strongly predicted the intended picture name. In the "predictable" condition, the cloze-item picture was presented for naming immediately following the auditory presentation of its matched cloze-sentence stem: in the "non-predictable" condition the sentence stem predicted a rhyme partner of the to-be-named picture: in the "neutral" condition each picture was presented in a stand-alone context. In Experiment 2 the paradigm was extended to include a second "neutral" context, in which pictures were preceded by matched cloze-sentence stems played in reverse.

Results and Discussion

Picture-naming response latency and error rates were treated as outcome variables. The presence of sentential primes facilitated the naming of highly-predictable items, but did not inhibit the speed of naming of matched unpredictable items, compared to each of the neutral conditions. Cloze-sentence duration did not improve model fit, although item identity did. We interpret these findings as evidence that the effects of sentential primes on picture-naming latency reflect automatic rather than strategic processes, consistent with an integrated theory of language production and comprehension under which comprehension is facilitated by the production of forward-models associated with speech production.

We consider whether our failure to demonstrate inhibitory effects, such as those reported in the contextual naming study of Roe et al. (2000), relates to paradigmatic differences in; (i) the relationship between targets and "distractor" sentences, or; (ii) the specific information given to participants as to the nature of the task. We propose that the difference in the findings of the two studies arises because the relationship between distractors and targets permits two potential effects: an early effect which is automatic and facilitatory, and a relatively late-developing inhibitory effect. We note that this interpretation is consistent with a response selection account of PWI effects. The inhibition effect, we argue on the basis of this study, is strategic in origin and may not represent a prototypical aspect of speech production within a dialogue-like context.

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It's there whether you see it or not: Syntactic representation of null arguments

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Key words: Syntactic processing; null argument; structural priming; Chinese

To what extent is sentence comprehension mediated by syntax? A case of study is linguistic omissions. Do people build syntactic representations for missing elements, or simply reply on discourse information, to interpret them?
We investigated the processing of null arguments in Mandarin (e.g., 1c,d), using structural priming, which is extensively used to investigate syntactic representation. Null arguments are assumed by many syntactic theories to be phonologically null syntactic representations (Rizzi, 1986), but are these representations constructed in language processing? If null arguments are syntactically represented, we should expect DO-NullTheme and PO-NullTheme (1c,d) where the argument *naben shu* is missing, to have the same syntactic representation respectively as DO and PO (1a,b), and therefore behave similarly in priming to DO and PO. Experiment 1 compared DO, PO, DO-NullTheme and Baseline. Experiment 2 replaced DO-NullTheme with PO-NullTheme. Participants heard a sentence (e.g., 1a), matched it with a picture, and then described a new picture, which could be described using a DO or PO sentence in target trials.

1a. Niuzai mai-le yiben shu hou song-gei-le shuishou naben shu.   **(DO)**
  cowboy buy-ASP a book after give -ASP sailor   the book
1b. …………………………………. song-le naben shu gei shuishou. **(PO)**
                  give-ASP the book to sailor
1c. …………………………………. song-gei-le shuishou *e*.   **(DO-NullTheme)**
                  give-ASP sailor.
1d. …………………………………. song-le *e* gei shuishou.   **(PO-NullTheme)**
                  give-ASP to sailor
(The cowboy bought a book and afterwards gave the sailor the book/ gave the book to the sailor/ gave the sailor/ gave to the sailor.)
1e. banqiu xuanshou zai dapengti   **(Baseline)**
  cricket player be sneeze (The cricket player was sneezing).

Experiment 1 (48 participants, 32 target items) found 35%, 33%, 28%, and 16% DO responses following DO, DO-NullTheme, Baseline and PO respectively. LME analyses revealed most DO responses following DO and DO-NullTheme (which did not differ), next following Baseline and fewest following PO. **Experiment 2** (48 participants, 32 target items) found 19%, 13%, 7%, and 7% DO responses following DO, Baseline, PO-NullTheme, and PO respectively. There were most DO responses following DO, next following Baseline and fewest following PO-NullTheme and PO (which did not differ).
Taken together, the effects of a prime with no theme argument were the same as the equivalent sentence including a theme argument. This suggests that the processor builds a full syntactic representation for DO-NullTheme and PO-NullTheme, with null arguments syntactically represented. The results are consistent with structural priming evidence for implicit arguments in language processing and stand in contrast with structural priming evidence against syntactic reconstruction for gaps and VP ellipsis (e.g., Cai, Pickering, & Sturt, in press). We discuss these discrepancies and their implications for the representation of null elements in language processing.

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Persistence of Word Order: A Matter of Thematic Roles or of Phrase Structure?

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Keywords: sentence production; structural priming; word order

Speakers have been shown to parallel the phrase order of previously produced sentences, a finding that has been accounted for by reference to the positional level of sentence production (Hartsuiker & Westenberg, 2000). However, more recent studies (e.g., Cai, Pickering, & Branigan, 2012) suggest persistence of thematic roles' order in the production of alternations.

In three sentence generation experiments in German, we tested for the influence of thematic roles' order in primes on word order in targets and for an (additional) involvement of phrase structure.

In Experiment 1, we paired double object (DO) primes in two word order variants (P1-P2) with non-alternating DO targets in two noun order conditions (T1-T2). Participants generated 14% accusative-before-dative (acc-dat, marked word order) responses, 7.0% more after acc-dat primes than after dat-acc primes. GLMMs revealed independent effects of word order in primes ($p < .01$) and noun order in targets ($p < .001$). We conclude that the order of case-marked objects can be primed.

In Experiment 2, prepositional object (PO) primes in two word order variants (P3-P4) were presented before DO targets from Experiment 1 (T1-T2). Participants generated 10% acc-dat (marked word order) responses; 3.0% more after acc-PP (normal word order) than after PP-acc (marked word order) primes. Again, the effects of word order in primes ($p < .05$) and noun order in targets ($p < .01$) were significant. The priming effect indicates that thematic roles' order persists irrespective of phrase structural differences.

In Experiment 3, we paired DO and PO primes in two word order variants (P1-P4) with DO targets favouring acc-dat responses (T2). Participants produced 20% acc-dat responses, with a 3.7% DO and a 4.3% PO priming difference. Again, word order in primes had an effect ($p < .05$), but there was no effect of phrase structure ($p = .91$) and no interaction of word order and phrase structure ($p = .20$). This outcome replicates the finding of thematic roles' priming from Experiment 2 and indicates that seeming differences in effect size between Experiments 1 and 2 were rather due to variation between participants than to phrase structural differences.

We conclude that word order can be primed at the conceptual level where information structuring of thematic roles takes place or shortly thereafter where thematic relations are mapped onto syntactic forms. As the strength of DO and PO primes did not differ, there is no evidence for additional persistence of word order at the positional level.

P1	DO, dat-acc	*Der Rentner schickt dem Minister den Beschwerdebrief.*
		the.NOM retiree sends the.DAT minister the.ACC complaint-letter
P2	DO, acc-dat	*Der Rentner schickt den Beschwerdebrief einem Minister.*
		the.NOM retiree sends the.ACC complaint-letter a.DAT minister
P3	PO, PP-acc	*Der Rentner schickt an den Minister einen Beschwerdebrief.*
		the.NOM retiree sends to the.ACC minister a.ACC complaint-letter
P4	PO, acc-PP	*Der Rentner schickt einen Beschwerdebrief an den Minister.*
		the.NOM retiree sends a.ACC complaint-letter to the.ACC minister
T1	DO, as dat-acc	*erläutern Vorgesetzter Angestellter Arbeit*
T2	DO, as acc-dat	*erläutern Vorgesetzter Arbeit Angestellter*
		explain boss employee task/task employee

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Priming the Internal Structure of Noun-Phrases in Comprehension

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Keywords: Garden-path sentences; sentence processing; syntactic priming; eye-movements

It is known that experiencing a particular syntactic structure facilitates subsequent processing of the same structure. We investigated this phenomenon, called syntactic priming, in the comprehension of noun-phrases (NPs) in Japanese. Complex NPs can have either left-branching internal structure such as *nigai kohi-no kappu-o* 'bitter coffee cup' or right-branching structure such as *hadena kohi-no kappu-o* 'flashy coffee cup' so that the phrase-initial adjective can attach to either N1 (coffee) or N2 (cup). Because of an overall preference for the left-branching analysis, readers tend to experience processing difficulty when the right-branching structure is forced by semantic mismatch between the modifier and N1. We conducted an eye-tracking reading experiment to investigate whether processing of these NPs would be influenced by an immediately preceding experience of a similar sentence. Given that there is increasing evidence that comprehenders of head-final languages do not delay associating pre-head arguments until the head is received (see Kamide, 2006, for a summary), our interest is to examine whether priming occurs before the lexical head is encountered. Such a finding would be evidence against proposals according to which syntactic priming in comprehension is head dependent (Pickering & Traxler, 2004).

In our study, participants first read a prime sentence such as (1) and next read a target sentence that also had a complex NP in one of the two alternative structures without any lexical overlap. Various reading time measures were analyzed for the target sentences with Prime Type and Target Type as fixed factors using LME models.

Region 4 (*kohi-no*): The critical region contained N1, the first possible host for the modifier (*nigai*, 'bitter' or *hadena*, 'flashy'). The measures of first-pass, right-bounded, and regression path reading times consistently showed a main effect of Target Type: right-branching targets were slower to read than left-branching targets. This indicates that readers attached the adjective to N1 and experienced difficulty due to the semantic mismatch in the right-branching condition. Although there was a trend for an interaction between Prime Type and Target Type, it did not reach significance.

Regions 3+4 (*nigai/ hadena kohi-no*): We combined region 4 with region 3 as region 4 was relatively short and may have been previewed from region 3. The analysis of this combined region showed a significant interaction between the two factors in addition to the main effect of Target Type in the right-bounded measurement. Further analyses showed that the simple effect of Prime Type was marginally significant for both target types. This indicates that right-branching primes reduced processing difficulty for the less-preferred right-branching targets and left-branching primes further facilitated the processing of left-branching targets.

Crucially, the priming effect was observed before readers processed the head N2 (*kappu*, 'cup'), suggesting that Japanese readers incrementally build the internal structure of NPs before encountering the phrase-final head. The results also suggest that syntactic priming can be induced independent of the lexical head.

Example sentence

Regions: 1   2   3   4   5   6   7
1. Onnanoko-ga   hahaoya-ni   hadena/nigai   kohi-no   kappu-o   hohoeminagara   sashidashita.
   girl-NOM   mother-ACC [flashy/bitter   coffee   cup]-DAT   with smile   gave
   "The girl gave the flashy/bitter coffee cup to her mother with a smile."

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The Importance of Everyday Situations for Representing, Processing, and Categorizing Abstract Concepts

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Research on abstract concepts has long emphasized two factors. In Dual-Coding Theory, abstract concepts are represented via verbal knowledge regarding their associations with other words. However, word association alone seems insufficient for capturing the rich knowledge associated with abstract concepts. Context Availability Theory has emphasized the linguistic contexts in which abstract words are used. However, context availability studies have not studied knowledge of common situations per se, but instead have demonstrated decreased difficulty with abstract concepts in sentences in which they are highly predictable. Our research stems from the view that real world situational knowledge plays an important role in the representation and processing of abstract concepts. People learn about abstract concepts through experiences that can be summed up by them (i.e., the situations are exemplars), or through experiences that produce internal states corresponding to them. Experiment 1 tested the novel and central prediction that if real-world situations are important for abstract concepts, then their processing should be facilitated by descriptions of situations, even when those descriptions do not contain word associates. Participants heard three-sentence situations such as (1) and (2), and then made a lexical decision to a target abstract concept that was visually presented at the offset of the auditory situation. Critically, significant priming was obtained. For Experiment 2, we chose situation-abstract concept pairs for which the abstract concept captures the essence of the situation as a whole (relational abstract concepts as in 1), and compared them to pairs in which the abstract concept corresponds to an internal state of the character "you" (as in 2). The two groups were equated on 13 variables, including rated situation-concept relatedness, context availability, and emotional valence. This is a novel on-line test of the Conceptual Act Theory (Wilson-Mendenhall et al., 2011). The procedure was the same as in Experiment 1. A large, significant priming effect obtained for abstract concepts that relate aspects of the situation as a whole. In contrast, facilitation for internal states was nonsignificant. These results support the idea that situations must be conceptualized before a person can feel the internal state that is then relevant. In other words, one must conceptualize a situation as dangerous prior to feeling fear. In conclusion, situations are central for the representation and processing of abstract concepts, and the distinction between abstract concepts that denote internal states of individuals and those that integrate situations as a whole is important for understanding abstract concepts.

1. *ignore*: Relational Abstract Concept: *You're walking to get some food when you see a homeless man out of the corner of your eye. You do not turn your head. You keep walking.*

2. *fear*: Internal State Abstract Concept: *You're walking through a neighbourhood that you don't often go through. It's a run-down neighbourhood with graffiti and boarded-up houses and abandoned cars. You notice that a man seems to be following you, he's starting to walk faster and you are the only two people on the street.*

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Juxtaposing adjectival and verbal passives

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Keywords: language comprehension; adjectival passives; verbal passives; event structure

Recent linguistic accounts (Gehrke, in press; Maienborn, 2009) of adjectival passives (e.g., *The window is still opened*) propose that interpreting an adjectival passive involves the activation of a contrasting state (e.g., open window). A previous study in German (Claus & Kriukova, in press) provided preliminary evidence for this proposal by indicating that a contrasting state is mentally better available after reading a sentence with an adjectival passive (e.g., geöffnet (opened)) than after reading a corresponding sentence with an adjective (e.g., *offen* (open)). However, this finding could also simply be accounted for by assuming that processing the passive participle activated the root verb's event structure including the initial state. To evaluate this objection, the present study juxtaposed German adjectival passives with verbal passives built with the same passive participles; see (1a) and (1b). (Note that in German, unlike in English, adjectival passives and verbal passives are expressed by different forms: copula *sein* (be) + participle and auxiliary *werden* (become) + participle, respectively.) All passive participles of the experimental sentences rooted from change-of-state verbs. That is, the contrasting state corresponded to the initial state of the root verb's event. Thus, if processing an adjectival passive does indeed involve the activation of a contrasting state, then this should be reflected by an enhanced mental availability of the root verb's initial state.

(1a) *Das Fenster ist geöffnet.* 'The window is opened.' adjectival passive
(1b) *Das Fenster wurde geöffnet.* 'The window was opened.' verbal passive

   To test the mental availability of the contrasting state, picture-identification latencies were measured: After reading a sentence such as (1a) or (1b), participants were presented with a picture that either depicted the initial state (e.g., closed window) or the resultant state (control condition, e.g., open window) of the participle's root verb. Participants had to press a key as soon as they had identified the depicted object. Analyses of the picture-identification latencies – that were assumed to reflect the mental availability of the depicted state – yielded a significant interaction between picture type and passive type. For pictures showing the resultant state, picture-identification latencies did not differ between the adjectival and verbal passive condition. In contrast, for pictures showing the contrasting, initial state, picture-identification latencies were significantly shorter after sentences with adjectival passives than after sentences with verbal passives. The results are in line with Gehrke's and Maienborn's linguistic accounts of adjectival passives. The effect of passive type was specific to the contrasting, initial state; it was not found for the resultant state (control). Furthermore, the enhanced availability of the contrasting, initial state with adjectival passives cannot be attributed to its activation as part of the root verb's event structure. Note that the results do not rule out the possibility that the initial state was activated with both, adjectival and verbal passives. Yet, they indicate that the initial, contrasting state was better available with adjectival passives than with verbal passives. Thus, the pattern of results can be considered to provide empirical support for the proposal that processing adjectival passives activates a contrasting state.

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Semantic Priming of Complex German Verbs:

Effects of Transparency

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German disposes of complex verbs, in which the prefix can stand separately from the stem (particle or phrasal verbs); their meaning is either composed of prefix and stem meaning (transparent) or not (opaque). In morphology, they are treated as bi-morphemic. German unimodal visual priming experiments (Smolka, Komlósi & Rösler, 2009) suggest morphological priming independent of semantic relatedness between verb stem and particle verb. Participants were faster in lexical decision tasks to visually presented verb stems (e.g., 'fallen' *to fall)* upon seeing transparent particle verbs (e.g., 'hinfallen', *to fall down)* and opaque verbs (e.g., 'auffallen'*, to attract attention*), extending the Prefix Stripping Model by Taft and Forster (1975) to German. In this study, we investigated whether this morphological activation of the stem cascades through to the semantic, conceptual level. We therefore conducted a cross-modal associative priming experiment in which participants performed lexical decision tasks to visual targets that are semantically related to the stem (e.g., ‚Sturz', *downfall*; determined by means of a web experiment with 105 participants).

Fifty-four participants listened to complex verbs in three conditions (opaque, transparent and unrelated, manipulated as between-subjects factor). The experiment consisted of 232 trials (24 experimental, 208 fillers), presented in two counter-balanced blocks. Reaction times (log RTs) were analysed using linear mixed effects models with *participants* and *items* as random factors. *Condition* and other control predictors (*lexical target frequency, block, word class*, and *RT to the preceding trial*) were added as fixed factors. Results showed shorter RTs in the second block compared to the first (543 vs. 519ms, an effect that approached significance: $p < 0.08$). There was a main effect of *condition* and an interaction between *condition* and *block* ($p < 0.05$): there was no effect of *condition* in Block2 ($p > 0.4$), but in Block1, transparent particle verbs (520ms) were significantly faster than the unrelated control condition (535ms, $p < 0.005$); while opaque particle verbs were not (526ms, $p > 0.2$).

Our results show an effect of condition in Block1 only (that had overall slower RTs). Possibly, the fast RTs in Block2 did not leave enough time to fully access the semantic. Importantly, our results show a clear priming effect for transparent verbs only. This suggests that the morphological activation of the stem is not automatically cascaded to the semantic level (or is inhibited by the meaning of the complex verb).

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Semantic Transparency Effect And Its Time Course on Chinese Compound Processing

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Keywords: Cross-language masked priming; Semantic priming; Chinese compound processing.

In the current study, we examined the influence of semantic transparency and its time course on morphological facilitation in the recognition of Chinese compounds in three lexical decision experiments. What is typically reported in the literature is none semantic transparency effect in the recognition of morphologically complex words with short SOAs in the priming paradigm (Feldman, Soltano, Pastizzo, & Francis, 2004). Most previous work investigated this effect with derivational morphology. Different from the previous studies, the current study attempted to investigate the contribution of semantic transparency and its time course in processing written Chinese compounds. This opens another window for us to understand morphological processing because Chinese written texts are morpheme-based; namely, each morpheme is marked in texts by default, which is different from English texts. In addition, we adopted a cross-language priming paradigm to avoid effects at the form (orthographic) level in order to seek the effects purely from the morphological activation in priming, while previous studies (e.g., Zhou, Marslen-wilson, Taft, & Shu, 1999) in Chinese compounds may confound the form level with the semantic level contribution in morphological processing. Therefore, the primes were Chinese compounds along different semantic dimensions and the targets were English translations of the shared morpheme. Decision latencies to visual targets (e.g., *flower*) were measured after semantically transparent Chinese compound (e.g., 花园, 花 means *flower*, 园 means *yard*, 花园 means *garden -- TT*) primes, in contrast to semantically opaque Chinese compound (e.g., 花生, 花 means *flower*，生 means *birth*, 花生 means *peanuts --OO*) primes. In addition, contrasts were observed between semantically transparent Chinese compound primes (e.g., 油田 means *oil field*，油 means *oil*，田 means *field -- TT*) and partial transparent Chinese compound primes (e.g., 油菜 means *a type of vegetable*, 油 means *oil*，菜 means *vegetable -- OT)*; and the English target was the shared morpheme across these two conditions *(e.g., oil)*.

In order to use this cross-language paradigm, we recruited Mandarin-native, but also proficient English readers. In the comparison between TT and OO compounds, the Chinese transparent compounds demonstrated robust priming across all three SOAs, with bigger effects when the prime durations were longer. In contrast, Chinese opaque compound primes started to show priming effects only at the SOA of 150ms and 250ms. Transparent compounds showed bigger priming effects than opaque compounds. This contrast shows that the semantic effect from morphological constituents can occur in the early stage of processing for fully transparent compounds, but not opaque compounds. Partially transparent compounds demonstrated priming at the SOA of 50ms, but priming disappeared at the SOA of 150ms and restored at the SOA of 250ms. The pattern is in general consistent with transparent compounds, except for the 150ms condition. The results suggest that semantic transparency modulates the magnitude of morphological segmentation in reading Chinese compounds, even with short SOAs. This could be due to the unique feature of Chinese texts where morpheme marker is salient. More critically, this semantic influence is time-sensitive.

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The impact of focus sensitive particles on memory for information-structural alternatives

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Focus sensitive particles establish a contrast between an expression in focus and its alternatives. For example, the meaning of the particle *only* is modeled as excluding elements of a set of possible alternatives (e.g., König, 1991). Prosodic means of indicating contrast have recently been shown to affect memory for contextual alternatives (Fraundorf et al., 2010) and it is well established that focus structure plays a role in the representation of texts (see for example Sturt et al., 2004).

Combining these lines of research, we investigated the effects of focus particles on memory for information-structural alternatives in a delayed recall experiment. We hypothesized that focus operators should alter the representation of the alternative set such that its members become more accessible. Participants were presented with short prerecorded dialogs in which a set of elements was introduced and a person performed an action with one of the elements (cf. (1)). The critical manipulation was whether the texts contained the exclusive particle *nur* ('only'), the inclusive particle *sogar* ('even') or no particle as a control condition. After being exposed to blocks of ten dialogs, participants were asked to recall the elements in the first setting sentence. To discourage a strategy of concentrating on the list of elements, comprehension questions on filler items with the same structure were interspersed with the test items.

(1) Setting Sentences (speaker 1):
In der Obstschüssel liegen Pfirsiche, Kirschen und Bananen. Ich wette, Carsten hat Kirschen und Bananen gegessen.
'In the fruit bowl there are pears, cherries and bananas. I bet Carsten ate cherries and bananas.'

Critical Sentences (speaker 2):
*Nein, er hat **nur/sogar/_** Pfirsiche gegessen.*
'No, he **only/even**/_ ate pears.'

The analysis of correctly recalled items revealed that memory for the focus alternatives was better in both conditions with particles compared to the control condition (*even* vs. control: t = 2.48, SE = 0.028, p < 0.05; *only* vs. control: t = 2.11, SE = 0.029, p < 0.05). Crucially, there was no difference in recall of the focused constituent across particle conditions (*even* vs. control: z = -0.17, SE = 0.27, p = 0.87; *only* vs. control: z = -0.5, SE = 0.27, p = 0.61). Our data reveal that focus sensitive particles specifically modulate the representation of focus alternatives and enhance a listener's memory performance. We suggest that this enhancement is due to better encoding of the alternative set. These results are in line with recent proposals concerning the role of prosody in eliciting encoding of information about contrast items (cf. Fraundorf et al. 2010) and they demonstrate for the first time that focus operators have a similar impact on longer-term representations of a text.

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Semantic Transparency and the Distributional Origin of Constituent Effects in Compound Processing

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Keywords: semantic transparency; compound processing; distributional semantics; lexical decision; frequency effects

Semantic transparency (ST) is a measure indicating the strength of the semantic association between a compound ("swordfish") and either of its constituents (modifier: "sword"; head: "fish"). It has often been hypothesized that ST modulates constituent access in compound processing. Nevertheless, significant effects are rarely reported in psycholinguistics, and ST seems to play a limited role (if any) when recognizing a compound. However, the way ST is traditionally measured is sub-optimal in terms of reliability and definition, being usually based on off-line ratings of human participants.

In this study we have borrowed ideas from computational linguistics in order to obtain an objective, quantitative, and corpus-based measure of ST. Following the tenets of distributional semantics (e.g., Turney & Pantel, 2010), we assumed that word and phrase meanings can be approximated by vectors recording their co-occurrences with the other words in the reference corpus. Head and modifier ST measures were then characterized in terms of proximity of the compound vector to the head and modifier vectors, respectively. The impact of these distributional measures on word processing was investigated in an analysis of lexical decision latencies.

1550 compound words, and their associated lexical decision latencies, were extracted from the ELP database (Balota, Yap, Cortese, Hutchison et al., 2007). For each compound, head ST and modifier ST were calculated as described above. Moreover, constituent frequencies, compound frequency and compound length measures were collected. The effect of all these variables on latencies, as well as all the possible two-way interactions, were investigated employing Generalized Additive Models.

Interactions between modifier frequency and modifier ST and between head frequency and head ST were found to be significant. Constituent frequency effects are mainly found for high ST values, i.e. only when the constituent is semantically associated to the compound, the facilitatory effect of its frequency is found: the contribution of constituents in recognizing the compound emerges only when these are related to the compound itself. We thus conclude that the lack of ST effects in the psycholinguistic literature might be due to the inappropriate way in which it is measured, and that the distributional view of meaning provides an objective way to measure ST that can profitably be employed in psychological studies. In ongoing work, we are exploring whether the same effects are observed if the distributional representation of compounds is compositionally derived from the representations of its constituents, instead of being directly extracted from the corpus.

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Morphological Processing in Reading Russian: Evidence from Eye Movements

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Keywords: parafoveal processing; morphological processing; eye movements; reading; lexical access.

Introduction

Recent cross-linguistic reading research has focused on language-specific effects on processing as evidenced by eye movements. With respect to morphology, evidence suggests that morphological information is not extracted parafoveally in English (Lima, 1987) or Finnish (Hyönä et al., 2004); however, morphology is processed parafoveally in Hebrew, modulated by syntactic context (Deutsch et al., 2005). Allocation of attention to morphemic integration is augmented for within-word processing vs. between words (Hyönä et al., 2004). Two experiments investigated whether syntactic information in Russian modulates integration of inflectional morphology across (Experiment 1) and within-words (Experiment 2) during parafoveal processing of nouns.

Method

Russian allows all six possible word orders. A V-initial string is equally likely to continue as VOS or VSO (Kemp & McWhinney, 1999). VSO sentence frames were normed for target plausibility as subject/object. Morphological processing in the parafovea was examined via the boundary-change paradigm (Rayner, 1975) with an invisible boundary at the end of the word *n-1* for between-word (5 char. nouns) and between the 5th and 6th characters of word *n* (10+ char. nouns) for within-word examination (Hyönä et al., 2004), thereby equating the distance between boundary and target across experiments.

Changing the last letter (inflectional morpheme) of the target word resulted in 3 preview conditions:

[NOTE: vertical line = invisible boundary location]

identical (no change)

E1: | лодк**а**$_{subjectNOM}$; | лодк**у**$_{objectACC}$ boat   E2: путешестве|нниц**а**$_{subjectNOM}$; путешестве|нниц**у**$_{objectACC}$ traveler

related (morphologically related inflectional ending):

E1: | лодк**у**$_{objectACC}$; | лодк**а**$_{subjectNOM}$ E2: путешестве|нниц**у**$_{objectACC}$; путешестве|нниц**а**$_{subjectNOM}$

nonword (illegal nonword):

E1: | лодк**д**   E2: путешестве|нниц**д**

If morphological processing occurs in the parafovea, related and identical conditions should differ from nonword. If only orthographic processing occurs, only identical should differ from nonword. If syntactic context affects processing, preview condition should interact with target position (Subject vs. Object). If parafoveal processing is augmented due to greater allocation of attention for within-word identification, then preview effects should be attenuated in E1 vs. E2.

Design: 2 (Subject vs. Object target) X 3 (preview) Latin square within-participants design. ***Participants***: 42 native speakers of Russian in each experiment. ***Apparatus***: SR Research Eyelink 1000.

Results

In E1 (between-word), gaze duration differed between identical and nonword only, suggesting morphological information in the parafovea was not used. In E2 (within-word) gaze durations on the 2nd half of the word in identical and related differed from nonword, and there was an interaction between target position and preview. A larger facilitation effect for related preview in Subject (53ms) vs. Object (7ms) indicated greater allocation of attention when either argument was syntactically possible.

Conclusions

The results indicate that morphology can be processed parafoveally in Russian, but is modulated by allocation of attention and syntactic context. The evidence suggests that words are processed serially in Russian. When the eyes are fixated on a word, morphemes available parafoveally are used to limit lexical candidates and support lexical access.

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Phonological Word-Object Mapping is Contingent upon the Nature of the Visual Environment

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Keywords: Attention; Eye Movements; Inhibition; Phonological Mapping; Visual Search

Four eye-tracking experiments investigated the impact of the nature of the visual environment on the likelihood of word-object mapping taking place at a phonological level of representation during language-mediated visual search. Dutch participants heard single spoken target words while looking at four objects embedded in displays of different complexity and were asked to indicate the presence or absence of the target object. During filler trials the target objects were present, but during experimental trials they were absent and the display contained various competitor objects. For example, given the target word '*beaker*', the display contained a phonological (a beaver, *bever*), a shape (a bobbin, *klos*), a semantic (a fork, *vork*) competitor, and an unrelated distractor (an umbrella, *paraplu*). When objects were embedded in semi-realistic scenes including four human-like characters (Experiment 1, 3, and 4a), there were no biases in looks to phonological competitors even when the objects' contours were highlighted (Experiment 3) and an object naming task was administered right before the eye-tracking experiment (Experiment 4a). In all three experiments however we observed evidence for inhibition in looks to phonological competitors, which suggests that the phonological forms of the objects had been retrieved. When objects were presented in simple four-object displays (Experiments 2 and 4b) there were clear attentional biases to phonological competitors replicating earlier research (Huettig & McQueen, 2007). These findings suggest that phonological word-object mapping is contingent upon the nature of the visual environment and add to a growing body of evidence that the nature of our visual surroundings induces particular modes of processing during language-mediated visual search.

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Get- and Be-Passives Project Different Pragmatic Information about the Patient

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Keywords: English passive; get; be; syntax; paraphrasing

In English, the same transitive event can be described via an active-voice sentence (*Mary hit Bob*) or a passive-voice one (*Bob was/got hit [by Mary]*). Whilethe active is generally more frequent, the passive is known to serve distinct functions, for example, topicalizing the event's patient (Keenan & Dryer, 2006). At the same time, little is known about factors that promote the use of *get-passives*over the more frequent *be-passives*. Though some theories suggest that both types of passive are interchangeable (Chomsky, 1981), others acknowledge that the two variants are associated with distinct syntactic properties (Haegeman, 1985) and that they serve different semantic (Givon& Yang, 1994) and pragmatic (Carter & McCarthy, 1999) functions. More specifically,several theories propose that, by using a get-passive, the speaker puts specific emphasis on such properties of the patient as responsibility (Lakoff, 1971),purposefulness (Downing, 1996), and control (Givon& Yang, 1994).

Here,we analysed how increasing the patient's accessibility, by means of its information status (*given* versus *new*),and putting attentional focus on the patient, by means of syntactic clefting,jointly affect the speaker's bias to paraphrase apreviously encountered active-voice sentence using one of the two passive voice constructions.

Participants read 24 two-sentence stories, in which the second sentence always described a transitive target event in active-voice. Two factors were orthogonally manipulated: (1) The patient of the target eventwas either new (agent given) or given (agent new), and (2)attentional focus (via syntactic clefting) was either on the agent or the patient of the target event.After reading each story, participants produced a single-sentencedescription of what happed in the target event.

Out of all available responses, we separately analyzed proportions of active-voice ("*a manager fired a janitor*"), be-passive("*a janitor was fired* [*by a manager*]") and get-passive descriptions ("*a janitor got fired* [*by a manager*]"), using binary logistic Generalized Estimating Equations. Analyses revealed that participants produced fewer active-voice descriptions when the patient in the target event was Given.Moreover, we found the two passive-voice variants were differently sensitive to the two experimental manipulations:While proportions of be-passiveparaphrases increased in the Patient-Givenconditions(significant main effect of information status, complementary to what we found in proportions of active voice), get-passives became more likelyin the Patient-Focused conditions (significant main effect of attentional focus). There wereno reliable interactions between the two factorsin any of the three dependent variables.

We conclude that the be- and get-variants of the English passive may serve distinct pragmatic functions: While be-passives appear tomark*given*(hence, generally more accessible) patients, get-passives are more likelywhen the speaker wants to refer to an event with particular attentional focus (or emphasis) on the patient's role in the event.Our results thereforesupport the view that get- and be-passives are not arbitrarily interchangeable: They are distinct syntactic devices that project different types of pragmatic information.

Attention switching trait in recognition of Japanese sentence-final particle *ne*: An ERP study

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Keywords: Japanese sentence-final particle; Interpersonal function; Autistic trait; Attention switching, LPP (late positive potential)

Sentence-final particles in Japanese

Japanese sentence-final particles work as pragmatic function words, such that their appropriateness cannot be decided unless contexts and/or interpersonal relationships are set. In conversations, native Japanese speakers add the particle *ne* to about 10% of their utterances (Kiyama, 2005). In addition, Japanese children begin to use *ne* even at the age of two (e.g., Kajikawa, Amano, & Kondo, 2004). However, autistic children/adults seldom use *ne* (e.g., Watamaki, 1997). The abovementioned observations lead to the assumption that sensitivity to sentence-final particles may be affected by individual autistic traits. The present study conducted an event-related potential (ERP) experiment to explore native speakers' individual differences in comprehension of Japanese sentence-final particle *ne* in comparison with another commonly-used sentence-final particle *yo*. Based on Hajcak and Olvet (2007) who observed LPP (late positive potential) on response to affective stimuli, we compared the LPP between healthy participants with high and low autistic tendency (as indexed by the Japanese version of Autism-Spectrum Quotient: AQ, Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006).

Method

Twenty-five right-handed native Japanese speakers heard short dialogs in which sentence-final particles were presented at the end of the last utterance, and made judgments on whether the sentence-final particles were appropriately used or not, as quickly as possible. Based on a pretest, we manipulated appropriate and inappropriate uses of sentence-final particles within an identical dialog, where *yo* was suitable to the dialog while *ne* was anomalous (i.e., *yo* appropriate condition), and where *ne* was suitable while *yo* was anomalous (i.e., *ne* appropriate condition).

Results

Results revealed that only the attention switching subscale of AQ significantly affected our participants' judgments on uses of sentence-final particles, both in behavioral and ERP data. A regression analysis of behavioral data showed that the lower participants scored in attention switching (i.e., skilled in attention switching), the more quickly anomalous ne was rejected ($p < .05$).

After visual inspection of ERPs, the mean amplitude in the 500-850ms time window was analyzed by utilizing a linear mixed effect (LME) model (Baayen, 2008), setting participant group (high/low score in AQ-switching), appropriate/inappropriate condition, and presented particle (i.e., *yo* and *ne*) as fixed variables, and participant and channel as random variables. According to Hajcak and Olvet (2007), central and parietal 11 electrodes (CP1, CP2, CP5, CP6, P3, P4, P7, P8, PO3, PO4, Pz) were selected for the following statistical analysis.

Results revealed significant main effect for appropriate/inappropriate condition ($F_{1, 1014} = 4.661$, $p < .05$). Appropriate use of sentence-final particles elicited greater positivity than inappropriate use ($N = 26$). Significant interaction was found between app/inapp condition and presented particle (*yo*/*ne*) ($F_{1, 1014} = 4.119$, $p < .05$), which indicated that the above main effect was greater in *ne* than *yo*. Significant interaction was also found between app/inapp condition and participant group (skilled/less skilled attention switching) ($F_{1, 1014} = 4.022$, $p < .05$). It indicates that the above main effect was greater in participants with skilled attention switching than those with less-skilled attention switching. The present ERP results suggest that native speakers with high skill in attention switching are more sensible to Japanese sentence-final particle *ne*.

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Impaired Inflectional Morphology in Children with Developmental Dyslexia: Converging Evidence from Behavioral and Electrophysiological Measures

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Keywords: Developmental Dyslexia;Specific Language Impairment; Morphosyntax; ERPs.

Introduction

General agreement has been reached on the presence of impaired inflectional morphology in Specific Language Impairment (SLI). Based on the widely recognized overlap between SLI and Developmental Dyslexia (DD) (e.g., Bishop & Snowling, 2004), the study of these features in DD gains theoretical and clinical relevance. Recent studies focusing on children with DD-only revealed impaired inflectional morphology in this population as well, both in production (e.g., Altmann, Lombardino & Puranik, 2008) and in comprehension (e.g., Robertson & Joanisse, 2010), suggesting that the linguistic deficit in DD goes beyond the sphere of phonology. However, some issues need further investigation, in particular concerning the direct comparison between DD children with (DD+SLI) and without SLI (DD-only), and between the domains of production and comprehension.

Method

In the present study we used converging evidence to better characterize impaired inflectional morphology in a sample of Italian DD children. Thirty-two children with DD (16 with DD-only and 16 with DD+SLI) and 16 control children (aged 8-12) were tested with a behavioral linguistic battery requiring the production of nominal and verbal inflections using words and pseudo-words. In addition, sentences containing subject-verb agreement violations were auditorily presented and children were asked to judge the grammaticality of the sentences while ERPs time-locked to the critical morphemes were recorded.

Results

The behavioral results show impaired production of inflectional morphology in DD children. In particular, the deficit emerges in the inflectional manipulation of both words and pseudo-words in DD+SLI children, while it is evident only for pseudo-words in DD-only children. In comprehension, the sensitivity to subject-verb agreement violations (expressed as A' score) is impaired only in the DD+SLI children group ($p < .01$). Interestingly, the three groups show different ERP responses to the violations: the control group shows the typical pattern associated to agreement violations (LAN+P600), the DD+SLI group shows only a non-significant Positivity, and the DD-Only group shows a broadly distributed Negativity ($p < .005$), interpretable as a N400 component.

Discussion

These results provide us with a better understanding of the impairment in inflectional morphology in DD children with and without SLI. DD+SLI children show a pervasive disorder involving both production and comprehension. DD-only children show a more restricted deficit, involving only the production of pseudo-words. However, the difference between the two dyslexic groups is not likely to be only quantitative, since qualitatively different patterns emerge at the electrophysiological level. Based on theoretical models of morphology (e.g., Ullman, 2001), we hypothesize that the strategy reflected in the N400 is related to the retrieval of the inflected forms as stored in the lexicon. This hypothesis, coherent with the behavioral result of specific difficulties with the inflections of pseudo-words, highlights the peculiarity of the morphological impairment in DD.

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Atypical subject relative clause processing deficit in children with autism

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Delays and deficits in language development are among the diagnostic criteria for autism. However, work investigating grammatical abilities remains scarce and mostly limited to English(see Roberts, Rice &Tager-Flusberg, 2004 and references cited therein).Relative clauses (RCs) are a useful tool for detecting syntactic difficulty (Friedmann&Novogrodsky, 2004) yet there is no experimental assessment of RC comprehension in any language to date for children with autism spectrum disorder (ASD). Our study isthus the first experimental assessment of relative clause (RC) processing by children with ASD. Object relative clauses (ORs) are typically acquired later than subject relative clauses (SRs) cross-linguisticallyand appear selectively impaired in various syntactic deficits.This asymmetry is usually accounted for by the increased syntactic complexity of ORsas compared to SRs (Friedmann, Belletti&Rizzi, 2009). The present study shows that both French and Italian-speaking ASD children manifest an overall delayed acquisition of RCs withatypical enhanced difficulties in the processing of SRs.

Twenty-four participants diagnosed with ASD took part in the study: (i)8 French-speaking children,mean-age 7, (ii) 8 French-speaking children, mean-age 10;6 and (iii) 8 Italian children, mean-age 9;6. Three control groups of typically developing (TD) children were selected such that they matched each of the ASD groups' performance with ORs, so as to comparatively assess their performance with SRs: (i) 8 French-speaking,mean-age 5, (ii) 8 French-speaking, mean-age 7 and (iii) 12 Italian, mean-age 3;6taken from Adani (2011). Materials involved SR and OR sentences (Examples 1 and 2) as well as filler items, all illustrated by drawings. A pointing procedure was used.

Results reveal that ASD participants are globally delayed for the acquisition of RCs, and even more so for SRs: (i)French-speaking ASD children aged 7 performed similarly to TD children aged 5 for ORs, but significantly below them for SRs ($p<0.05$); (ii) French-speaking ASD children aged 10;6 performed similarly to 7 year old TD children for ORs, but significantly below them for SRs ($p=0.05$); (iii) Italian-speaking ASD children aged 9;6 scored similarly to TD children aged 3;6 for ORs but significantly below them for SRs ($p=0.05$). Recent work from our group on French-speaking ASD adults suggests that this distinctive pattern persists into adulthood.

This profile of enhanced delay for SRs as compared to ORs has, to our knowledge, not been attested in other populations and therefore appears as a potential signature of ASD.Further research is still needed to tease apart the role of syntactic chain formation (movement) and that of embedding in the attested difficulty.

Example target sentences

1. Montre-moi les grand-parents qui peignentl'enfant /Mostrami i nonni che dipingono il bambino
   'Show me the grand-parents that are painting the child'.
2. Montre-moi l'enfant que les éléphants lavent / Mostrami il ragazzo che gli elefanti bagnano/
   'Show me the child that the elephants are washing.

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Phonological- and lexical-level effects in toddlers' word recognition

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Twenty-four-months-olds show phonological priming effects in word recognition (Mani & Plunkett,2011). Contrasting with literature on adult word recognition arguing for a lexical-level influence of the prime on target recognition (Dufour & Peereman, 2003), the prime is argued to exert only a limited phonological-level influence in toddlers. The current paper seeks to clarify the processes underlying word recognition in toddlers and examines phonological and lexical-level effects on word recognition by manipulating prime and target cohort size.

Forty-six German 24-month-olds participated in an intermodal preferential looking task. Each trial presented a prime picture (1500 ms), followed by a blank screen (200ms), followed by target and distracter pictures side-by-side (2000ms) and the target label. Each child saw 5 trials with prime and target sharing the initial consonant (e.g. Bett 'bed' –Bein 'leg') and 5 trials with prime and target being urelated (e.g. Auto 'car' – Bein 'leg'). Half of prime and target labels belonged to a large cohort, the other half to a small cohort.

Onset overlap between the labels for prime and target image interfered with target recognition ($t_{(44)}$=1.992, p=.05). Yet, both prime and target cohort size modulated children's looking behaviour (trial type*prime cohort size: $F_{(1,83)}$=21.642, p<.001; trial type*target cohort size: $F_{(1,79)}$=2.946, p=.09). Same-onset primes facilitated target recognition when prime and target belonged to a small cohort (tsmall prime cohort(40)=-3.457, p=.001; tsmall target cohort(38)= -2.121, p=.04). In contrast, same-onset primes interfered with target recognition when the prime belonged to a large cohort ($t_{(43)}$=3.303, p=.002) and had no effect on target recognition when the target belonged to a large cohort ($t_{(41)}$=0.615, p=.54). To further investigate the specific contribution of prime and target, we looked at interactions between prime and target cohort size in different-onset trials ($F_{(1,124)}$=9.998, p<.001) as only these allow a crossed pairing of prime and target from small and large cohorts. Target recognition for targets from small cohorts was better than for targets from large cohorts following presentation of a large cohort prime ($t_{(59)}$=-1.920, p=.06), while the opposite holds for target recognition after presentation of a small cohort prime ($t_{(65)}$=2.586, p=.01).

We argue that the results are indicative for the application of different mechanisms during prime and target recognition. Since the prime was only visually presented, priming effects are contingent on the child's implicit generation of the prime label. Primes from large cohorts are more easily generated (Vitevitch, 2002) and interfere with target recognition, while primes from small cohorts can feed through their phonological activation to aid target word recognition in related trials. In unrelated trials, lexical-level inhibition of the prime is irrelevant and targets from small cohorts are recognized better (Luce & Pisoni, 1998), while phonological-level activation can only be overcome by a large target cohort.

Input Effects on Parser Development: Evidence from Japanese Word Order Development

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Keywords: Word order; child sentence processing; Japanese; input

Child sentence comprehension research has largely focused on their ability to incrementally use multiple sources of information, but little is known about how children learn to parse constructions that vary cross-linguistically. One potential mechanism of parsing development is syntactic priming that increases processing efficiency (Chang, Dell & Bock, 2006), and this predicts a correlation between the frequency of relevant input and the developmental trajectory. We tested this prediction by taking word order development as a case study, where previous preferential looking studies on French found evidence for adult-like word order comprehension at 19 months (Franck, Millotte, Posada, & Rizzi, 2011). Our analyses of child-directed speech show that the frequency of sentences with two overt arguments is smaller in Japanese than in French due to frequent argument omissions in Japanese. Next, our preferential looking study that used materials from Franck et al. (2011) with Japanese 19-, 27- and 32-month-olds showed that comprehension of SOV sentences does not fully develop until 32 months.

CHILDES. Our analysis of the word order distribution in Japanese and French child-directed speech (Aki and Anais corpus, respectively) showed that sentences with two overt arguments (French SVO vs. Japanese SOV) are far more frequent in French (40.0%: 1538/3844) than in Japanese (8.9%: 1532/17726). This establishes the premise of the study that Japanese word order input is impoverished.

Experiment: We tested 22 19-month-olds (mean=19.1), 22 27-month-olds (mean=27.5) and 23 32-month-olds (mean=32.3). The experiment consisted of (a) puppet and novel action familiarization phases, and (b) a test phase with 6 trials, half of which had a grammatical SOV order, the other half an ungrammatical SVO order with a prosody control that blocked a superficially similar object right dislocation structure. Each test trial consisted of 4 presentations of a split-screen movie with two videos: i) a causative video (a puppet performed a novel action on another puppet), and ii) a non-causative video (two puppets performed the same novel action on themselves). The first movie presentation established the baseline visual preference, and the subsequent three movie presentations with a target sentence constituted the critical regions of analysis. Sentences contained pseudo-verbs that prevented infants from relying on existing verb knowledge. If the word order information guides comprehension, infants should prefer the causative video only in the grammatical condition.

We analyzed the proportion of looks to the causative video in the baseline period and 3 critical regions. For 32-month-olds, Region 2 revealed a significant preference for the causative video in the grammatical condition only (p=.037). All the other comparisons in this age group or the 19- and 27-month-olds revealed no significant preferences (all ps>.1).

These results suggest that the development of SOV processing is delayed in Japanese compared to SVO processing in French, and this difference patterns with the input frequency of two-argument sentences in two languages. It remains to be seen whether this could be interpreted as evidence for a change in linguistic knowledge as opposed to parsing development.

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Age of Acquisition Effects in Delayed Naming Tasks

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Keywords: word production; age of acquisition

Within the field of study dealing with word-production, it's a highly reliable observation that words acquired earlier in life are processed faster than words acquired later in life. The locus in which this Age of Acquisition (AoA) effect has its origin, however, is still a matter of debate. Critically, discrepant conclusions about the issue might stem from the fact that different experimental paradigms have been used to evaluate different loci (Catling & Johnston, 2008).

The aim of the present work is to asses the possible loci of the AoA effect within the same experimental task: delayed picture naming. Two different experiments were designed. In both experiments, a picture has to be named after a delay (1000 ms.) on the 25% of trials. On the remaining 75% of trials, participants have to perform a different task after the delay: semantic categorization in Experiment 1, grammatical gender decision in Experiment 2. The rationale underlying this paradigm is to bias the processing occurring during the delay (see Almeida, Knobel, Finkbeiner, & Caramazza, 2007). During the delay, participants in Experiment 1 are biased to prepare the response to the categorization task, processing the picture up to the conceptual-semantic level, while in Experiment 2 participants are biased to prepare the response to the gender decision task, therefore selecting a lexical representation.

An AoA effect was found in Experiment 1, suggesting that the effect stems from stages after semantic processing. In a control immediate naming experiment (i.e. without delay) a similar AoA effect was found, suggesting that the conceptual processing occurring during the delay is not able to reduce the AoA effect. In Experiment 2, where participants are biased select a lexical entry during the delay, AoA effect was small but still significant, suggesting that AoA also affects stages subsequent to lexical selection, i.e. phonological encoding. When the delay was removed in a control immediate naming experiment, the AoA effect detected was significantly larger compared to the delayed-naming condition, coherently with the idea that part of the effect occurred during lexical selection.

Taken together the results support a dual-locus account, in which AoA affects lexical selection and phonological encoding. Critically, the experiments reported investigated different possible loci of AoA within the same task.

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Effects of Statistical Learning in Eye Movement Behavior during a Visual Search Task

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Keywords: word frequency; transitional probability; eye movements; visual search.

Probabilistic theories of sentence processing (Levy, 2008) argue that statistical regularities in language influence the difficulty of processing particular words or structures during reading. Effects of *word frequency* and *predictability* support the hypothesis that more frequently encountered individual and co-occurring words are more accessible from memory and thus more easily processed (Rayner, 1998). However, this assumes that cognitive processes related to sentence processing (e.g., memory retrieval) directly influence decisions about when to move the eyes during reading. This assumption is contested and some argue that causal links between cognitive processes and eye-movement control have not been demonstrated (Kliegl, Nuthmann, & Engbert, 2006; *cf.*, Rayner et al., 2007). To address this dispute, we report a visual-search experiment investigating the effects of learning on eye movements and show that the frequency of exposure to a stimulus and the transitional probabilities between stimuli affect the number and duration of fixations that they receive.

Participants scanned lines of *Landolt-C* clusters to locate one containing an *O*. Analyses used linear mixed-effects models with participants and items as random effects. We tested for predictability effects based on the transitional probability (0, .25, .50, .75, and 1) of cluster *n* given cluster *n* – 1. Gap size of the current and preceding cluster, the number of encounters with the current cluster, the number of encounters with the pair, and trial number (to account for practice effects) were entered as fixed effects. More exposures to a cluster were associated with fewer and shorter fixations on predicted clusters. Interactions of other predictors (e.g., gap size, number of encounters with the current cluster) with transitional probability suggested that for some clusters (e.g., of larger gap sizes) higher values of transitional probability are associated with shorter fixation durations.

The results demonstrate that experimental manipulations of frequency generate eye-movement effects similar to the word frequency effects observed in reading and suggest that learning through repeated exposure, and concordant differences in memory accessibility, have rapid effects on eye-movement behavior. The results also suggest that successful learning of transitional predictabilities may require more exposures than to individual stimuli. The findings regarding transitional probability contribute to the debate about transitional probability effects in reading (Frisson, Rayner, & Pickering, 2005; McDonald & Shillcock, 2003) and are consistent with the past observations that the effects of form-based predictability on eye movements in reading are likely to be very weak, if present.

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Learning New Concepts through the Verbal vs Visual Modality: an Eye-Tracking Experiment

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Introduction

We studied the controversial issue of new concept acquisition, where language-based accounts are opposed to embodiment theories, by means of an eye-tracking study. Subjects were asked to learn new concepts (novel verbs expressing a combination of existing concepts, like the nonword PORIGARE meaning "to use some objects to reach other objects"), either in visual modality, i.e. seeing a series of pictures (situations) representing positive and negative instances of the concept, or in verbal modality, i.e. listening to a verbal description of each situation (corresponding to the pictures, according to judges' ratings). Subsequently subjects had to read sentences in which the newly introduced term was used correctly (congruent, half of the sentences) or incorrectly (incongruent, half of the sentences) and had to judge them for plausibility (judgement task). Filler sentences were also presented. Fixation times (on the new word) and number of regressions (in order to integrate/repair the representation of meaning for the whole sentence) were considered as indicators of the degree of learning of the newly acquired concepts.

Methods

Twenty adult Italian native speakers took part in the experiment. They had to read 270 sentences, presented on a CRT monitor. Ten abstract concepts subtended the target words. Each new concept was presented before every sub-block, through either verbal descriptions or pictures.

Every sentence was characterized by two variables: learning modality of the target concept (visual or verbal) and presentation order (the first, second or third time the sentence was presented). Three or four Areas Of Interest (AOIs) were defined for each sentence: Subject-S, Verb-V, Target-T and, if present, Added Term-C. The parameters were subdivided into two classes: AOI-related and non-AOI-related.

The parameters that were extracted in a trial for each AOI were: Number of fixations, Mean fixation duration; Total viewing duration. The non-AOI-depending parameters were: Number of fixations, Total viewing duration, Number of regressions, Response time.

Eye and response data were analysed using repeated-measures ANOVA. Factors were CONGRUENCE, PRESENTATION ORDER, LEARNING MODALITY and, if present, AOI.

Results and Discussion

All effects were more evident in the 2nd repetition. A CONGRUENCE effect emerged, with congruent sentences requiring longer reading time. We interpret such an effect in terms of serial searching for a possible incongruence through the sentence – an exhaustive search is necessary to decide that a sentence is congruent, while, on the average, the incongruence in an incongruent sentence is detected before reaching the end of the sentence. Additional difficulty may be due to the figurative use of the verb, which may entail less strict boundaries for its extended application. Interestingly, a significant CONGRUENCE x LEARNING MODALITY interaction was found, with *congruent, verbally introduced* sentences yielding worse ocular parameters (longer reading time and a higher number of fixations and regressions), as well as lower judgement accuracy. The greater effort required to read sentences after verbal than visual presentation of the novel concept is a challenging result, that will be discussed in terms of information univocity, definedness and seriality.

The Impact of Neighbour Acquisition on Phonological Retrieval

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Keywords: word learning; memory consolidation; phonological retrieval; neighbours

Speaking is a semantically driven task: we try to find the words that best express the meaning we want to convey. Consequently, there is no obvious reason why form-related competitors should be involved. Still, various studies show that the more a word has similar sounding 'neighbours', the faster it can be prepared and the least likely it is to lead to a tip-of-the-tongue state, or an error. The present study relied on a word consolidation paradigm (cf. Dumay & Gaskell, 2012) to examine whether all neighbours have the same facilitative influence.

Twenty-eight hermit words of English ('carousel') had their empty phonological neighborhood artificially populated by teaching participants fictitious items, either cohort or rhyme neighbours of their target hermit ('carousem' vs. 'barousel'), and their meaning. Familiarization involved a single massed exposure session with 36 presentations. Participants initially shadowed each spoken item and memorized its meaning conveyed by the picture of an exotic object, plant or animal semantically unrelated to the target hermit (e.g., an exotic fish). For the last nine presentations, they then had to recall the novel items in full in response to probes in which the last syllables were missing, but reappeared in the feedback given on each trial.

As lexical engagement requires consolidation, effects of exposure were tested immediately as well as a week later. Engagement of the new neighbour in lexical activity was assessed by tracking the emergence of inhibition in speech perception, by means of a pause detection task on the initially hermit word ('carouse_l'); influence of the new neighbour on speech production was assessed using picture naming ('carousel'). As picture naming systematically contained a preview of the hermit labels, day 8 included two rounds of retests separated by a 2-alternative recognition test reactivating the consolidated but potentially weakened neighbour.

Inhibition of pause detection latencies emerged after a week in the cohort (+28 ms), but not in the rhyme condition (-1 ms), and only after the recognition test had reactivated the new neighbour. In contrast, at the very same time point, picture naming showed facilitation from the rhyme neighbour (-26 ms), but no effect from the cohort neighbour (-6 ms). Meanwhile, recognition showed no indication that the novel neighbours were harder to learn in one than in the other condition (cohort: 97.4% vs. rhyme: 96.5%).

The rhyme facilitation in picture naming argues for interactivity in speech production: feedback between phonemes and words would allow the neighbours of a word to support encoding of the segments they have in common (e.g., Dell & Gordon, 2003). However, the absence of facilitation in the cohort condition demonstrates that not all neighbours support phonological retrieval. As indicated by the pattern of malapropisms, the cohort —by contrast to the rhyme— condition also induced competition for the final, mismatching segment: on day 8 second test round participants started to name pictures using the cohort neighbours. In other words, when mismatching information is yet to come, the target's new best friend quickly becomes its worst enemy.

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When the Worm Paints the Bear: Visual Context Effects on Real-time Thematic Role Assignment in Both Children and Adults

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Keywords: eye tracking; child language comprehension; visual context; depicted events.

Introduction

Adults but not children can rapidly use visual *referential contrast* for syntactic s disambiguation (Trueswell, Sekerina, Hill & Logrip, 1999). However, can other kinds of information in visual context, e.g. *depicted events*, influence children's real-time language comprehension?

Method

In two eye-tracking studies, children (Exp1) and adults (Exp2) inspected either a clipart depiction of three characters (e.g. a worm, a bear and a bull), or of two events between these characters (e.g., a worm (AGENT) paints a bear (AMBIGUOUS); the bear pushes the bull (PATIENT)). After a 2000ms preview, they heard either an unambiguous German subject-verb-object (SVO) sentence (e.g., literal translation: 'Look, the bear (subj) pushes soon the bull (obj)') or an object-verb-subject (OVS) sentence (e.g., 'Look, the bear (obj) paints soon the worm (subj)'). Post-listening, participants named the event agent or patient when asked (e.g., Who pushes?/Who is being painted?). We recorded eye movements, response accuracy, and (for children) working-memory (WM) scores (Kauffmann-ABC).

Hypothesis

Both SVO and OVS word orders are grammatical, but OVS is non-canonical. Without event depictions five-year olds are at chance in understanding unambiguous OVS sentences (Dittmar, Abbot-Smith, Lieven & Tomasello, 2008). If children can rapidly use depicted events for thematic role assignment, their gaze pattern -indicating visual context effects- should resemble that of adults in Experiment 2. If WM is essential for rapid event effects, we should see these only for high-WM children.

Results

Children's response accuracy was higher for SVO than OVS sentences, and for depicted (vs. no depicted) events (*ps*<.001; SVO. 87% vs. 77%; OVS: 60% vs. 42%). Qualitatively, children's gaze pattern resembled that of adults: With event depictions, children anticipated the PATIENT (the bull) more often for SVO than OVS sentences, and the AGENT (the worm) more often for OVS than SVO sentences during the adverb. Without event depictions, that pattern emerged only as the target character was named (NP2). Analyses of eye gaze for the adverb region revealed an interaction between sentence structure and event depiction (subjects: $p < .005$; items: $p < .15$), suggesting case marking at the first noun phrase alone was insufficient for early thematic role assignment in children; the events, however, enabled early thematic role assignment. That interaction was significant for high (but not low) accuracy children and significant by subjects for high (but not low) WM children (median split). Adults' eye movements revealed even earlier visual-context effects, during the verb ($p < .005$; $p < .01$).

Discussion

Thus, events depicting who-does-what-to-whom incrementally influenced both adults' and 5-year-olds' visual attention and thematic role assignment. Depicted-event information and case marking (but not case marking alone) helped children revise their initial SVO preference when interpreting unambiguous OVS sentences. However, visual context effects occurred later in children (vs. adults), and varied as a function of their accuracy and WM.

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When Exactly do Dealers Deal more than Corners Corn?
Incremental Masked Priming and Morpho-Orthographic Effects

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Keywords: morpho-orthographic segmentation; incremental masked priming; visual word recognition

Introduction

It is widely accepted that complex words such as "dealer" are decomposed into their constituent morphemes during visual word identification. There is also substantial evidence that the same happens to pseudo-derived words like "corner" (that would be broken down into "corn" and "er"; e.g., Rastle et al., 2004), but some contradictory results have indeed emerged in this respect (e.g., Feldman et al., 2009). In the present study, we address this issue in an incremental priming experiment, which allows us to track the temporal pattern of the effects by varying quasi-continuously the Stimulus Onset Asynchrony (SOA) between primes and targets within the same experiment.

Materials and Methods

95 prime-target pairs of Italian words were assigned to each of 3 conditions. In the first, genuine derived words primed their stems (artista-ARTE, artist-ART; transparent condition); in the second, pseudo-derived words primed their pseudo-stems (retaggio-RETE, legacy-NET; opaque condition); in the third, simple words primed orthographically related stems (corallo-CORO, coral-CHOIR; orthographic condition). All prime-target pairs were tested in five different SOA conditions: 11.8 ms, 23.5 ms, 35.3 ms, 47.1 ms, and 58.8 ms, which correspond to one, two, three, four, and five refresh cycles of an 85-Hz computer screen.

Each trial started with a string of hash marks presented for 500 ms in the center of a computer screen, followed by the prime word, and then by the uppercase target string on which the subject had to make a lexical decision. Each target word was shown to the 208 participants only once, which was achieved through the adoption of a Latin square design with five rotations.

Results

In a mixed-effects analysis where each SOA was compared with the immediately shorter one and the orthographic condition was set as the baseline, answers turned out to become faster between 24 and 35 ms of SOA in the opaque condition (estimated effect = 10.6 ms, p = .03), and between 35 and 47 ms of SOA in the transparent condition (estimated effect = 14.1 ms, p = .001). When each SOA was instead compared with the shortest one (12 ms), in order to track cumulative effects at each SOA as in classical masked priming, facilitation was shown to be equivalent in opaque and transparent pairs at 24, 35, and 47 ms of SOA, and larger in transparent pairs at 59 ms of SOA (estimated effect = 9.8 ms, p = .02).

Conclusions

The present study shows that, although both transparent and opaque complex words are indeed decomposed during processing, this happens with different temporal patterns. Surprisingly, there seems to be a condition (between 24 and 35 ms of SOA) where opaque words are decomposed, but genuine derived words are not. Furthermore, these data show that morpho-orthographic and morpho-semantic priming do not differ up to 59 ms of SOA, contrary to what shown in some previous studies (e.g., Feldman et al., 2009).

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Assessing Generality and Specificity in Adaptation to Novel Vowel Productions

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Keywords: perceptual adaptation; novel accents; generalization of learning; vowel perception

Speaker adaptation refers to processing adjustments, such as changes in lexicality judgments and phonemic categorizations, that result from exposure to a particular talker's idiosyncratic pronunciations. An open question, and the focus of this experiment, is the extent to which such adjustments are specific to or generalize beyond the experienced input (Eisner & McQueen, 2005; Kraljic & Samuel, 2006).

Studies investigating generality of adaptation have tended to expose listeners to idiosyncratic productions of a single consonant contrast (e.g., /s/-/ʃ/). Here, idiosyncratic vowel productions are used to investigate whether adaptation to a shift in one direction (e.g., lowering) generalizes to shifts in other directions (raising, backing). Listeners were exposed to a novel accent involving a systematic remapping of the American English vowel space. We then tested whether adaptation generalized to untrained but accent-consistent words (i.e., pronunciations that follow this remapping) and whether adaptation affected perception of accent-inconsistent words (i.e., pronunciations that follow a different vowel space remapping).

Method

The design used a modified version of Maye et al.'s (2008) *weckud wetch* paradigm. Participants performed a lexical decision task, then listened to a story read by a trained phonetician in a novel front vowel lowered accent in which all front vowels (but not back vowels) were lowered one phonemic category (e.g., *witch* was realized as [wɛtʃ] instead of /wɪtʃ/. Participants then performed a second lexical decision task. Lexical decision targets comprised three types of near words, all of which were produced by the same phonetician and were one phonemic category from an English citation form: (1) front vowel lowered items (FV-Lowered, e.g., *witch* as [wɛtʃ]); (2) front vowel raised items (FV-Raised, e.g., *chest* as [tʃɪst]); and (3) front vowel backed items (FV-Backed, e.g., *itch* as [ʊtʃ]).

Results

Lexical decisions were fitted with a mixed logit model with random intercepts for participant, word, and the particular vowel that was shifted in each word. Participants accepted more FV-Lowered pronunciations as words after exposure to the FV-Lowered accent (β=.18, p<.01), indicating adaptation. Participants also endorsed more FV-Raised pronunciations after accent exposure (β=.18, p<.02), suggesting generalization of adaptation to an accent-inconsistent contrast. Fewer FV-Backed pronunciations were endorsed after exposure (β= -.17, p<.05), ruling out the possibility that listening to the novel accent leads to indiscriminate endorsement of all near words and indicating the generalization to accent-inconsistent contrasts is at least somewhat selective. This pattern of results suggests that the process of adapting to the lowered vowel accent made available a more general strategy for interpreting certain accent-inconsistent pronunciations.

Regarding generalization to novel lexical items (lexemes that did not occur during exposure), only a marginally significant increase was found for FV-Lowered pronunciations, relative to baseline rates, suggesting that adaptation was lexically driven. By contrast, a robust endorsement increase was found for FV-Raised pronunciations of novel lexical items, relative to baseline rates, which further suggests that listeners developed a general strategy for interpreting these accent-inconsistent pronunciations.

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Sharing the beginning is sometimes sharing nothing at all in word recognition:

Evidence from the visual world paradigm in Japanese

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Keywords: Visual World Paradigm, spoken word recognition, Japanese.

Several studies using visual world eyetracking (tracking looks to pictures of referents of words as a word is heard) have suggested that in English spoken word recognition words sharing their beginnings compete more than words sharing their ends. However, except for Dahan et al. (2001)'s study of coarticulation in English CVC's, previous work has not examined the influence of degree of overlap between target and competitors. For instance, would the word *beetle* be activated when participants heard the first consonant /b/ or only when they heard the entire first syllable /bi/?

We used the visual world paradigm to study the relative activation differences between cohort and rhyme competitors in Japanese CVCV words. Japanese is a mora-timed language, which means that the initial and final syllables of bisyllabic words could be made to have approximately equal duration to control for degree of overlap between cohort and rime competitors. We manipulated location of overlap and length of overlap (in segments) between target and distractor words to examine whether the cohort competitor has an advantage even if it has very little overlap with the target. In our Condition 1 (C_ _ _ vs. _VCV), the cohort competitor shared only the first consonant with the target, while its rhyme competitor shared the rest of the word (e.g., target: *kame*, cohort: **kuchi**, rhyme: **mame**, unrelated: *tora*). In Condition 2 (CV_ _ vs. _ _ CV), the cohort competitor shared the first syllable/mora with the target while the rhyme competitor shared the last syllable/mora (e.g., target: *tsume* , cohort: **tsuki**, rhyme: **same**, unrelated: *koppu*). Results were analyzed using growth curves in linear mixed effects models.

When the cohort competitor and the target shared only the initial consonant, participants fixated the referents of rhyme competitors significantly more often than those of the cohort competitors (p=.02, Condition 1) and did not fixate referents of cohort competitors any more than referents of unrelated words. This may be due to the fact that when two words share an initial stop (which was true for most stimuli in our study), there is no point at which there is ambiguity regarding which word is being presented: the cues to initial stop identity are in the following vowel.

When both competitors shared a syllable with the target, the rhyme competitor was fixated upon as much as the cohort competitor (p=.25), both competitors phonologically related to the target were fixated more than the unrelated competitor (p<.05) and the recognition of the target was delayed (p=.03), indicating increased competition for recognition. In a follow-up study, we found that sharing three initial segments (CVC_) had stronger cohort effect than sharing two segments (CV_ _). Thus our results demonstrated an influence of length of overlap. We are currently running a follow-up study in which we examine the effects of type of initial consonant and subphonemic coarticulatory influences on the length of overlap and consequently competition for recognition.

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Balancing Long-Term Syntactic Knowledge Against Short-Term Experience: The Case of the Missing Adjective

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Experience teaches us that color adjectives are used to help uniquely identify, e.g., one of two differently colored tulips (e.g., Sedivy, et al., 1999). This pragmatic expectation can have far-reaching effects. For example, visually-based pragmatic constraints—specifically the need (or lack-thereof) to produce an adjective to uniquely identify a referent—can restrict cohort competition to a given form-class (i.e., nouns vs. adjectives; Magnuson et al., 2008). But can it also influence lexical activation *within* a class? Would the *absence* of a color adjective suggest that neither tulip is likely to be the referent?

We predicted that, given a scene including a tuba and, critically, either one or two tulips (identical, but differently colored), past experience with the modifying properties of adjectives would cause participants to direct more attention toward the tuba for the spoken noun "tuba" when the scene contained two tulips. In other words, we hypothesized that adding another onset competitor to the display would (perhaps counter-intuitively) *facilitate* recognition of the target.

Such an effect of the absence of a pre-nominal color adjective would stem from long-term experience with the syntax of English (in which color adjectives are typically prenominal). We also asked whether short-term experience with missing adjectives could override such constraints. Throughout the experiment, participants always heard a bare noun as the target (the experiment did not include multi-word phrases or color adjectives). On some trials, however, the target did not uniquely identify a single referent (participants were instructed that in such cases they should click on one instance of the target.) Hence, we predicted that over the course of the experiment, participants would learn that the absence of a pre-nominal color adjective was *not* informative about target identity.

Consistent with our first prediction, early in the experiment there was a numerical advantage (in number of eye movements launched during the word) for the target "tuba" when the scene included two tulips vs. one tulip (scenes A vs. B in the table below). Moreover, consistent with our second prediction, this advantage was eliminated over the course of the experiment (interaction by block, *p*=.02). (When the target [e.g., "boot"] was *not* a cohort competitor of any displayed object, the difference between the two and one tulip conditions [scenes C vs. D] did not change over time.) This pattern suggests that the presence of two identical objects caused participants to expect an adjective, allowing them to narrow in on the target more quickly when there were two cohort competitors.

By showing that lexical competition can be influenced by expectations stemming from long-term knowledge about the syntax and associated pragmatics of the language, these findings highlight the language processing system's interactivity. Further, these expectations can create a context in which an additional competitor actually *facilitates* target recognition; pragmatic expectations due to the relationship between the additional competitor and the existing competitor facilitate recognition of the target. Finally, these expectations are malleable enough to be overridden by short-term counterevidence–a feature that may promote switching between languages with different word orders.

CONDITIONS (48 items in each):

Scene type A:	tuba (target)	tulip (pink)	tulip (yellow)	boot
Scene type B:	tuba (target)	tulip (pink)	couch	boot
Scene type C:	boot (target)	tulip (pink)	tulip (yellow)	couch
Scene type D:	boot (target)	tulip (pink)	couch	medal

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Retrieval of irregular Polysemes: Evidence from Priming, Eye-Fixations, and Evoked Potentials

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Keywords: polysemy; homonymy; lexical ambiguity; priming; eye-tracking; ERP.

We provide behavioral and electrophysiological evidence that readers do not initially commit to a particular interpretation when retrieving irregular biased polysemes like OIL (car; cooking), whose senses differ in frequency and cannot be related via productive rules. We compared biased polysemes with biased homonyms (BANK: financial institution; side of river) whose meanings are semantically unrelated. Eye-tracking investigations of homonyms (Duffy, Morris, & Rayner, 1988) show that lexical access is affected by the relative frequency of meanings. While only a homonym's dominant meaning is accessed in the absence of context, prior contexts supporting subordinate meanings lead to meaning competition. Evidence regarding irregular polysemes is mixed. Some studies support separate entries (Klein & Murphy, 2001) while others support a single entry (Beretta, Fiorentino, & Poeppel, 2005). Crucially, most studies failed to carefully control the relative frequency and degree of semantic relatedness of irregular polysemes senses, issues addressed in this study.

In Experiment 1, experimental trials consisted of a homonymous or polysemous prime (BANK, OIL) and a target instantiating the dominant (ROB, TRADE) or subordinate (SWIM, KITCHEN) reading. Targets following unrelated words served as baselines. Participants made lexical decision to both primes and targets. Priming was only observed for dominant targets of homonyms. The 20 ms priming effect for both polyseme targets was not significant. This suggests that, in contrast to homonyms, readers do not commit to either sense of polysemous words.

We next examined whether non-commitment to one polyseme sense persists in sentence reading by eye-tracking clauses containing homonyms or irregular polysemes preceding contexts biased toward their subordinate readings. Relative to when they followed control words, subordinate contexts were read more slowly only when they followed homonyms. Reading times following polysemes and controls did not differ, again suggesting lack of commitment to either polyseme sense. Importantly, not committing to one sense led to processing costs in the 2-word spillover region between polysemes and their sense disambiguating contexts.

Experiment 3 examined N400s associated with semantic integration to investigate the electrophysiological correlates of sense non-commitment in sentences structurally identical to those we eye-tracked. Compared to matched controls, we observed larger N400s for homonyms but smaller N400s for polysemes. No differences were observed in spillover regions. Additionally, larger N400s were observed on disambiguating words when they followed polysemes or homonyms instead of control words. That differences spilled over to the next word for homonyms reflects the shift from dominant to subordinate readings. Smaller N400s and lack of spillover for polysemes indicate that prior to encountering disambiguating contexts, readers only access and integrate shared semantic features. When context requires full interpretation, semantic processing is increased compared to unambiguous controls but is less costly than for homonyms.

Taken together, our results show that irregular polysemes are processed differently than homonyms. This suggests that they are represented differently. Our results are most consistent with a single-entry account where shared semantic features allow for non-commitment to either sense of biased irregular polysemes in the absence of disambiguating context.

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Lexical processing of Italian ambiguous nouns

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Keywords: lexical ambiguity, frequency, inflectional class, nouns.

The existence of differences in lexical processing of ambiguous and unambiguous words has not been universally accepted. Some researchers found an ambiguity advantage effect, while other authors failed to observe any effect at all (for a review, see Lupker, 2007). Lexical ambiguity seems to be a non-homogeneous phenomenon, which is affected by several variables. One factor taken into consideration in psycholinguistic literature is the frequency of each meaning of ambiguous words. A study based on eye-movements (Staub & Rayner, 2007) has found longer latencies in reading sentences containing balanced homonyms than unbalanced ones.

Our aim was to investigate the role played by frequency dominance (balanced vs. unbalanced homonyms) in word recognition, without any context information biasing toward one meaning. We also aimed at exploring the influence of inflectional class information on Italian ambiguous nominal forms. We expected to find a significant role of this variable, comparable to the one played by grammatical class of homonyms.

We carried out two visual lexical decision experiments. In the first experiment (54 participants) we used homonyms belonging to the same inflectional class (e.g., *credenza*, cupboard/belief); in the second experiment (74 participants) the critical stimuli belonged to different inflectional classes: nouns ending in –e/i and nouns ending in –a/e or –o/i (e.g., *teste*, heads/witness). In both the experiments, the critical stimuli were split in two sub-lists: homonyms having two meanings with the same average frequency (balanced, N=N) and homonyms having one meaning more frequent than the other one (unbalanced, N>N). Each subset of items was compared to unambiguous nouns, which were matched for the final suffix.

A main ambiguity disadvantage effect was detected only in Experiment 2, both on reaction times and errors. Analyses on single categories (N=N vs. N>N) revealed a significant inhibitory effect on N=N ambiguous forms, while no effect was found on N>N forms. In Experiment 1, we did not find any difference between latencies on critical stimuli and unambiguous control forms.

The results are consistent with our initial hypothesis, confirming the role played by frequency dominance and inflectional class in lexical processing of words with multiple unrelated meanings. The ambiguity seems to inhibit word recognition only when the multiple meanings of homonyms are balanced. Moreover, the differences between the results of the two experiments suggest a role played by inflectional class information in the processing of homonymic nouns: ambiguous forms belonging to different inflectional classes are subject to an additional source of competition.

These data are compatible with some assumptions about the role played by lexical and morphological variables in lexical processing and organization.

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Position-Specific Phonological Stroop Effect even with Mirror Strings: Evidence for an Integrated Model of Implicit Orthographic Processing

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Keywords: Stroop effect; mirror-reversed; mirror reading; DRC model.

Introduction

When subjects are required to name the colour of a word, they are faster when the word shares a phoneme with the colour name. This phonological Stroop effect is position-specific: it is larger when the shared phoneme is the first (e.g. RAT written in red) than when it is the last (BAD written in red) with respect to a baseline condition (CAT written in red; Coltheart et al., 1999). We wondered whether such an effect would also be observed when stimuli are left-right mirror-reversed (e.g. RAT -> ТАЯ). If this were the case, we would learn that canonically-oriented abstract letter identity descriptions (Caramazza & Hillis, 1990) are derived even in the odd situation in which orthographic information is neither necessary to the task (subjects have to name the colour and ignore the word), nor directly available to the system (orthographic information is masked in mirror stimuli, and transformations are needed to extract it).

Methods

Sixty-four subjects participated in the study. Thirty-two of them named the colour of 120 *nonwords* which could share the initial, the final, or no phoneme with the colour name ("rosso", red, or "verde", green) and could be either canonically oriented or mirror-reversed. The other thirty-two subjects performed an identical experiment, with the only difference being that stimuli were *words*.

Results

Colour naming reaction times were significantly faster when the string and the colour name shared the first phoneme than in the other two conditions (e.g. the nonword RUGGA written in red was colour-named faster than TUGGO and TUGGA also written in red). Interestingly, stimulus orientation (canonical vs mirror) produced no detectable effect. Results from both experiments (with words and nonwords) were virtually identical.

Conclusions

These results confirmed the hypothesis that a canonically-oriented abstract letter identity description (Caramazza & Hillis, 1990) is derived from orthographic material when orthographic information is irrelevant to the task, even when strings are presented mirror-reversed. Hence a combination of two reading models, Caramazza and Hillis's (1990) three-stage model and Coltheart's Dual-Route Cascaded model (DRC), is supported. The Stroop effect pattern was virtually identical with canonical and mirror-reversed strings; we would have expected a smaller Stroop effect with mirror-reversed strings, because mirror-reversed letters should take longer to be identified. We explained this lack of string-orientation effect by assuming that subjects prevent activation of the abstract letter identity description from rising too much; this method would allow them to accomplish the task, i.e., to name the colour while avoiding to read the string.

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The Domain-General Nature of Item Doubling: Evidence from Perseveration Errors

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Doubling serves as a critical tool for linguistic processing. In morphology, derivation rules can consist of repeating a syllable or a morpheme (e.g., Turkish: *yavaş*<SLOW> vs. *yavaşyavaş*<SLOWLY>). Segments can be lengthened to create minimal pairs within a language (e.g. Finnish: *taka*<BACK> vs. *takka*<FIREPLACE>). These phenomena have led researchers to propose thatknowledge that an item is doubled is separable fromknowledge about the identity of the item. This special representation of doubling may reflect a general property of cognitive processing. We investigatedthe representation of doubling in spelling and verbal short-term memory.

Our approach to this issue relies on perseveration errors, the inappropriate intrusion of an element from a previous response into a subsequent response. For example, the word "under" may be spelled as UNDEL, withthe L also appearing in the prior response, MOTEL. Perseverations are common in immediate serial recall (e.g., Henson, 1999) and in individuals with acquired language disorders (e.g.,Helmick& Berg, 1976). Analyses of perseverations have focused on item identity, yet other aspects of representation may also perseverate. For example, item-doubling information could perseverate even when item-identity information does not, resulting in the intrusion of a doubled item immediately following a response containing a different double letter.

The first analysisfocuses ondouble-letter intrusion errors produced by a single dysgraphic individual, LSS, who perseverates in spelling-to-dictation task. We identified 57 double-letter intrusions in which the prior responses did not contain the exact same double letter (e.g. "child" → CLIDD). Of these errors, 31 (54%) were preceded by responses that contained a different double letter (e.g. HAPPY). Using Monte Carlo analyses, we conclude that this rate of perseveration is far greater than what would be expected by chance. A second analysis used identical methods to investigate the representation of doubling in immediate serial recall, relying on errors produced by undergraduates in an immediate serial recall task. We identified 131 double-item intrusions in which the prior responses did not contain the same doubled item, and found that74 of these intrusion errors were preceded by a response with different doubled item (56%). Again, this was greater more than would be expected by chance.

These results indicate that item-doubling information can perseverate independently of item-identity information in both spelling and verbal short-term memory, supporting a separable representation of item-identity and –doubling in these domains. The special representational status of doubled items that plays such a critical role in linguistic processing appears to reflect a more general property of how sequences are represented.

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Acoustic Prominence Perceived Differently for Fluent and Distracted Speakers

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Keywords: acoustic prominence; discourse status; prosody; distraction; eyetracking.

Spoken words can range in pronunciation, from acoustically reduced to accented, and listeners understand words more quickly when their prosodic realization matches the context. For example, when listeners followed instructions like "Put the camel on the triangle. Now put the candle …," an accented target ("CANDLE") led to rapid fixations on the discourse-new target, whereas an unaccented target led to a preference for the discourse-given *camel* (Dahan et al., 2002) Acoustic prominence can result from both the presence of a pitch accent and longer duration, relative to the surrounding context.

But prosody can also indicate that the speaker is having production difficulty, e.g. slowed speech and hesitations may reflect distraction. Disfluency itself can lead to a new-referent bias (Arnold et al., 2004). When a speaker is distracted, the entire utterance may sound longer and more accented. How then do listeners interpret the prominence of a target word in distracted speech? Hypothesis 1: If the information status function of prosody is primary, listeners may rely on relative prominence. E.g., a longish target might sound prominent in fluent speech, but the same length pronunciation in distracted speech might sound reduced. That is, listeners might know that a slow-down due to distraction alone does not reflect discourse-new information status unless the target is even more prominent than the context. Hypothesis 2: If listeners are sensitive to both pragmatic and processing functions of prosody, they may show a general expectation for distracted-sounding speech to refer to discourse-new information, consistent with the disfluency bias toward new objects, and only show a given bias for reduced targets in a fluent context.

In two visual world eyetracking experiments, we examined how listeners responded to both acoustically prominent and reduced targets, in instructions like the one above. The first instruction mentioned either candle or camel, making the target (candle) either discourse given or new. All subjects heard one block of items where the speaker was supposedly distracted by a secondary task of responding to beeps on a computer, and one not. The same speaker recorded both sets of instructions. Both distracted and fluent contexts had prominent and reduced target conditions. Prominence was achieved with higher pitch in both blocks, and longer duration in the fluent block. The distracted instructions were overall longer than the fluent ones, with hesitant pauses.

Experiment 1. In the fluent condition, we found the expected effect of acoustic prominence: reduced targets led to faster given target looks, while prominent targets led to faster new target looks. By contrast, the distracted condition yielded little effect of acoustic prominence. Instead, distracted-sounding speech worked like other disfluency cues, and led to a new-target bias. In Experiment 2 we acoustically manipulated the fluent target words to create distracted targets that were longer but matched for pitch. Preliminary results show a similar pattern as in Exp. 1.

These findings demonstrate the ambiguity inherent in prosodic cues, which can signal either discourse status or speech difficulty. Listeners are sensitive to both functions.

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Visual Search for Objects is Influenced by Phonologically-Mediated Visual Information

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Keywords: visual search; naming; phonological codes; visual representations; homophones; automaticity

We examined the claim that seeing an object results in the rapid and automatic activation of its name. The strongest evidence supporting this idea comes from a visual-search study by Meyer et al. (2007). They found that visual search for a target object (e.g., a picture of a flower) was slowed down by the presence of a homophonous though visually distinct competitor (e.g., a picture of flour).

In Experiment 1, we replicated Meyer et al.'s experiment. Participants saw a search target, followed by a fixation dot (each presented for one second), followed by a visual display including four objects. Their task was to report whether or not the visual display included the search target. Following Meyer et al., we examined if the presence of a competitor picture, which was either semantically related to the target (e.g., target: hand, competitor: foot) or homophonous with the target (e.g., target: flower, competitor: flour), affected search times. Throughout the experiment, the target was present on half the trials. The competitor was present on half of those trials, and on half of the trials on which the target was absent. We focus on the results obtained in the homophone condition. When the search display included the target, the homophone competitor did not significantly affect RTs. When the search display did not include the target, the homophone competitor slowed down RTs significantly, by 16 ms. Meyer et al. hypothesized that this latter result is due to the rapid activation of the names of the objects in the search array.

In Experiment 2, we explored an alternative account for the homophone effect. According to this view, upon seeing the search target, participants activate its name, which then results in the activation of visual information associated with that phonological form (thus, visual information associated with the target, and visual information associated with objects with the same name). Thus, the presence of a competitor that is visually similar to an object whose name is homophonous with the target should slow down search times. We tested this prediction by replacing homophonous competitors with visually similar objects. For instance, if the search target was a flower, the competitor was a (clearly identifiable) pillow, which is visually similar to a bag of flour. When the search display included the target, the visual competitor slowed down RTs significantly, by 17 ms.

Our results suggest that performance in this type of visual search task is affected by phonologically-mediated visual information. These effects might arise because memory demands encourage subjects to phonologically code the search target.

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Can Listeners Use Creaky Voice to Constrain Lexical Interpretation?

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Keywords: creaky voice; speech perception; eye-tracking; perceptual adaptation; indexical features

Creaky voice is a form of phonation in which the vocal folds vibrate irregularly. It has recently gained media attention as an example of language change initiated by young American English-speaking women. The phenomenon is prevalent among this group and is sometimes used to express disinterest.

While listeners store information about whether a particular talker generally uses creaky voice (Bohm & Shattuck-Hufnagel, 2009), it is unclear whether this knowledge is tied to the specific lexical or phonemic contexts in which that talker typically creaks. Listeners do store information about the contexts of phonological processes, such as which phoneme contexts are affected by a vowel shift in a regional accent (Dahan, Drucker, & Scarborough, 2008). However, in English, creaky voice is never a contrastive feature—that is—creaky voice is not used to distinguish between phonemes. Because creakiness is non-contrastive, while listeners may notice that some talkers creak more than others, that information might not be used to constrain speech perception because listeners do not encode the contexts of use.

To test whether listeners learn and use context-specific information about creaky voice, participants (n=48) completed an eye-tracking task in which they listened to naturally-produced recordings of a female American English speaker. Creaky voice was manipulated between-subjects: The talker either <u>never</u> used creaky voice, or consistently used it <u>only</u> on words ending in –ag (e.g., *bag;* see Dahan et al. for evidence listeners learn accents in which this vowel is raised). On critical trials, participants viewed objects representing four words: an -ag word, an -ack word with the same onset (e.g., *bag* and *back*), and two unrelated fillers (e.g., *wig, wick*). On each trial, participants heard the speaker say "*Click on*," followed by the target word.

Predictions

If participants in the creaky condition learn the specific context of the creaky vowel, on –ack-target trials, they should consider that the –ag-word would have been produced with a creaky vowel, and thus be able to rule out the –ag competitor more easily than participants in the no-creak condition. Likewise, on –ag-target trials, they should be better able to rule out the –ack competitor.

Results

Target advantage scores (target minus competitor) were calculated across two time windows (200-1000ms and 1000-1800ms after word onset). On –ack trials there was a significant time-by-creak interaction: Despite a baseline preference to fixate the –ag-word competitor, during the late time window, participants in the creaky condition fixated the target more than participants in the no-creak condition ($p<.05$). A qualitatively similar, albeit smaller, effect was found on –ag trials ($p=.05$).

Conclusions

In conclusion, creaky voice is an acoustic process that listeners track in a context-specific manner and use to guide spoken word recognition. These results extend previous findings that listeners can make use of 2nd-order constraints in the phonological processes of a regional accent (Dahan et al., 2008) to non-contrastive acoustic processes more typically associated with social devices of young females. More generally, they demonstrate that listeners encode and use speech information that is not integral to word identification per se.

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Are pitch accent patterns necessary for lexical access by native Japanese speakers?

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Japanese pitch accents

Japanese pitch accent patterns are assumed to be an attribute of lexical items (Sugito & Tahara, 1989; Vance, 2010). However, regional differences in pitch accent are abundant. Accents in the Osaka region often show pitch reversal compared to, for instance, the Tokyo-standard accent such as: 'a hat' /boosi-ga/ LHHH (H=high pitch, L=low pitch) in Tokyo versus HLLL in Osaka. Therefore, Japanese pitch accents may not be a very reliable cue for lexical access during spoken word recognition. The present study, employing both behavioral and electroencephalographic measures, investigated whether native Japanese speakers necessarily activate pitch accent when accessing the concept of a lexical item when processing accent-contrasted homophonic pairs (e.g., *ame* [LH] for 'candy' and *ame* [HL] for 'rain').

Method

Nineteen right-handed native Japanese speakers living in the Aichi-region (central part of Japan) participated in the study. All participants were familiar with Tokyo standard pitch accent. Forty-eight paired sentences across three conditions were prepared; (1) sentences with correctly-accented target words (Tokyo-standard accent) as in *Kodomo-ni mainityi ame wo katte ageteiru* (Everyday [I] buy candy for children.), (2) the same sentences with incorrectly-accented target words which have different meanings. For example, *ame* [HL] 'candy' becomes *ame* [LH] 'rain', and (3) the same sentences with semantically-incompatible words (e.g., *eki* 'station'). In addition, 48 filler sentences were added (to avoid awareness of the experimental manipulation), totaling 48 × 4 = 192 items. All sentences were auditorily presented. One second after sentence presentation, participants were asked to judge whether or not the sentence was correct. The event-related potential (ERP) triggers were locked to the initiation of a critical target word embedded in an auditorily-presented sentence.

Results

Judgment accuracy was 97.0% for correctly rejecting sentences with semantically-incompatible words, 92.5% for correctly accepting sentences with correctly-accented words, and 87.7% for correctly rejecting sentences with incorrectly-accented words. A LME (linear mixed effect) model analysis showed a significant main effect [$F(2, 4128)=37.220$, $p<.001$]. Multiple comparisons showed that the incorrect pitch accent condition was more difficult than the other two conditions. Although native Japanese speakers showed very high accuracy rates across the three conditions, they had difficulty rejecting incorrectly-accented words. Nevertheless, the N400 amplitude was found to differ between semantically-incompatible items and correct/incorrect-pitch accented items. No other ERP components were found. The N400 denotes an ERP component indicating sensitivity to the meaning of a word which is integrated into the surrounding context. In the present study, the N400 amplitude was found only in the sentences with semantically-incompatible words against both correctly- and incorrectly accented words. Although there is evidence that native Japanese speakers may use pitch-accent during lexical access (e.g. Cutler and Otake, 1999), the result of the present study did not find electrophysiological evidence (i.e., N400) for the involvement of pitch accent when processing incorrectly accented words during sentence comprehension. The lower accuracy rate of incorrectly-accented words (87.7%) against the correctly-accented words (92.5%) may indicate that a pitch accent could be activated after lexical access and even after sentential understanding.

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Are DOOR and DEER completely unrelated words?
ERP evidence from a perceptual matching task with overlapping consonants

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Keywords: visual word recognition; subset priming; consonants; N2/P3 complex.

Letter identity coding and letter position coding are two key steps for efficient visual word recognition, and decades of research have demonstrated the amazing tolerance of the reading system to minimal identity or position variations. For instance, nonwords created by transposing two internal letters from a real word (e.g., cholocate from chocolate) are often perceived as their base words. Also, nonwords that share with real words all their consonants (e.g., perte from party) effectively activate the corresponding lexical representations of the latter. The bulk of evidence supporting this tolerance of the word recognition system to disruptions in the information provided by the letters' positions and identities suggests that the orthographic code is cracked into minimal pieces of information that are accessed at an abstract level allowing for certain location variance. The present study explores whether or not two explicitly presented words that share the same consonants in the same position but that differ in their vowels (e.g., the Spanish words "ducha" and "dicho", meaning "shower" and "saying") effectively activate each other more than two word pairs that do not share their consonants (e.g., "ducha" and "vello", meaning "hair"). Furthermore, the lexical status of the items was also manipulated, testing whether or not a nonword that shares with a word all its consonants produces a different pattern of target activation (e.g., the nonword "dochi" and the word "ducha"). We recorded participants' electrophysiological responses while they performed an explicit perceptual matching task (same-different judgment). Word and nonword targets were presented preceded by a referent word that could either share all the consonants at the same position or have no letters in common. Similar effects were obtained for both types of targets (words and nonwords), starting at 200ms post-target onset. In a negative-going deflection found between 200 and 300ms (characterized as a N2 component) and in a positive-going deflection found between 325 and 550ms (P3 component), related referent-target pairs significantly differed from unrelated pairs. Critically, the lexicality of the items did not modulate the effects in any specific manner. Considering preceding evidence on the cognitive basis of the N2-P3 complex, the present data suggest that targets containing the same consonants included in the references are processed as being highly similar to them. Furthermore, these data speak for a certain degree of independence between letter identification processes and lexicality effects.

Infants' Ability to Perceive Codas: ERP Evidence

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Keywords: infants, MMN, coda perception, ERPs, CPS

When infants produce their first words, they often omit target coda consonants from their productions, such as [kæ] for *cat* (Fikkert, 1994). These errors could result from an initial constraint to produce any codas. However, recent research on infant perception abilities suggest that infants already experience difficulty in perceiving codas correctly at the word level. For instance, Levelt (*Cognition*, 2012) showed that when 14-month-olds were taught a novel word, they noticed when a consonant was added to the coda (/pat/ instead of /pa/), but not when the coda was omitted (/pa:/ instead of /pa:t/). The insensitivity to coda omission together with the sensitivity to coda addition suggests that infants this young were at least able to perceive codas at some level, but are not yet able to encode them lexically.

The present study aims to further explore whether coda omissions in production are due to a failure to perceive codas correctly by testing coda perception at a lower level of speech perception, namely at the phonetic/surface level. We tested 18 14-month-olds (8 females) with an oddball paradigm that peeks into earlier stages of language processing, using Event-related potentials (ERPs). Infants listened to a series of different tokens of the same monosyllabic non-word while occasionally a deviant non-word is presented. The difference between standard and deviant was the presence or absence of a coda in an otherwise identical syllable, such as /ba:/ and /ba:t/ (both non-words). Both directions of change were tested. Crucially, our experiment is not a word-learning task but a pure acoustic task, since word learning in infants this young could negatively affect their pure acoustic discrimination skills. We also tested adults (n = 16, 9 females) for comparison with children.

The adult study showed that the deviant with coda addition elicits a mismatch negativity (MMN) time-locked to end of vowel: Adults clearly noticed an acoustic change from /ba:/ to /ba:t/. Adults also detected the change involving a coda deletion (from /ba:t/ to /ba:/), although here it was the ERP waveform to the standard syllable (/ba:/) that was informative of the change detection: The ERP to standard /ba:/ elicited a slow positive drift (a Closure Positive Shift (CPS)*)* indicating processing of expected silence, while the ERP to deviant /ba:/ did not elicit a MMN, but a delayed CPS. The latter finding reveals that the brain was anticipating the coda /t/. Results from the infant study show similar patterns: Infants' brains show a MMN when codas are added, so infants can detect this acoustic change. When codas are omitted, infant ERPs show a delayed CPS for the deviant /ba:/, revealing that infants, too, are anticipating the coda. Together, these results show that developing infants do not have difficulty perceiving codas acoustically, but that errors in coda perception probably stem from a failure to storing codas correctly into the mental lexicon.

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Early but not so Early Detection of Word Class Violations

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Keywords: eLAN; Left-anterior Negativity; Word Class Violations; Syntax-first Models.

Friederici (2002) argued that the syntactic structure building takes place at a very early stage of processing during sentence comprehension. This is based on a very early ERP effect with latency around 150 ms elicited by word-class violations (eLAN: early left-anterior negativity). According to syntax-first models, at this stage the cognitive system should exclusively exploit word class information of the word. Only at a second stage, after lexical access completion, thematic role assignment and agreement checking can take place.

   Later studies carried out in different laboratories failed to consistently replicate such early effects for word- class violations, and several interpretative and methodological problems have been pointed out (e.g. Steinhauer, 2011). One point is that the eLAN could be due to difference in the processing of the previous word (spill-over effect), because in most of the studies reporting an eLAN the word before the violation varied systematically across conditions. Italian, which allows both Noun-Adjective and Adjective-Noun orders in noun phrases, enabled us to develop a paradigm that overcomes this methodological limitation. As shown in (1) a word-class violation (no preposition is grammatical in 1.b after the adjective) is realized by removing the noun preceding the adjective. The word preceding the critical word is exactly the same across conditions.

   (1)
a. Il   presidente ha   promesso un premio importante <u>a</u>   tutta la   squadra.
   The president has promised a   bonus important <u>to</u> the whole team.
   The president has promised an important bonus <u>to</u> whole the team.

b. * Il   presidente ha   promesso un   importante <u>a</u> tutta la   squadra.
    * *The president   has promised an   important <u>to</u> the whole team.*
    * The president has promised an important <u>to</u> whole the team.

   A total of 104 sentences, in the conditions (1.a) and (1.b) counterbalanced across subjects, were presented word by word on a computer screen. Every word was displayed for 300 ms and followed by a 300ms blank display. Participants (35 native right-handed Italian speakers) were asked to silently read the sentences and judge their grammaticality. The electroencephalogram was recorded during the whole experimental session.

   The comparison of ERPs elicited by the critical words (underlined in 1) revealed a left-lateralized negativity significant in the interval 300-350ms after the stimulus onset, followed by a positive component emerging at about 500ms (P600) for (1.b) with respect to (1.a). Although the latency of the negative component was relatively shorter than that of the classic LAN elicited by agreement violations that typically emerge in the interval 350-450ms, the effect was clearly at a later stage than what predicted by Friederici's model (eLAN at about 150ms).

   Despite the lack of replicability of the eLAN, the early LAN latency for word-class violations leaves open the discussion about serial stages of syntactic processing.

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Behavioral and Neural Correlates of Deictic Reference

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Keywords: Deixis; ERP; Demonstratives; Dutch; Turkish

Establishing triadic joint attention on a referent is a very basic human communicative ability. People generally use deictic speech (e.g., demonstratives such as *this* and *that*) and gesture (e.g., pointing) to do so. Despite large scale cross-linguistic descriptions of demonstrative systems (Diessel, 1999), the mechanisms underlying the production and comprehension of such referential acts are not well understood. Therefore, we tested the factors that influence how people use demonstratives in triadic situations across two different languages (Dutch and Turkish) based on previous descriptive work (Experiment 1), and the neural mechanisms underlying the comprehension of multimodal deictic reference in Dutch (Experiment 2).

In Experiment 1, twenty-nine Turkish and twenty-four Dutch participants were presented with pictures including a speaker, an addressee, and an object (the referent). They noted which demonstrative they would use in the depicted situations. The distance of the referent and the addressee's focus of visual attention on the object were systematically manipulated in the pictures. In Turkish, both the referent's distance and the addressee's attention influenced demonstrative choice. In Dutch, on the other hand, demonstratives were used only on the basis of the distance of the referent.

In Experiment 2 we exploited the finding that in Dutch, demonstratives were used on the basis of distance. Twenty-three Dutch participants saw pictures containing a speaker and two similar objects. One of the objects was close to the speaker, whereas the other was either distal from the speaker but optically close to the participant ("vertical orientation"), or distal from both ("horizontal orientation"). The speaker pointed to one of the objects, and participants heard sentences spoken by the speaker containing a demonstrative that could be congruent or incongruent (e.g., a proximal or distal demonstrative for an object close to the speaker). Also, we manipulated whether the speaker referred to the object using a correct label or not ("semantic violation"). EEG was recorded to investigate the neural mechanisms and time-course underlying the comprehension of multimodal reference.

Interestingly, the incongruent use of a demonstrative influenced comprehension only in the vertical orientation. When the speaker referred to the object close to herself, such a violation led to a negative deflection, significant 200-600 ms after demonstrative onset. This effect had a time-course and scalp distribution similar to the N400 effect we found for the semantic violation. In contrast, when the speaker referred to the object close to the participant, incongruent demonstrative use led to an early, positive effect, significant 100-300 ms after demonstrative onset. Thus, the comprehension of multimodal referential acts depends not only on the referent's location from a speaker's point of view, but also from the addressee's perspective.

In sum, our findings show that in different languages both similar and different factors play a role in how people produce demonstratives in context. Furthermore, the brain's sensitivity to different spatial properties (i.e., the addressee's perspective, the orientation of objects) reveals new insights about the processes underlying demonstrative reference.

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Can L2 speakers acquire lexically-specific syntactic restrictions?

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Keywords: adult L2 knowledge; lexically-specific syntactic restrictions; structural priming; ungrammatical sentences.

Are second language (L2) speakers able to master lexically-specific syntactic restrictions in English? A response to this question might be informative about how such restrictions are acquired and represented by both first language (L1) and L2 speakers. We investigated this issue in a structural priming experiment, observing whether highly-proficient L2 speakers can be primed to produce ungrammatical double object (DO) dative constructions with non-alternating verbs such as *donate* (1), which allow only prepositional object (PO) structures.

Previously, we found that L1 English speakers are primed to produce such sentences by the same type of ungrammatical prime sentences with the same verb as the targets (2), but not by well-formed DO sentences with alternating verbs (which allow both constructions; (3)). This exclusively lexically-induced persistence in L1 speakers implies that lexically-specific restrictions for these speakers cannot be overridden in production by the activation of abstract syntactic structure. It is unclear, however, whether L2 English speakers whose L1 lacks the DO construction would be sensitive to the fine-grained lexically-specific syntactic restrictions for non-alternating verbs in English.

The participants were 28 native speakers of Romance languages (Spanish = 16, Romanian = 5, French = 3, Italian = 2 and Portuguese = 2; mean age 25 years), who were highly-proficient in English. Participants described in English dative-eliciting pictures (containing two animate and one inanimate entities and a written verb (4)) after reading dative primes in a PO or DO version. Prime verbs were of two types: alternating (*give*), and non-alternating (*donate*). All target verbs were non-alternating, and were always the same as the verbs in the non-alternating prime verb condition.

L2 participants were primed to produce ungrammatical DO constructions with non-alternating verbs both by the same type of prime sentences with the same verb as the target (19%, p = .001), and marginally so by grammatical primes with alternating verbs (4%, p = .052); cf. with the effects previously obtained with L1 speakers: 9% and 1%, respectively (group differences p < .01 and p = .14, respectively). Furthermore, L2 speakers produced more DOs with non-alternating verbs (10%) than L1 speakers (3%) overall (p < .01), and also more ungrammatical DOs (6%) in the alternating prime verb condition than L1 speakers (0.5%; p < .05).

These findings indicate that L2 speakers whose native language lacks the DO construction have partially acquired the relevant fine-grained lexically-specific syntactic restrictions of non-alternating verbs in English; however, their knowledge is not native-like. These results are consistent with theories of sentence production linked to language learning (Chang, 2002), and with accounts whereby the lexically-specific syntactic restrictions of non-alternating verbs are acquired on the basis of evidence for the difference in the frequency of occurrence of the correct (PO) and incorrect (DO) alternatives: L2 speakers have had less exposure to English, and therefore have less evidence for the relevant difference than L1 speakers.

1)   The waitress donates the soldier the banana.
2)   The nun donates the boxer the ball.
3)   The nun gives the boxer the ball.
4)   WAITRESS, SOLDIER, BANANA; DONATE

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Syntactic Representations in Bilinguals: The Role of Word Order in Cross-linguistic Priming

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Keywords: Syntactic priming; bilingualism; word order; language production; syntactic representation.

Abstract

A central question in bilingualism research is whether syntactic information is shared between two languages or stored separately for each language. Monolingual priming studies show that exposure to a particular structure in one sentence (e.g., prepositional object dative [PO], 1a) influences use of the same structure in the next sentence, as compared to a different structure with identical propositional content (e.g., double object dative [DO], 1b) (Bock, 1986). Similar studies with bilinguals show that priming can also occur cross-linguistically (e.g. Loebell & Bock, 2003), thus indicating that syntactic representations are shared across languages to at least some degree.

In order to further investigate the shared-representations hypothesis, we examined cross-linguistic priming of the dative alternation from German to English. In both languages, the dative can be expressed using two alternate structures: PO (1a), DO (1b). Importantly, these structures share the same word order cross-linguistically in the main clause but not in the subordinate clause (1c, 1d). Although previous studies have looked at the effect of word order on cross-linguistic priming, no previous study has investigated German-English cross-linguistic priming effects for PO/DO structures.

Twenty-nine advanced German (L1) learners of English (L2) participated in an on-line sentence completion task with German primes and English targets (1-3).

(1)   Primes:
         a. Main Clause, PO: Der Botschafter sandte einen Brief an den Präsidenten.
                 'The ambassador sent a letter to the president.'
         b. Main Clause, DO: Der Botschafter sandte dem Präsidenten einen Brief.
                 'The ambassador sent the president a letter.'
         c. Subordinate Clause, PO: Der Autor erzählte, dass der Botschafter einen Brief an den Präsidenten sandte.
                 'The author said that the ambassador sent a letter to the president.'
         d. Subordinate Clause, DO: Der Autor erzählte, dass der Botschafter dem Präsidenten einen Brief sandte.
                 'The author said that the ambassador sent the president a letter.'

(2)   Target, Main Clause: The patient sent _____.
(3)   Target, Subordinate Clause: The doctor thought that the patient sent _____.

On the basis of previous evidence showing strong cross-linguistic priming effects when word order is repeated (e.g. Loebell & Bock, 2003), but no priming with different word orders, we predicted cross-linguistic priming in the main clauses, and no priming in subordinates (i.e., different word order between L1 and L2).

Our results showed PO and DO priming from L1 (German) to L2 (English) in the main clause condition. There was no effect of priming, however, in subordinate clauses. This suggests that word order is a very relevant factor in how languages influence each other, and that abstract structural similarity is not enough to facilitate shared syntactic representations.

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The role of dynamic pragmatics in negation processing

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Keywords: Negation, semantics, pragmatics, verification.

In this paper we demonstrate how dynamic pragmatics can allow us to re-interpret key previous work on negation processing. In dynamic approaches, meaning affects the update of a context (or 'common ground'), which includes information on the utterance's purpose, commonly described in terms of Questions Under Discussion (QUDs), (see Ginzburg 2012 for a recent overview). A key to understanding many previous studies is the idea that without further context, participants accommodate the most likely QUD. In previously published research, we have shown that for simple negatives like (1a) presented without context, participants accommodate the simple polar question, (2a). Here we present evidence for a dynamic re-interpretation of the often reported polarity/truth-value interaction in verification studies (e.g. Clark & Chase 1972) where RTs have the pattern: TA<FA<FN<TN, where items like (1a,b) would be verified/falsified against images of *raw* or *cooked spaghetti*. We argue this pattern is the result of a participant strategy born of the interference of the common positive QUD, (2a) for the negative sentence (1a), while the task QUD is (2b). If participants work with the task QUD directly, then we should expect main effect of polarity and truth-value. The alternative strategy is to answer the simpler QUD and then, for negative sentences, reverse the polarity of that answer to do the task. We note that the interaction pattern is found in classic studies where long training blocks precede a lengthy, repetitive testing phase. In our baseline study involving 56 trials and no training block, participants respond to a single image, confirming or disconfirming sentences like (1a,b). The interactive pattern only emerged in the second half of the experiment. With a second group we used an image of two cookable objects, one of which is cooked or not (e.g. raw or cooked spaghetti and raw or cooked potato) plus clefted fillers (1c,d). In this condition we thus bias a different QUD, (2c) that does not interfere with the verification task. As such we predict no strategy formation and a main effect only. A 2(polarity)*2(truth-value)*2(QUD)*2(half) ANOVA yielded the predicted four-way interaction ($Fs>4.23$, $ps=0.04$). In the baseline study, when QUD interferes, a marginal 3-way interaction was found (**F**s>3.49, $ps=0.069$), while no interaction was found in the two image condition when QUD does not interfere.

1. a. The spaghetti is not cooked
   b. The spaghetti is cooked
   c. It is the spaghetti that is not cooked
   d. It is the spaghetti that is cooked

2. a. Is the spaghetti cooked?
   b. Is it true that the spaghetti is not cooked?
   c. Which one is not cooked?

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Syntactic Effects on Compensation for Assimilation

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Keywords: compensation for assimilation; top-down effects; speech perception; syntax.

Background

Compensation for assimilation is an important mechanism for making sense of the speech stream as words are often distorted due to coarticulation and/or phonological assimilation across word boundaries. There has been a debate as to whether these effects can be explained purely in terms of bottom up processes as in autonomous models, or whether top-down information from the lexicon plays a role as in interactive models (e.g., Samuel & Pitt, 2003).

This paper presents a series of experiments that test for a novel top-down effect on speech perception during sentence processing. Assimilation is more likely across weaker prosodic boundaries than across stronger ones (Holst & Nolan, 1996), and the strength of boundaries in turn depends on syntactic constituent structure. We test whether syntactic information alone can influence compensation.

Methods and Results

To answer this question, we created stimuli involving nonce words with a fricative taken from a 6-step continuum from [s] to [sh], in 8 different target sentences with two syntactic conditions:

A. Intransitive
  If you fra[s/sh], Sheila will be upset.
B. Transitive
  If you fra[s/sh] Sheila, Jim will be upset.

To remove any effects of prosody, sentences were acoustically identical (except for the spliced-in fricatives) up to the end of the context word (i.e., "If you fra[s/sh] Sheila"), and completions were spliced in (here, "will be upset" or "Jim will be upset"). Listeners chose between /frass/ or /frash/, and rated the naturalness of the utterance. An effect of syntax predicts more compensation for assimilation (more [s] responses) in the transitive condition where more assimilation is expected. 16 speakers of North American English participated in each experiment. We used mixed model logistic regressions to analyze the results.

Participants of Exp1 saw all stimuli in pseudo-randomized order with fillers. No effect of syntax on the perception of the nonce word was found, but there was a significant interaction between syntax and the naturalness rating. Assimilated [s] tended to be rated as more odd in the intransitive condition but unassimilated [s] in the transitive condition. This may be because there is no online syntactic effect on the initial perception of the nonce word, but the degree of assimilation is in turn used as a cue for syntax. Thus participants garden path-ed when the two did not match.

In Exp1, syntactic information may not have shown an effect on initial perception simply because it becomes available too late. We tested this hypothesis with two additional experiments. In Exp2 the syntactic manipulation was a between-subjects-factor and all trials were transitive or intransitive. In Exp3 participants saw each sentence (without the critical fricative) before hearing it. Both experiments showed a significant effect of syntax.

Conclusions

In sum: Our results show that syntactic information can influence compensation for assimilation in sentence processing, but only if the information is made available early enough for it to exert an effect; otherwise, degree of assimilation may in turn serve as a cue for syntax. We discuss these results vis-à-vis autonomous vs. interactive models.

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Comprehension of Anaphora and Cataphora in Italian: Comparing Null and Overt Pronouns

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Pronoun interpretation is central for comprehension. Prior work focused mostly on anaphora, where pronounsrefer to previously-mentionedantecedents (ex.1a). Less research is on cataphora, where the antecedent followsthe pronoun (ex.1b). Existing work (van Gompel&Liversedge, 2003, Kazanina et al, 2007) suggests cataphora triggersan active-search mechanism: The parser actively searches for a syntactically-licensed antecedent.

Exp#1: (1a) Maria hugs Rita, while {she/NULL} is talking about the trip. [Main+Subordinate_clause_with_anaphor]
         (1b) While {she/NULL} is talking about the trip, Maria hugs Rita. [Subordinate_clause_with_cataphor+Main]

   We investigated anaphora/cataphora in Italian, which has both null and overt pronouns (ex.1), allowing us totest how linguistic/form-specific referential biases interact with processing biases, such as the active-searcheffect. We also strive to clarify what the form-specific biases are: Existing findings are mixed. For anaphora,Carminati (2002) found nulls prefer subjects, contra Belletti et al. (2007). For cataphora, Serratrice (2007), Belletti et al. (2007)also obtained conflicting results.

   We conducted two questionnaire studies manipulating clause-order (anaphora/cataphora) and pronoun-type (null/overt),while controlling plausibility and discourse-coherence. Targetshad two possible referents, both plausible antecedents. Furthermore, to investigate syntactic-effects (Binding),we manipulated pronoun location (Exp#1=subordinateclause, ex.(1a,b); Exp#2=mainclause, ex.(2a,b)).Participants (n=24/exp) read sentences and answered questions probing pronoun interpretation (e.g.,Who istalking about the trip? Maria/Rita/Could_be_either/Someoneelse).

Exp#2: (2a) While Maria hugs Rita, {she/NULL} is talking about the trip. [Subordinate+Main_clause_with_anaphor]
(2b) {She/NULL} is talking about the trip, while Maria hugs Rita. [Main_clause_with_cataphor+Subordinate]

Results: Exp#1

Nullsprefer subjects in both configurations, but this preference is weaker in the anaphoraconfiguration (Anaphora: 78% subject-choices, 14.5% object-choices; Cataphora: 84% subject-choices, 3.1% object-choices;more object-choices with anaphora, p's<.05). Overt pronouns prefer objects in anaphora configurations (76% object-choices),but in cataphora conditions, we find a split between subject/object/someone-else (33.3%/37%/28.1%, p's<.05). Thus, anasymmetry emerges: The subject bias of nulls is clearer in cataphoraconditions, whereas the object preference of overtpronouns is clearer in anaphoraconditions. We attribute this to the processingload associated with holding a (cataphoric)pronoun unresolved in memory: Assuming the 'impatient' parser actively searches (vanGompel&Liversedge, 2003) for a potential antecedent to "discharge" an unresolved (null/overt) pronoun as quicklyas possible, we found cataphora configurations to show a boost in subject-choices, since subjects linearlyprecede objects.Exp#1 suggests processing biases minimizing unresolved dependencies affect both null and overt and 'ignore'distinctions in referential form. Exp#2 (pronoun=main-clause) tested whether these biases also ignore/overridesyntacticfactors (Binding Theory).

Results:Exp#2

Unlike Exp1, the nulls'subject bias (79%) and overt pronouns' object bias (61%) are both clearer inthe anaphoracondition —in fact, these biases disappear in the cataphor condition, where both show an equally-strongpreference for 'someone-else' (null: 92.7%%% someone-else, overt: 95.8% someone-else), with only 3.1%subject-choices in both. This suggests Binding constraints arepowerful enough (cf.Kazanina et al., 2007) toprevent effects of the 'impatient' processing bias from surfacing in final interpretations.

   Null and overt pronouns have distinct referential biases. However, the anaphor/cataphor distinction plays a keyrole:Encountering the pronounbefore the potential referents strengthens nulls' subject-bias and weakens the overts' object-bias, a consequence of the incrementality of language processing.

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Orthographic and phonological priming during sentence reading

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Keywords: priming in text reading; eye-tracking; English

Paterson, Liversedge, and Davis (2009) showed inhibitory priming effects for a word when preceded by a word's orthographic neighbour: *blue* was fixated for longer when *blur* appeared in the immediate prior context compared to the control word *gasp*: *There was a blur [gasp] when the blue lights...* This is an important finding as it suggests that (sub)lexical competition and/or suppression effects, which have mainly been attested in single word recognition tasks, can also be found during normal reading.

Following Coltheart et al. (1977), Paterson et al. defined orthographic neighbours as words that differed from each other by one letter, irrespective of other attributes (e.g., phonological overlap). In Experiment 1 (N = 28), we tested whether all types of overlap lead to inhibitory priming effects. We distinguished 4 types, with 32 items per type:
(1) O+P+: Orthographic + phonological overlap (rhyming):
    The birds ruffled their **wings** [*tails*] as the **kings** watched from their palace.
(2) O+P+: Orthographic + phonological overlap (non-rhyming):
    The captain found it a **strain** [*burden*] to negotiate the **strait** at the end of a long voyage.
(3) O+P-: Orthographic-only overlap:
    On noticing the giant **bear** [*tree*] John changed **gear** and pedalled away quickly.
(4) O-P+: Phonological-only overlap:
    The husband had a big **smile** [*fight*] walking down the **aisle** of the local supermarket.
Results showed that only O+P+ overlap resulted in inhibition (with the rhyming condition showing an immediate inhibition effect on the target word and the non-rhyming condition on the spillover region). No inhibitory or facilitatory priming effects were found on any eye-tracking measure for the O+P- or the O-P+ overlap conditions. The lack of an effect for the O+P- and the O-P+ conditions suggests that the activation of pure orthographic or phonological neighbours does not suppress or compete with the recognition of the target word.

Experiment 2 (N=60) examined whether the inhibition effect reduces when the distance between the prime and target word increases. This was indeed the case, with inhibition found only for the "short" condition (prime and target separated by 3 words on average) but not for the "long" conditions (prime and target separated by 9 words on average, and prime and target either in 1 or 2 separate sentences). However, a significant correlation was found for the long 1-sentence condition between the Gray Silent Reading scores, which tests the level of reading comprehension, and the inhibition difference scores, with greater inhibition for the good readers. This suggests that good readers keep orthographic neighbours active for longer (or can better reactivate their episodic memory trace), and that they discard this activation at the end of the sentence.

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Dynamic Representations of Speed in Sentence Processing

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Keywords: spatial representation; motion events; speed, verb semantics; mental simulation; eye movements

It has been increasingly argued that meaning in language is rooted in our perceptuomotor experience (Barsalou, 2008), and that language comprehension can lead to experiential "simulations" (Zwaan, 2004). In understanding the linguistic description of motion events, listeners need to make various inferences such as the locations of entities, along with paths and manners of motion. One such inference is the speed at which an entity moves. We used an eye tracking visual-world paradigm to assess simulations (Coventry, et al., 2010), investigating how speed information signalled by verb semantics would influence visual attention to a scene. In addition, we looked at how speed-associated inferences influenced movement time in a mouse tracking task.

A norming study was conducted to help select 18 "fast" and 18 "slow" verbs that were rated to differ in speed and be appropriate as verbs describing agentive movement. Then, these verbs were used in sentences to describe events in visual-world scenes which featured an agent moving along a depicted path to a goal location on the other side of the screen. An example sentence is "*The soldier will RACE/CREEP along the path to the castle.",* concurrently presented with a display depicting a soldier, castle, and road between them.

Eye movements were recorded as participants heard the spoken sentences whist looking at the matching scenes. Following the eye-tracking study, participants were again exposed to the pictures and sentences but after the sentence ended they used the mouse to move the agent, with instructions to focus on the end state of the movement event by moving the agent to where the sentence describes it will move to.

Our main prediction was that participants would spend more time looking along the path for the slow sentences compared with the fast sentences. We restricted our analysis to the mean total duration of fixations between the onset of the verb and offset of the object noun. We found a significant interaction between verb speed and scene regions. While there was no significant differences for the agent or background regions, as we predicted, participants spent more time looking along the path region for slow verb sentences compared with fast verbs. In addition, we found significantly greater looking times at the goal region for fast verb sentences consistent with a faster event leading to earlier arrival at the goal. The analysis of the mouse tracking study revealed significantly greater total movement time for the slow verb sentences compared with the fast verb sentence, indicating that the verb semantics influenced motor processing.

These results indicate that dynamic information associated with the inferred speed of a linguistically described motion event influence visual attention and motor execution in a way consistent with simulation-based accounts of language comprehension. These results further our understanding of the on-line processing involved in the understanding of motion events.

Linking Language and Space: Effects of Inferred Paths on Eye Movements in Motion Event Processing

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Recently, an increasing volume of research has explored how comprehenders process linguistic input describing motion events. In particular, the issue of the updating of spatial representations has attracted much attention in research that investigates the mapping between linguistic and visual stimuli (Altmann & Kamide, 2009; Richardson & Matlock, 2007). Such studies have implications for accounts claiming that language comprehension involves mental simulations of events described in the linguistic input (Barsalou, 1999; Glenberg, 1997).

In the present work, we look at how overt spatial attention is influenced by the paths implied in language describing movement events. The use of eye tracking allows us to demonstrate shifts in overt attention without the presence of a spatially biasing task, and reveal important information about the time course of spatial inferencing processes. In Experiment 1, we presented participants with visual-world scenes containing a novel 'alien' agent (to avoid agent-verb biases) on one side of a scene, a goal on the other, and an obstruction in the middle. Scenes were presented with spoken sentences in which the verb phrase described movement of the agent to the goal in a high path over the middle obstruction (1a), a lower path below the obstruction (1b), or no movement (1c):

1. Tiltock will (a) *jump into* (b) *creep into* (c) *think about* the sofa .
visual scene: 'Tiltock', sofa, television (obstruction)

Analysis of the mean Y-coordinate of fixations across time revealed that vertical verb biases emerged from verb offset. Regions Of Interest analysis also showed that, as early as during the verb, participants looked at the upper half of the obstruction region more often in (1a) than (1b) or (1c) (and for the lower half: (1b) > (1a), (1c)). Our intuitions about the implied paths in our stimuli were confirmed in a mouse-tracking task whereby participants moved the agents across the screen in accordance with events described by the spoken sentences.

In Experiment 2, we additionally included a condition with no middle obstruction in order to test whether effects were contingent on its presence (2x3 design). In an eye-tracking study we replicated the main results of Experiment 1 with 'obstruction' scenes. There were substantially fewer looks to the middle region than in Experiment 1 with 'no obstruction' scenes, presumably because in visual-world paradigms fixations tend to be primarily directed to objects rather than empty regions. While effects were weaker, however, we still found evidence that the verbs were able to bias attention upwards or downwards, even without the presence of an obstruction to constrain the path of the agent.

These results indicate that the paths implied by verb semantics modulate overt attention shifts, indicating rapid verb effects on updating spatial representations of moving objects. Our study helps to reveal the dynamics of mental simulations invoked in the course of understanding language.

Same Subject, Different Marking: Consequences of Case-Marking on Discourse and MemoryRepresentations

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Key words: DiscourseRepresentation; Memory Retrieval; Accessibility of Discourse Entities; Korean Topic-Marking

Linguisticstructures influence people's*expectations about upcoming discourse*and how well entities are *retrieved from memory*. For example, clefted/focused entities are more likely to become topics and are remembered better than unfocused entities(Birch et al.,2000), suggesting that discourse-and memory-representations are connected. Weexplored the relation between memory and discourse by looking beyond English clefting and investigatedhow Korean case-marking influences discourse expectation and memory. We manipulatedKorean sentential subjects, marked with the nominative case-marker (NOM, *–i/–ka*) or thecontrastive-topic marker(TOP, *–(n)un*).Nominative subjects (ex.1a) are interpreted as default topics(Han, 1998). Subjects marked with TOP can have different interpretations: regular-topic,contrastive-focus, and contrastive-topic. We investigated the **contrastive-topic** reading (enforced by context), where the subject is construed as contrasting with other discourse entities (ex.1b).

(1a/b)*John-**i/-un**Mary-lulsalanghanta*(John-**NOM/TOP**Mary-ACC love)
NOM: 'John loves Mary.'
TOP: 'As for John, he loves Mary.'Infers other discourse members love others. e.g., 'As for Peter, he loves Ann.'

Exp1--Story continuation. 24 Koreans read four-sentence stories (ex.2) and provided three continuation-sentences.

(2) *Exp1 item (English translation)*
Dr. Lee is a psychology professor at SeoulUniversity. She has {a few advisees}$_{set}$. Her students all have different research interests.[The student from *Busan*]-**NOM**/-**TOP** wants to do research on child psychology.

The first sentence of each target story introduced a *global topic* whom the story was about. The second sentence introduced a set that the global topic was associated with. The third sentence provided set member information. The fourth sentence introduced one set member (*local topic*), marked either with NOM or TOP. The subjects of continuation sentences were analyzed. In **NOM-conditions** (local topic=NOM-marked), the global topic was the most likely subject in all three continuation-sentences. However, in **TOP-conditions** (local topic=TOP-marked),*participants preferred to introducebrand-new set members*(*p*s<.04), e.g. a student from *Incheon*. Thus, contrastive TOPIC-marking (TOP-conditions) increasethe discourse prominence of *previously-unmentionedset members*.

Exp2--Probe-word recognition. To test whether*topic*-marking improvesrecall, 24 new participants read four-sentence stories, in which two subjects were either both NOM-marked or TOP-marked(ex.3).

(3) *Exp2 item (English translation)*
[A teacher-NOM]$_{SUB1}$ and [a reporter-NOM]$_{SUB2}$ stopped by a bookstore. The two-TOP wanted to buy new books as they have finished the books they were reading. **[The teacher-NOM/TOP]$_{SUB1}$**who likes novels finds Jiyoung Gong's new novel interesting. **[The reporter-NOM/TOP]$_{SUB2}$** who reads autobiographies a lot skims through Obama's autobiography.

After a 15-second delay, participants saw one of the subjects and indicated whether it had appeared in the story.The results showedrecency effects: SUBJECT2was recognized more accurately than SUBJECT1 (*p*s<.05). Strikingly, there was no significant difference in recognition latencies between NOM-marked and TOP-marked subjects.

SUMMARY: Our results suggest that topic-marking may have different effects on discourse expectations and memory retrieval. In a discourse-based sentence-continuation task, TOP-marking increases the prominence of entities associated with topic-marked subjects. However, the memory task showed that TOP-marking, compared to NOM-marking, doesnot increase memory retention of entities, suggesting a possible dissociation between discourse representations and memory representations.

Feel between the Lines: Implied Emotion from Combinatorial Language Processing

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Keywords: Combinatorial Semantics; Emotion; Inference; fMRI

During reading, people not only retrieve meaning from individual words, they also combine words into multi-word meaning representation and derive inference from it. In single word studies, action verb meaning (kick) is understood through the activation of motor areas, typically interpreted as showing the necessity of these sensorimotor regions as part of a semantic circuit for language comprehension (Pulvermüller & Fadiga, 2010). But it remains unclear how this association-based theory scales up to understanding sentence meaning and how the semantic circuit subserves inference making at the sentence level.

The current study asks how the brain supports the computation of implied meaning that cannot come from word associations and can only come from inference. In "*The boy fell asleep and never woke up again*", no word is negative by association, yet the sentence feels negative. Combinatorial theories of language would predict that such implied emotion meaning emerges from combinatorial processes, possibly occurring in the left inferior frontal gyrus (LIFG) (Semantic Unification Theory, Hagoort, 2005), and that the constructed, implied meaning leads to activation in the emotional network. In addition, the emotional network, if activated, may in turn excite the LIFG via re-entrant processes. In contrast, association-based theories would predict that understanding language meaning requires sensorimotor/emotion simulation cued by words, and that without emotional words these sentences would not activate the emotional network.

16 right-handed native-speakers participated in an event-related fMRI experiment. 120 negative and neutral sentences (e.g., *The secretary walked to the copy machine and picked up the printouts.*) were created, such that there was no emotional word in either type of sentences. The two types are matched in terms of animacy, concreteness, length, and structure. A pretest following Affective Norms in English Words (Bradley & Lang, 1999) was carried out. On a 1-10 scale (1=negative), negative sentences were rated 2.4, and neutral sentences, 5.2. During the scanning, participants silently read the sentences. Catch trials of nonsense sentences were inserted (25%) to ensure that participants read for comprehension. Participants' emotional network was localized by a localizer task using negative and neutral pictures from the International Affective Picture Systems (Lang & Bradley, 2008) after the main experiment.

The most prominent activation for negative>neural contrast was in amygdala (whole brain, p<.05, corrected), a crucial part of the emotional network. A region of interest (ROI) analysis of amygdala indicated that the negative>neutral contrast in sentences was left lateralized. Another ROI based on *a priori* semantic unification area (Inferior frontal pars orbitalis, ~BA47) showed more activation for negative sentences relative to neutral. In addition, the second most prominent activation for negative>neural contrast was in medial frontal cortex (whole brain, p<.05, corrected).

Thus, implied emotion from inference, not from word associations, activated emotional network and enhanced language areas, supporting combinatorial language theories. The left-lateralization of amygdala for implied emotion indicates that not all abstract, emotional meaning must be right lateralized. Finally, medial frontal cortex is typically related to mentalizing (Frith & Frith, 2006), suggesting a future direction linking (emotional) inference and mentalizing abilities.

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MTG involvement in differential activation of psych verb template

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Keywords: verbs of psychological state; MTG; fMRI; priming; argument structure.

Theoretical linguistics predicts that psych verbs are special with regard to the thematic roles and argument structure they associate with (Belletti & Rizzi, 1988). Psychological verbs can fall into several distinct syntactico-semantic classes within a given language (Levin, 1993), but they possess a common trait of not having an external Agent argument in their structure, but rather an internal Experiencer argument. Syntactically, the Subject of these verbs has to be derived by movement from the internal argument position to the external one.

Neurological correlates of linguistic distinctions between psych verbs and other verb classes have been elusive, although prior studies suggested a possibility that verb event structure templates, which account for syntactic-semantic differences between verb classes, might be represented in left pars opercularis (Kemmerer & Gonzalez-Castillo, 2008) or left posterior MTG (Shetreet, Friedmann, & Hadar, 2010). We report an fMRI experiment aimed at investigating the differences in the neural representation of event/argument in verbs of psychological state compared to action verbs.

This study used an explicit priming approach to elicit enhancement and suppression effects in the regions implicated in the processing of event structure. Prior priming studies have demonstrated that when verbs are primed by other verbs, the observed effects include semantic suppression (due to activation of the same semantics during priming), and/or thematic suppression (due to activation of similar event and argument structure template). The participants carried out a lexical decision task (word/non-word categorization of the target), while action verbs were primed by (1) other action verbs (e.g. RUN – WALK); or (2) verbs of psychological state (e.g. LEARN - COUGH). LSA similarity of the stimuli was 0.017(0.09) for action verb pairs, and 0.04 (0.05) for cognition-motion verb pairs; similarity judgment ratings were 3.15(0.93) for action verb pairs, and 1.2(0.28) for cognition-action pairs. We expected to see differential activation in the left posterior MTG or IFG between (1) and (2) due to differences in thematic roles (Agent vs. Experiencer) between motion verbs and verbs of psychological state. The activation for all conditions in this region was explored by extracting contrast estimates for each participant. Condition (2) elicited significantly stronger activation in MTG than condition (1) ($F(1, 18)=4.931$, $p<.039$, ep2=.215), due to signal suppression for Action verb pairs in the region.

These results suggest that the automatic activation of the verb structure template involves MTG. The finding narrows down the region of interest for investigating cortical representation of syntactically distinct classes in the semantic domain of psych verbs (Belletti & Rizzi, 1988).

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fMRI representation of topic and taxonomy in concrete and abstract concepts

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Keywords: concept; multivariate pattern analysis; fMRI; concrete; abstract.

Understanding the neural basis of concept representation is fundamental to cognitive science, relevant to linguistic disorders, and has implications for artificial intelligence. Multivariate pattern analyses of fMRI data have identified systematic differences between neural representations of concrete object categories (e.g. animals and tools). Neural representations have been interpreted in terms of our experience interacting with objects and the associated sensorimotor mechanisms activated. For instance the neural representation of violin might conjoin a violin's visual appearance, with the sound and motor programs associated with playing the instrument. Little is known of the structuring of abstract knowledge which is less easy to fit to a taxonomic genus-differentia model (e.g. is an instrument, has strings). Nonetheless taxonomic classification schemes encompassing abstract and concrete words have been devised (e.g. WordNet, DOLCE). An alternative organizational hypothesis is that concepts are arranged topically, in that they are linked to the scenario in which they occur. So, violin and rhythm might all be represented in a specialized music processing area.

To investigate the explanatory value of taxonomic and topical classification schemes to neural organisation we devised a test set of seventy words, 50% unambiguously relating to the topic *law*, the others *music*. The words were cross classified using seven taxonomic categories from WordNet. Abstract taxonomic classes were WordNet top level categories with high abstractness scores such as: *attribute* (e.g. illegality, melody); *communication* (e.g. accusation, song), *event* (e.g. trial, festival). Concrete classes were *tool* (e.g. truncheon, violin) and *location* (e.g. jail, auditorium). Words were presented visually in five sessions in a random order. Seven participants were instructed to imagine a situation associated with the word, when cued. Whole brain activity was measured once per second using a 4T Bruker MedSpec MRI Scanner. Data were preprocessed and a series of cross-validation analyses run, using a multivariate pattern classifier to probe taxonomic and topical organization.

- 'Leave one session out' cross-validation tested whether the classes could be decoded. Summing results across participants and analyzing according to Olivetti et al. (to appear), the posterior probability that (a) all taxonomic classes can be classified is .93 and (b) both topical classes can be distinguished is >.99.
- 'Leave one concept category out' cross-validation (e.g. training a taxonomic classifier with one topic left out and testing on that topic, *vice versa* for topical classification) tested whether decoding information in the left out test category overlaps the training category/categories. Summing results across participants and analyzing according to Olivetti et al. (to appear) the most likely taxonomic hypothesis is that tool and location are independent and all abstract classes conflate (posterior probability=.67). Topics can be distinguished (posterior probability>.99). This is in accordance with the suggestion that abstract taxonomic classes are represented within different topical processing areas.
- 'Leave one participant out' cross-validation tested for commonality in representation across participants. Analyzing according to Olivetti et al. (to appear) the most likely taxonomic hypotheses are that tool and location are independent and most/all abstract classes conflate (highest posterior probability=.1). Music and law can be classified across participants (posterior probability>.99).

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Passive listening and evaluation: Different processes of discourse comprehension

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Keywords: discourse comprehension; integration; language network; neurobiology of language; task difference; semantic processing

This research investigates the neural bases of two processes in discourse integration: passive comprehension (information assimilation during ordinary listening) and evaluation (deliberate assessment of a text portion with respect to prior context). Neuroimaging studies show that different linguistic tasks involve, at least partially, different functional networks (e.g., Ferstl & von Cramon, 2002). Behavioral research also shows that distal context is more often available during evaluation than passive comprehension, suggesting that these processing strategies impact the scope of integration (e.g., Egidi & Gerrig, 2006).

In an fMRI experiment, fourteen participants listened passively to stories and fourteen listened to stories while judging whether the endings were consistent with prior context. All stories included an ending that was consistent or inconsistent with the immediately preceding, local context. The distal, global context was relevant or irrelevant for the integration of this ending: when irrelevant, the consistency of the ending was determined by local context, but when relevant, the consistency of the ending depended on both local and global context. A whole-brain analysis in the 2D surface domain identified Beta values for all participants for each vertex. The ANOVA used one between-participants factor: Task (Listening, Judging) and two within-participants factors: Global Context Relevance (Irrelevant, Relevant) and Ending Local Consistency (Consistent, Inconsistent).

The analysis identified three effects. The first was a main effect of task in areas usually associated with linguistic semantic processing (IFG, SFG, STG, STS, AG), showing stronger activation during evaluation that during listening. This suggests that evaluation prompts more extended semantic processing than passive comprehension. The second result was an interaction between task and the local consistency of the endings. Several regions showed sensitivity to local consistency only during passive listening (AG, PostCG, PreCG, CingG, CingS, and insula). Finally, there was an interaction between task and global context relevance: Several regions (STG, STS, precuneus, and PHG) showed stronger sensitivity to global context during evaluation than during listening. This suggests that these regions, usually associated with inconsistency detection, are sensitive also to the amount of information considered at the time of integration.

Taken together, these results show that the processing strategy adopted during discourse comprehension changes the way linguistic content is integrated with prior context. Consistent with prior literature, local integration is found to be predominant for passive comprehension and global integration for evaluation. Although evaluation prompts more extended semantic processing in language regions, passive comprehension and evaluation engage different brain regions. Discourse comprehension therefore results from the coordination of cortical systems sensitive to different aspects of integration, and the process adopted for comprehension determines which brain systems are recruited. We will discuss the implication of these findings for the current knowledge of language processing in the brain.

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Alignment of speech rate: Testing an oscillator account of convergence

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Keywords: Alignment; dialogue; speech rate; simulations; oscillators

It has long been known that conversational partners tend to align on common ways of talking about the world, not only in choice of syntactic structures or referring expressions (Pickering & Garrod, 2004), but also in manner (Giles et al., 1991). Alignment in both of these areas has received considerable theoretical attention, however while accounts of the alignment of representations have considered the linguistic mechanisms responsible (for example Pickering and Garrod's, 2004, *Interactive Alignment account*), theories of the alignment of performative aspects of conversation, such as speech rate, have largely tended to limit their scope to motivational explanations (most notably in *Accommodation theory*; Giles et al., 1991).

One exception to this trend has been Wilson and Wilson's (2005) oscillator model of turn-taking. In order to explain high coordination in turn-taking (in particular the very short intervals between turns) they propose that endogenous oscillators in the brains of conversational partners, representing their readiness to speak, have their frequencies determined by each others' speech rate. As these oscillators become entrained (as partners align on speech rate) turn-taking should become more closely coordinated, resulting in more seamless turn-taking.

Using data from the 128 dialogues in the Map Task Corpus (hereafter MTC; Anderson et al., 1991) we tested three predictions which follow from the oscillator account. First, speakers should prime each other, with each speaking at a similar rate to the speech they have just heard their partner produce; second, that as partners take turns to speak this process of repeated, reciprocal, priming should lead their speech rates to converge over the course of the dialogue. Our third prediction was derived from a simulation of the oscillator model, which demonstrated that as the convergence between partners increases, the entrainment of oscillators should cause the duration and variability of dialogue turn-intervals to decrease.

Data from the MTC supported the first two predictions, with partners' speech rate converging over time through apparent priming between turns. There was however no evidence to support the third prediction: The duration and variability of interlocutors' turn-intervals did not decrease as they converged.

In absence of support for this important claim of the oscillator model, but with evidence for priming of speech rate in dialogue, we suggest that the interactive alignment account may extend beyond *what* is said, to *how* it is said. Specifically, we propose an account where the alignment of rate comes as a consequence of the use of production systems during comprehension (Pickering & Garrod, 2007). Finally, our analyses provide a demonstration of the strength of sophisticated modelling techniques for investigating fine-grained linguistic phenomena within dialogue.

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Lexical restrictions on passive uses in English: A large-scale corpus investigation

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Keywords: English passive; get; be; syntax; semantics; corpora

In English, two different auxiliaries (*be* and *get*) are used to produce a passive sentence (e.g. "*he was/got fired [by ..]*"). Although *be*-passives are regarded as 'canonical', *get*-passives are also common and may even be preferred in certain circumstances. While some theories treat the two forms as interchangeable (e.g., Chomsky, 1982), others assume that they serve distinct syntactic and semantic functions (e.g., Collins, 1996; Haegeman, 1985; Givon & Yang, 1994; Rühlemann, 2007).

The present corpus-study examined the distribution of various English passive forms, focusing particularly on the notional verb with which these passive forms occur. 1316 verbs with passive-voice counts ≥ 10 in both COCA (400+ million words, American English) and BNC (100+ million words, British English) were identified. The frequency counts per verb were further split into 16 categories, taking into account regional variant (American, British), modality (spoken, written), passive-auxiliary (*be*, *get*), and by-phrase inclusion (full, truncated). Initial inspection of the data indicated that different notional verbs contribute differently to the counts per category, suggesting a high degree of verb-dependent clustering.

A Principal-Component-Analysis (using log-counts/million) revealed that the 16 categories were reducible into four orthogonal components with Eigenvalues > 1 (capturing 68.5% of the total variance): (1) *truncated* and (2) *full be*-passive use; (3) *truncated* and (4) *full get*-passive use – frequency counts from different sub-corpora (COCA/BNC; spoken/written) loaded equally on these components, suggesting largely consistent verb-uses across regional variants and modalities.

The four principal components were then used as clustering dimensions for k-means clustering (Hartigan & Wang, 1979; Ding & He, 2004), partitioning the 1316 verbs into clusters of 'syntactically similar' verbs. Over 1000 runs with different random initializations (using cross-validation to determine the optimal number of clusters), we identified an 11-cluster solution as the best/most reliable partitioning (93% cluster purity over different random initializations). The largest cluster contained 329 verbs and the smallest 28 verbs. The clusters not only displayed highly distinct patterns across the four passive-type components, but also distinct baseline frequencies of passives.

We then employed Latent Semantic Analysis (LSA, Landauer & Dumais, 1997) to obtain an independent measure of *semantic similarity* for the 28 most 'prototypical' (in terms of centroid-proximity) verbs per syntactic cluster. Each of the 28 prototypical verbs per cluster was compared to the other 27 prototypical verbs of the same cluster (~4.2K comparisons), yielding an average *within-cluster* LSA-similarity-score of 0.14. Next, each prototypical verb from a given cluster was compared to the prototypical verbs from all other clusters (~43.1K comparisons), yielding an average *between-cluster* LSA-similarity-score of 0.11. The difference was highly reliable ($p < .0001$), confirming that semantic similarity was greater *within* than *between* clusters of syntactically similar verbs.

We conclude (a) that passive verb-uses are consistent across regional variants and modalities, (b) that the use of different passive-forms (*get* or *be*, full or truncated) is constrained by the notional verb, and (c) that there is an intriguing relationship between syntactic and semantic similarity in the clustering of notional verbs. The results support lexical/functional accounts of the English passive.

The Effect of Reference Distance on Anaphora Processing: Evidence from a Reading Corpus of German Texts

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Keywords: anaphora; eyetracking-while-reading; reading corpus; reference; distance

Figuring out the antecedent of an anaphoric expression could be difficult – especially if we are dealing with densely packed webs of co-references. Anyhow, reference resolution seems to take place immediately (Sturt, 2003) and is successful most of the time. In most experiments dealing with anaphora resolution, the distance between an anaphoric expression and its antecedent is controlled for. In naturalistic texts, however, this distance may vary widely and it is not clear to what extent reference distance influences the processing of anaphors during natural reading. As long as an actor or event is not referred to, its activation in discourse space decays over time and other referents and events interfere. Accordingly, processing effort should be higher the farther away an antecedent is from the anaphor referring to it.

We measured reference distance as the number of intervening words between a referring expression (all pro-forms, but not relative pronouns) and its antecedent. The baseline model comprised word length, frequency and familiarity. Linear mixed-effects models with random intercepts and slopes (with respect to the position in the experiment) for subjects revealed reliable prolonging effects of reference distance on first-pass reading times (FPRTs) and regression path durations (RPDs) for anaphoric expressions in a reading corpus of German jurisdictional texts read by 40 participants. In line with this finding, the probability to launch a regressive saccade rises with rising distance between an anaphor and its antecedent (logistic mixed effect model with the same covariate and random effect structure as the above model).

What happens if no regression is launched upon encountering an anaphoric expression? We argue, that these cases are associated with one of two situations: (1) the relevant discourse representation is still available and could be retrieved from memory without the additional effort of launching a regression. (2) Reference resolution is not initiated and the reference relation is left underspecified – presumably, this is associated with cases where the distance between the anaphor and its antecedent is very high. If reference resolution is not initialized, we predict that FPRTs in cases without regressions should actually get shorter the higher the distance between an anaphor and its antecedent is – the converse effect compared to the one which was found for cases with regressive saccades. Linear mixed-effects modeling for the cases where no regressive saccade is launched indeed shows shorter FPRTs associated with rising reference distance.

Our results provide evidence that while reading natural texts, reference distance is crucial for predicting reading times. We propose that the absence of a regressive saccade paired with long reference distances point to cases of failed reference assignment. Further research would have to determine if the distance (in words) influences this behavior or if it is the number of intervening referents. It has also been shown that the frequency of the antecedent has an influence on anaphora resolution (van Gompel & Majid, 2004), which could also be investigated in reading corpora. Independent evidence from experimentally controlled stimuli if reference resolution really failed in the critical cases would be desirable.

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Meaning and Production Pressures in Speakers' Choices: Partitive "some"

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Keywords: production; alternations; partitive; communicative efficiency

What is an alternation? In psycholinguistics, allegedly meaning-equivalent forms such as the forms participating in the dative, voice, word order, and reduction alternations like "that"-omission have often been studied to investigate pressures governing the production system at choice points in incremental production (e.g. Bock & Warren, 1985; Jaeger, 2010). This line of work has revealed that form choice is affected both by accessibility effects and by the preference to communicate efficiently.

On the other hand, in functional linguistics the claim prevails that there are no true alternations: any difference in form implies a difference in meaning. We argue here that both of these approaches are prone to over-simplifying the choices speakers face in incremental production, albeit in contrasting ways. Meaning and production pressures operate in parallel in determining speakers' choice of form rather than production pressures operating on the categorical output of the conceptual stage in production.

We present a corpus study on the choice between simple "some" (as in "Trixie drank some whiskey") and partitive "some of the" (as in "Trixie drank some of the whiskey"), that have similar, but different meanings. We control for meaning factors that have been proposed to govern the choice of the partitive (givenness of the head noun) and two sets of production pressures that have been shown to affect speakers' choices in choosing one form over another in supposed alternations: a) accessibility of the to-be- communicated material (constituent complexity, head frequency, animacy) and b) a preference to distribute information uniformly (UID; Jaeger, 2010) in the service of maximizing communicative efficiency.

In a mixed-effects logistic regression we find effects of meaning and production pressures operating simultaneously. Given nouns (meaning), unpredictable cases of "some" (UID pressure), and complex constituents (accessibility) are more likely to occur in the partitive. However, the meaning effect is simultaneously an anti-accessibility effect. A similar anti-accessibility effectis present for animacy. We explain this with reference to the individuating function of the partitive.

Taken together, the results show that even in cases of non-alternations, production pressures affect form choice. However, meaning cannot be ignored either, and in fact in the partitive choice meaning overrides some production pressures (but not others).

This suggests an intriguing interplay between meaning factors and production pressures: speakers sometimes sacrifice precision in communicating an intended meaning to accommodate production pressures. This suggests alternations are not all-or-none: forms may display more or less similarity in meaning. The more similar they are, the stronger the effects of production pressures.

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Discourse Expectations and Implicitness of (Causal) Discourse Relations
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Keywords: Causality, Discourse relations, Discourse cues

Sentences are connected through discourse relations, which can be expressed explicitly using a discourse connector, or implicitly: "The streets are wet (because) it was raining." We here want to test existing hypotheses on discourse relations, which may suggest when and why discourse connectors can be omitted.

It has been argued that language users prefer causal relations to other types of relations (*causality-by-default hypothesis*, Sanders 2005). A second hypothesis is the *continuity hypothesis* (Murray 1997), which proposes that readers expect subsequent sentences to be causally congruent and continuous, hence predicting that causal relations are more expected than adversative ones and that causal relations that imply a non-linearity by presenting a consequence before its effect are less expected than those keeping the forward temporal transition. Finally, a recent study by Rohde and Horton (2010) indicates that implicit causality (IC) verbs (as in "Peter scolded Mary") may raise the expectation for a backward causal relationship.

Viewing these hypotheses in the context of the Uniform Information Density (UID) hypothesis (Frank and Jaeger 2008), which suggests that humans tend to spread information evenly across a text or utterance, thereby reducing or omitting redundant optional markers, we predict that (1) causal relationships are implicit more often than other discourse relationships, (2) forward causal relations should be implicit more often than backward causal relations and (3) backward causal relations that contain an IC verb are implicit more often than ones without an IC verb.

We test these hypotheses on the Penn Discourse Treebank (Prasad et al. 2008), a large body of text, which is annotated with explicit as well as implicit discourse relations. We find that causal relations are the most frequent implicit relationship in the corpus, and that the implicitness ratio for causals is significantly higher (0.65) than the general ratio of implicit relations (0.46; p<0.001). Overall, our findings partially confirm prediction (1), but also suggest that other commonly implicit discourse relations exist (in particular, instantiation and restatement). Regarding prediction (2), we observe a significantly larger implicitness ratio for forward causality in comparison to backward causality (0.69 vs. 0.62; p<0.001), thus providing support for the continuity hypothesis.

Finally, we find support for (Rohde and Horton 2010) in that sentences with an IC verb are more likely to be followed by a backward causal relationship than other verbs, and backward causal relationships are more likely to have an IC verb in their first argument (both p<0.01), but we do not find evidence of a higher likelihood to omit the connective when an IC verb is present, thus not confirming prediction (3).

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What We Talk About: Discourse Effects on the Animacy of Sentence Subjects

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Keywords: comparative corpus study; discourse topic; Dutch; English; register; target audience.

Subjects universally tend to be animate. In transitive sentences, animate subjects are preferably combined with an inanimate object (e.g., Dahl, 2008). An unresolved question is how discourse properties that extend beyond the sentence level affect these patterns. We present two comparative corpus studies that investigate this question.

The first study addresses effects of register (literary text, news) and target audience (adults, children) in written Dutch. We used four corpora consisting of news and literary texts written for children and adults. From each corpus 200 main clauses were taken. We found that sentences with an animate subject and an inanimate object were most prevalent in all corpora, with the highest frequency in literary corpora (for children: 78.5%; for adults: 67%), and lower frequencies in news corpora (for children: 62%; for adults: 50.5%). Sentences with two inanimate arguments occurred more often in news corpora than in literary corpora (32.3% vs. 5%). Multinominal regression analysis revealed a main effect of Register ($b = -3.07$, Wald $\chi^2(1) = 45.73$, $p < .01$), and a Target audience x Register interaction ($b = 2.53$, Wald $\chi^2(1) = 7.53$, $p < .01$) .

The second study focused on whether the animacy of the discourse topic affects the animacy of sentence subjects. It included four different television news corpora (*BBC News* for adults and *Newsround* for children in English; *NOS journaal* for adults and *Het Jeugdjournaal* for children in Dutch), each consisting of 20 episodes. Analyzing transitive sentences only, the occurrence of sentences with animate subjects was higher in episodes with animate than inanimate news topics (82.2% vs. 64.5%). The highest occurrence of animate subjects was found in Dutch children's news (88.8%). Binominal regression analysis revealed main effects of Language ($b = 1.01$, Wald $\chi^2(1) = 9.25$, $p < .01$), Target audience ($b = .79$, Wald $\chi^2 (1) = 4.78$, $p < .05$), and Topic ($b = -.82$, Wald $\chi^2(1) = 4.59$, $p < .05$), and a Language x Target audience interaction ($b = -1.08$, Wald $\chi^2(1) = 5.68$, $p < .05$). Taking into account all sentences, a complex pattern was found, including a Language x Target audience x Topic interaction ($b = -.86$, Wald $\chi^2(1) = 9.37$, $p < .01$). In summary, it was more likely to find inanimate subjects in inanimate news topics than in animate news topics. In Dutch, inanimate subjects occurred less often in animate news topics in children's news than in adults' news. No such difference was found in English.

The results of these two studies provide clear evidence that the animacy of the subject of a sentence depends on who or what we talk about. We will argue that the variation in the proportion of animate subjects in different corpora depends on the importance of animacy as a cue for subject identification.

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Is there a 'Stand' in 'Understand'? Embodied Representations of Simple and Complex Verbs in L1 and L2 Speakers

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Keywords: embodied cognition; fMRI; action; language; bilingual; morphology

We investigated two issues in native (L1) vs. non-native (L2) speakers: first, embodied representation of simple motor verbs; second, morphological decomposition of opaque complex verbs with motor stems. Regarding the first issue, the representation of action-related language such as motor verbs is called 'embodied' if these verbs elicit activation in the same brain areas as action itself. L1 fMRI studies (Rueschemeyer, Brass, & Friederici, 2007) have shown inferior parietal (IPC) and/or sensorimotor (SM) activation upon presentation of motor verbs (German 'werfen' – English *'throw'*), suggesting embodied representation of these verbs. L2 motor verb representations have not been investigated yet, but it has been suggested that L2 semantic representations may be less 'rich' than L1 representations. Also, cognate verbs (verbs sharing similar form and meaning in two languages, such as Dutch *'werpen'*– German *'werfen'*) may be processed differently than non-cognate verbs (such as Dutch *'gooien'* – German *'werfen'*) by non-native speakers, i.e. the meaning representations of cognates may be more easily accessed than those of non-cognates. Thus, the processing of (especially non-cognate) motor verbs may be less 'embodied' in L2 compared to L1 speakers. Regarding the second issue, behavioral studies have shown L1 speakers to differentially process transparent (*afwerpen* – *throw off*) and opaque (*ontwerpen* – *design*) complex verbs: the former, verbs semantically related to their stems, are often decomposed; the latter, verbs with semantically unrelated stems, seem to be processed holistically (Marslen-Wilson, Tyler, Waksler, & Older, 1994). However, little is known about L2 processing of these verb types. Also, an L1 fMRI study has shown no IPC or SM activation upon presentation of German opaque verbs with a motor stem (Rueschemeyer et al., 2007). However, it is possible that L2 speakers decompose such verbs, potentially leading to more activation of IPC and/or SM areas by the motor stem than in native speakers. In an fMRI experiment, 18 German-Dutch bilinguals and 20 Dutch native speakers made lexical decisions about visually presented simple motor and non-motor verbs and opaque complex verbs with a motor or non-motor stem. Region-of-interest (ROI) analyses were conducted on the IPC and SM regions reported by Rueschemeyer et al. (2007) for the interaction between complexity and motor meaning. Both L1 and L2 speakers showed IPC and SM activation for simple motor versus non-motor verbs. No such activation was found in either group for the contrast between opaque verbs with motor and non-motor stems. In statistical terms, there was an interaction between complexity and motor meaning for L1 speakers but not for L2 speakers in the IPC ROI. Results are discussed in the light of embodiment theory.

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Effects of multilingual competence on the development of cognitive control skills: an er-fMRI follow-up study in multilingual children

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Abstract

There is recent evidence that lifelong experience in dealing with two languages may lead to a neuro-cognitive advantage. For instance, behavioral studies have shown that bilingual children outperform monolinguals on tasks measuring executive functioning skills (Bialystok et al., 2012). As to fMRI studies, Abutalebi et al. (2011) reported that bilingual adults not only resolve cognitive conflicts with less neural activity but their brain seems also to be better tuned to monitoring cognitive conflicts. The authors suggested that early learning and lifelong practice of two languages exert a strong impact upon human neocortical development. However, an unresolved question concerns the neural development of this neurocognitive advantage and whether it is influenced by some factors such the degree of language proficiency.

For this purpose, in a longitudinal event-related functional magnetic resonance imaging (er-fMRI) study, we investigated the effects of multilingual competence (i.e., as a measure of proficiency) on the executive control attentional network through an ANT task (Fan et al., 2005). Fifteen multilingual Ladin-German-Italian-English children (10 boys, 5 girls) (mean age = 9.86; SD= 1.44 years) from South Tyrol, Italy, participated in this longitudinal study (mean scan interval (T1-T2) = 0.97 years, SD = 0.1 years). Global multilingual competence was calculated for each participant based on the mean value of the school marks related to all languages and the total school outcome.

We computed the conflict effect of the ANT as the contrast coding the difference between Incongruent and Congruent trials at both T1 and T2, and subsequently we created differential, subject-specific contrast images (T2-T1) for conflict effect-related brain activity and performed correlations with the multilingual competence differential scores between T2 and T1.

Our results revealed that lower levels of multilingual competence at T2 correlated with higher functional brain activity in a network of areas involving the left dorsolateral frontal cortex, the head of left caudate nucleus and the left putamen which have been found to subtend cognitive control for both attention and language.

These results highlight the presence of a direct relationship between multilingual competence and non-linguistic cognitive conflicts in multilingual children and suggests that the neurocognitive advantage exhibited by multilingual adults with respect to their monolingual peers in many studies (Bialystok, 2012) may already be traced at an early neural developmental stage in the form of a strong coupling between the degree of multilingual competence and activity in brain regions specifically recruited for cognitive control.

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There are no Mental Firewalls:
fMRI Evidence for Global Inhibition of the Native Language in Bilingual Speech

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Bilinguals activate both languages in speech production even when they intend to speak one language alone. This observation suggests that they possess a mechanism of cognitive control that allows them to negotiate potential competition across the two languages. A critical question is how that competition is resolved to allow fluent speech. One hypothesis assumes that the more dominant of the two languages is inhibited to enable speech planning in the less dominant language (Green, 1998). Recent studies supported this hypothesis, also observing brain activation in areas dedicated to cognitive control (Guo et al., 2011). However, up to now, the scope of the observed inhibitory effects (that is, whether potential inhibitory effects in bilinguals are observed beyond specific produced words) have not been examined. The goal of the present study was to investigate this factor using functional magnetic resonance imaging (fMRI).

A group of 20 English-Spanish (L2) bilinguals, and 10 English monolinguals performed a language blocked picture naming paradigm. In the first run, participants named pictures from three lexical categories (animals, body parts, vegetables) in L1 (English). In a second run, they named pictures from three different categories (clothing, furniture, kitchen items) in the L2 (Spanish) if bilinguals, or in English if monolinguals. Finally, in six subsequent runs, participants in both groups named pictures in English (L1) that were a mixture of items drawn from: a) the old items and categories presented in the first two blocks; b) new items from the old categories, and c) new items from new categories not previously named. Naming accuracies and latencies were recorded during fMRI to allow behavioral data analysis and response contingent analysis. We hypothesize that if bilinguals inhibit their L1 in order to access and produce the L2, a decrease in naming accuracies and activations in the brain areas linked to cognitive control and conflict monitoring (e.g., Anterior Cingulate Cortex -ACC-) should be observed. Importantly, monolingual speakers should show a different pattern of performance.

For the bilingual group, behavioral results provide evidence for significant inhibition in naming in L1 after an intervening block of L2, as revealed by decreased accuracy. Moreover, results show that only for the bilinguals (and not for the monolinguals) there was activation in the brain areas involved in general cognitive control (Anterior Cingulate Cortex, pre-supplementary area, and the basal ganglia) in all contrasts. Alternatively, the observed may be due to retrieval-induced forgetting mechanism -RIF-, by which lexical items -related to the items named previously- that compete for selection are actually inhibited. Another potential explanation is that the observed fMRI activation is due to a more general conflict-detection mechanism. However, if the observed results in bilinguals were only the consequence of a RIF effect or a general conflict-detection mechanism common to all speakers, we should have observed comparable results in monolingual speakers.

Taken together, these results provide important evidence supporting the inhibitory control hypothesis for bilingual speech production and furthermore show that the scope of inhibition extends beyond the lexical and to the entire language.

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Bilingual Brain Training: Investigating the Overlap between Language Switching and General Set Switching in Bilinguals

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Keywords: Bilingualism; fMRI; Language; Executive functions; Task switching

Introduction

The bilingual advantage on tests of non-linguistic executive functioning has been documented throughout the lifespan. Specifically, bilingual individuals exhibit general improvements on tasks that measure the ability to resist interference and to switch flexibly between tasks (see Bialystok, Craik & Luk, 2012 for review), which likely reflects increased experience with the demands necessary for managing multiple languages. The mechanism supporting this generalized advantage, however, is poorly understood. To be plausible, such a mechanism must account for the overlap between some facet of information processing that reliably characterizes the unique bilingual environment and enhanced bilingual performance on tests of non-linguistic functioning.

To investigate the neural basis of this mechanism, we created a paradigm in which language switching and task switching could be directly compared. In the "Task/Format" switch paradigm, participants made one of two semantic decisions (natural/manmade or larger/smaller than a shoe box) about highly imageable concrete nouns. For bilinguals, the nouns appeared in each of their two languages, whereas for monolinguals, nouns appeared as either words or line drawings. Manipulation of these two factors resulted in four conditions: Repeat (both format and task), Format Switch (task repeated), Task Switch (format repeated), and Both Switch (both task and format switched).

We used fMRI to compare the neural networks underpinning language and task switching processes within bilinguals, and to compare task switching "costs" between monolinguals and bilinguals. Participants saw four blocks of each type (16 total) presented in a latin-squared design. Data was collected from 35 total participants, but two were excluded for poor performance. Resulting analyses were conducted on 17 bilinguals (9 female, mean age = 20.5 years) and 16 monolinguals (6 female, mean age = 20.6 years) who were selected from a larger group to be matched on a measure of non-verbal-working-memory capacity (mean operation spans = 55.6 and 55.2 respectively).

Functional images were acquired (TR=2,000ms, TE=21ms, 44 axial slices, 2.75 x 2.75 x 3.2 voxels) while participants performed the tasks, and analyzed using the General Linear Model as implemented in SPM8.

Results

Neuroimaging results showed that the networks involved in language switching and task switching were highly overlapping in bilinguals. Specifically, both tasks resulted in activation in bilateral lateral prefrontal cortex, medial prefrontal cortex, temporo-parietal regions, and the striatum. In addition, bilinguals showed more efficient patterns of activation during task switching than did monolinguals, as evidenced by a greater task switch – task repeat differences in activation in monolinguals. This increased efficiency was observed in a network of regions known to be involved in executive function and working memory, namely bilateral middle frontal and parietal regions.

In summary, our results suggest that language switching in bilinguals invokes many of the same brain regions involved in general task switching, and that practice with language switching may give rise to more general benefits in cognitive flexibility.

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Comprehension costs reflect production patterns: Evidence from Spanish-English codeswitching

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 We examine a view in the sentence processing literature that attributes comprehension difficulty to particular distributional patterns in speaker's production choices (MacDonald & Thornton, 2009). The purpose is to ask whether the correspondence between production patterns and comprehension difficulty observed in monolingual sentence processing extends to bilingual codeswitching. We focus on Spanish-English codeswitches involving two types of auxiliary phrases because of their distribution in written and oral naturalistic codeswitching corpora. Switches involving the Spanish auxiliary *estar* 'to be' and an English present participle (los profesores *están* developing a course) occur with similar frequency as switches at the auxiliary (los profesores *are* developing a course*)*. However, switches involving the Spanish auxiliary *haber* 'to have' and an English past participle (*los actores han rehearsed*) are less frequent compared to switches at the auxiliary (*los actores have rehearsed)* (Pfaff, 1979; Poplack, 1980).

Two groups of bilingual codeswitchers were recruited: 18 Spanish-dominant bilinguals who arrived in the U.S. during adulthood (late codeswitchers) and 18 English-dominant bilinguals, born and raised in the U.S (early codeswitchers). Participants' eye-movements were recorded while reading sentences on a computer screen. The experimental stimuli comprised 96 item sets, each consisting of 4 versions of the same sentence, corresponding to 4 experimental conditions. Conditions 1 and 2 were codeswitched conditions with the progressive structure. In Condition 1, the switch occurred at the auxiliary (*El director confirmó que los actores* **are rehearsing** for the movie) and in Condition 2 the switch occurred at the English present participle (*El director confirmó que los actores están* **rehearsing** for the movie). Conditions 3 and 4 were analogous to Conditions 1 and 2, but involved the perfect structure (*El director confirmó que los actores* **have rehearsed** for the movie and *El director confirmó que los actores han* **rehearsed** for the movie, respectively).

 A two-way repeated measures ANOVA with auxiliary type (*estar* v. *haber*) and switch site (auxiliary v. participle) as within-subjects factors, and group (early v. late codeswitchers) as a between-subjects factor revealed for early codeswitchers a significant interaction of auxiliary type and switch site for gaze duration ($F(1,17) = 4.76$, $p = .043$) and total time ($F(1,17) = 13.49$, $p = .002$), and a marginally significant interaction for regression path ($F(1,17) = 4.32$, $p = .053$), indicating that participants took longer to read the critical region (the participle) in Condition 4 compared to Condition 3, but that switches in Conditions 2 did not incur more costs than switches in Condition 1. Similar results were found for the late codeswitchers (regression path= ($F(1,17) = 4.78$, $p = .043$); total time = ($F(1,17) = 9.29$, $p = .007$)). Taken together, the findings are congenial with models of language processing (e.g., the Production-Distribution-Comprehension model of Gennari & MacDonald, 2009) in which linguistic experience plays a crucial role in the way language is processed. The findings are also discussed in terms of the constraints that may be responsible for the distributional patterns of codeswitches found in production.

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Anaphora Processing of Native and Turkish Non-native Speakers of English: *It* and *This*

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Keywords: Anaphora; a good enough approach; residual indeterminacy; L1 and L2 online and offline processing

Many linguists handle *it* and *this* as oppositional, taking them to refer to different entities (i.e. *this* refers to a proposition whereas *it* refers to a noun phrase) and establish different foci/attentional states. Psycholinguistic studies generally compare the deictic *that* with the anaphoric pronoun *it*, or deictic expressions with the use of personal pronouns in German or French (1, 3, 6). This study differs from previous work in terms of the anaphoric expressions it handles; its foci on cognitive functions, and on textual deixis; its exploration of both native and non-native speakers' preferences; and its use of both eye-tracking reading experiments and norming experiments.

We report 2 eye-tracking and 2 norming experiments to test the antecedent preferences of *it* and *this*. Eye-tracking Experiment 1 (40 native speakers of English; 40 items) compared how *it* and *this* refer to the proposition and the noun phrase in the preamble *(i.e Alice pruned the bonsai tree.)*. Preferences were measured by referential expressions after the adjective following *it* and *this (i.e It/This was a splendid idea/plant…)*. Experiment 2 (40 Turkish non-native advanced English speakers; 40 items) used the same stimuli. In the norming Experiments (16 native speakers; 16 non-native speakers; 40 items), blanks replaced the words following *it/this*: participants were asked to complete the sentences.

In the online experiment, native speakers did not show strong referent preferences, whereas non-native speakers performed form-function mappings between anaphora and referent choices. Non-natives preferred *it* when referring to a proposition but *this* for a noun phrase. This contradicted predictions. In the norming Experiment native speakers used *it* to refer to a noun phrase and *this* to refer to a proposition, in line with the asymmetry account (3, 6). The norming Experiment with Turkish speakers did not show any referent preference for *this*: as opposed to the results of the online experiment, their antecedent choices for *it* were noun phrases. Non-native speakers' referent choices in all tasks reveal the cross-linguistic effect of the Turkish anaphoric system (4). Relying on the interface hypothesis (5), we argue that Turkish learners show a residue of L1 and 'residual indeterminacy' at the level of discourse. A 'good enough' approach (2) can explain shallow processing in the online experiment with native speakers.

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Advanced L2 Learners Differ from Native Speakers in Off-line, but not On-line Sentence Processing

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Keywords: second language processing; self-paced reading; word order; ambiguity; cognitive control.

Introduction

Recent accounts of syntactic difficulties that advanced second-language (L2) learners experience in their L2 (e.g., Sorace, 2011) hypothesize that the underlying cause is the allocation of processing resources. L2 learners employ less-automatic procedures than native speakers, and need to suppress their other language, leading to fewer processing resources to process complex constructions in their L2. We sought to further test this hypothesis by investigating the processing of cross-language structural ambiguities. If L2 speakers need to suppress their L1, the differences between native speakers and L2 learners will become most apparent in such constructions. Furthermore, we predicted that L2 learners with better ability to suppress prepotent information (better cognitive control) would more closely resemble L1 speakers.

Methods

We tested 39 native speakers of English, and 71 native speakers of Dutch who started learning English around the age of 10. The groups did not differ in cognitive control (Stroop, Trail making, Attentional Network Task), age and parents' education, but the L2 group performed worse that the native English group on English vocabulary, naming, and cloze tasks.

Participants read English sentences in a moving-window self-paced reading task, which included object relatives as in (1) and (2). Each sentence was followed by a statement that the participants were asked to verify.

(1)   a/b. Over there is the stewardess who the passenger**s** **have** /***has** insulted during the flight.
(2)   a/b. Over there is the stewardess who the passenger **has** /***have** insulted during the flight.

The relative clause subject was either plural (1) or singular (2); the auxiliary in the relative clause either agreed with the relative clause subject (1a, 2a) or did not (1b, 2b). To Dutch speakers, (1b) creates a potential language conflict since this structure corresponds to a grammatical subject-relative in Dutch (3); (2a) and (2b) are grammatical and ungrammatical, respectively, in both Dutch and English and served as control.

(3)   Daar is de stewardess die de passagiers heeft beledigd tijdens de vlucht.
       there is the stewardess who the passengers has insulted during the flight
       "Over there is the stewardess who has insulted the passengers during the flight."

Results

Starting from the auxiliary, both groups showed an increase in reading times in the ungrammatical (1,2b) vs. grammatical conditions (1,2a). L2 speakers read overall *faster* than native English speakers. Even when reading speed was controlled for, the L2 group did not differ from the native group in the processing of (1b-a) versus the control conditions (2b-a), or in the effect of cognitive control or English proficiency on processing. However, performance on the end-of-sentence statement verification task suggested that the L2 group selected a subject-relative interpretation more often than the native English, especially in the critical condition (1b).

Discussion

Our findings suggest that L2 speakers experience L1 interference off-line, but not on-line. This supports the view that native and L2 speakers differ in sentence processing, but that this is not related to L2 readers employing less automatic procedures or suppressing conflicting L1 information on-line.

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Syntactic Constraints in Native versus Non-native Pronoun Resolution

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Previous research comparing native and non-native processing of reflexives has shown that non-native speakers (NNSs) violate binding condition A during early processing stages and attempt to link a reflexive to a discourse-prominent but grammatically illicit antecedent instead (Felser & Cunnings, 2011). In contrast, native speakers (NSs) have demonstrated sensitivity to condition A from the earliest processing stages. This suggests that real-time pronoun resolution in a non-native language may be more vulnerable to antecedent competition or interference effects compared to native pronoun resolution, and less guided by syntactic cues.

To further test this hypothesis, we investigated the application of binding condition B during native vs. non-native sentence comprehension in two eye-movement monitoring experiments. 34 proficient German-speaking learners of English and 34 native English speakers were presented with sentences which contained a masculine or feminine pronoun (*him* or *her*) and two potential sentence-internal antecedents. Gender congruence between the pronoun and the proper names was manipulated (*match* vs. *mismatch*) to serve as a diagnostic for dependency formation, as shown in the examples below.

In Experiment 1, binding condition B rules out the local subject as an antecedent but permits binding by the non-local subject (compare example (a)).

a. **John$_i$ (Jane)** remembered that **Mark$_k$ (Jane)** had taught **him$_{i/*k}$** a new song on the guitar.

In Experiment 2, we used so-called 'short-distance pronouns' (SDPs) which are thought to be exempt from condition B (compare example (b)).

b. **Barry$_i$ (Megan)** saw **Gavin$_k$ (Megan)** place a gun near **him$_{i/k}$** on the ground.

Both groups demonstrated knowledge of condition B and awareness of the ambiguity of SDPs in a complementary offline task.

In Experiment 1, both groups showed effects of the non-local antecedent's gender at and following the pronoun region, consistent with the application of condition B.

In Experiment 2, only the NNSs showed sensitivity to the non-local antecedent's gender, in the absence of any effects of the local antecedent. The NSs, in contrast, showed evidence of processing being disrupted by a mismatching local antecedent at later sentence regions.

These results demonstrate that both NSs and NNSs showed online sensitivity to binding condition B in that local antecedents were not initially considered. Whereas the NSs showed sensitivity to different antecedents depending on the particular syntactic environment in which they appeared, NNSs showed sensitivity only to the matrix subject in both structures. This indicates that NNSs are less sensitive during processing to structural cues that differentiate SDPs from typical object pronouns, and prefer to link a pronoun to the most discourse-prominent antecedent (the matrix subject) instead.

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Thematic Role Assignment in Non-canonical Sentences: Is Non-Native more 'Shallow' than Native Sentence Processing?

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Abstract

One focus of recent L2 sentence processing research has been the extent to which processing by non-native speakers (NNS) can be native-like (e.g., Clahsen & Felser, 2006). According to the "shallow structure" hypothesis, this occurs because NNS – unlike native speakers (NS) – have limited access to syntactic information during sentence processing (Clahsen & Felser, 2006). According to the "cognitive load" hypothesis, however, L2 and L1 processing mechanisms do not differ. Rather, processing difficulties result from the high cognitive load that complex structures entail for NNS, analogous to the processing difficulties experienced by NS under conditions of artificially-induced cognitive load such as speeded response.

Ferreira (2003) showed that NS rely on semantic rather than syntactic information to process sentences when the syntactic structure is complex. Participants were asked to interpret the thematic roles of active and passive sentences in which the arguments were reversible, resulting in either plausible or implausible sentences (1). Implausible passives were misinterpreted significantly more than plausible passives – the agentive role was assigned to 'the dog' instead of 'the man' in (1d) – showing that semantics rather than syntax was used to interpret the sentence. Interestingly, however, thematic roles were assigned correctly in implausible active sentences (1c), showing that semantics-based interpretation is only used under conditions of higher cognitive load.

(1)   a. The dog bit the man. (active/plausible)
        b. The man was bitten by the dog. (passive/plausible)
        c. The man bit the dog. (active/implausible)
        d. The dog was bitten by the man. (passive/implausible)

The present study tests NNS processing patterns. Similar to Ferreira's (2003) monolingual English NS, our advanced German learners of English (n=40) make significantly more errors in semantically implausible than in plausible sentences (ps < .05). Interestingly however, the NNS - in contrast to the NS - showed no significant difference between active and passive structures (ps > .48), indicating that their responses were mainly affected by the meaning rather than the syntax of the sentences.

These results extend previous research on online L2 processing. We show that, even in a context where NS sometimes process sentences using semantics rather than syntax (Ferreira, 2003), NNS parsing strategies differ fundamentally from those of NSs (Clahsen & Felser, 2006). This supports the "shallow structure" hypothesis that NNS typically rely on semantics as an overall strategy to interpret sentences, rather than only resorting to semantics in cases of cognitive load.

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A comparison between nouns and verbs in a segment shifting task on Italian words

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Introduction

Some psycholinguistic models stress the role of morphological structure in achieving lexical access, and describe lexical processing as the result of the activation of morphemic constituents. Distributional data suggest that the morphemic access procedure is sensitive to the different tendency of affixes to occur also as pseudo-affixes, that is, homographic patterns which do not have any morphological role and may play as an interfering factor in morphological parsing (Laudanna, Burani & Cermele, 1994).

The likelihood of a pattern of letters to be processed as a morpheme during lexical access was tested in a segment shifting task (Feldman, 1991). This technique allows to remark internal morphological structure of words, since it requires to shift a final segment of letters drawn from a source word (e.g., -"ato" in "strato", "layer") to an initial segment which is displayed in isolation (e.g., "separ") in order to name an output word aloud (e.g., "separato", "separated").

Our aim was twofold: on the one hand we expected to assess the effectiveness of the morphological parsing procedure, on the other hand we tested the hypothesis that source verbs, which fall within the same grammatical category of the output word, are more likely to activate morphemic components.

Method

Source words (S) were nouns (N) or verbs (V) of Italian. A condition in which the output (O) was composed only of morphological segments (S: root + suffix: e.g. "vend-uto", "sold, past participle" (V) or "stat-uto", "statute" (V) O: "svenuto", "faint") was compared with two different conditions: in Condition 1 only one segment was morphologically ambiguous (S: pseudoroot + non suffix, e.g., "vend-icai", "I avenged" (V) or "form-icai", "anthills" (N); O: "praticai", "I practiced"), in Condition 2 both segments were morphologically ambiguous (S: pseudoroot + pseudosuffix, e.g., "trav-este", "he disguises" (V) or "temp-este", "storms" (N); O: "vendeste", "you sold", 2nd plural person").

Results

Latencies are faster when the shifted segment is drawn form a verb, which activates the same grammatical class feature of the output. Regardless of the grammatical category of the source word, the higher frequency of the morpheme (as compared to its frequency as a simple orthographic segment) determines faster latencies.
Source verbs determine the same facilitatory effect as compared to nouns in both stimuli embedding only morphological segments and stimuli with two morphologically ambiguous segments (Cond. 2), whereas they do not determine facilitation on stimuli which do not have any morphological structure (Cond. 1).

Conclusions

Consistently with approaches which maintain that morphological parsing is sensitive to distributional properties of affixes, the morphological reliability of suffixes predicts shifting latencies.
The results are compatible with the hypothesis that verbs, which have a richer morphological structure, are more likely to undergo a parsing procedure than nouns. The data are consistent with both models based on single morphemic units of access and models based on whole words representations morphologically organized according to their inflectional paradigms.
The data also support the view that morphological parsing is active with all morphologically structured stimuli, and is modulated by distributional and orthographic properties of segments.

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Universally local attachment: New evidence from PIC

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Attachment Preferences

Cuetos and Mitchell (1988), and much subsequent work, show that speakers of different languages differ in Relative Clause (RC) attachment preferences in complex NPs: Low Attachment (LA) is found in English (1a), and High Attachment (HA) in Spanish (1b).

(1) a. I saw the son_1 of the man_2 that EC_2 was running b. Vi al $hijo_1$ del $hombre_2$ que EC_1 corría

These findings questioned the universality of parsing of locality and raised important problems for language acquisition (Fodor, 1998a,b).
 We provide a new argument for the universality of parsing preferences by showing that variation across, and within, languages stems from structural differences: the availability of Pseudo Relatives (PR).
PRs: (1a) and (1b) have been assumed to be identical in this literature. However, HA languages like Spanish (and Italian, Dutch, Croatian, Bulgarian, Japanese, a.o.), but not LA languages like English (Romanian, Basque, German (see Augurzky 2005) a.o.), allow for an additional parse (2) in which the clauses introduced by *che* are interpreted as PRs.

(2) Ho [visto [SC Mario che correva]]
  *I saw Mario that ran
  I saw SC Mario running

 PRs, like Small Clauses (SC) in English, are not modifiers of NPs but complements or adjuncts of V, to which they attach (Cinque 1992). Crucially, just like SCs (3), PRs necessarily take the higher NP as their subject, giving the illusion of HA.

(3) a. pro [ho visto[SC il $figlio_1$ dell'$uomo_2$ che $EC_{1/*2}$ correva]]
  b. I [saw [SC the son_1 of the man_2 $EC_{1/*2}$ running]]

Hypothesis

i. When PRs are available, they attach as complements of the main verb (Minimal Attachment), where only NP1 can be the subject of a PR giving the appearance of HA. ii. If only RCs are available, and no other factor (e.g. intonation, context) is manipulated, LA arises.

Novel Results

In two questionnaires in European Portuguese (n=20, 24) we manipulated availability of PR in a 2*type*[perceptual/PRs vs. stative/noPR]x2*position*[subject, object] design (7): the two experiments tested full CPs (including *that was*) and Prepositional Infinitive Constructions (PIC). As predicted, we found significantly higher HA in the PR (71.3%), than in the noPR (43.5) condition, a mixed model regression analysis showed a significant effect of type (t= 6.65) and a significant interaction (t= -2.05).

(7) A. O João viu o filho do medico (que estava) a correr   (PR)
      John saw the son of the doctor (that was) running
   B. A foto do filho do medico (que estava) a correr é linda   (PR)
      The picture of the son of the doctor (that was) running is nice
   C. O João vive com of filho do medico (que estava) a correr   (noPR)
      John lives with the son of the doctor (that was) running
   D. A moto do filho do medico (que estaba) a correr é linda   (noPR)
      The motorbike of the son of the doctor (that was) running is nice

Conclusions

 All attachment is local (PRs attach locally to closest VP), and parsing variation originates from grammatical variation.

Incremental Processing Difficulty in Cross-serial and Nested Verb Clusters

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  keywords: embedding; cross-serial; parsing; Flemish; German

Certain Germanic languages like Swiss-German, Dutch and Flemish exhibit cross-serial verb clusters in embedded sentences. The cross-serial order is the opposite of the nested order attested in English and German. The co-presence of both orders in the world's languages plays a key role in motivating mildly context-sensitive (MCS) grammar formalisms (Morawietz, 2003, chapter 9). This work reports results from two eye-tracking studies, in Flemish ($n = 49$) and German ($n = 45$) respectively, that examine the incremental processing of embedded verb clusters on bilingual stimuli. A sharp dip in comprehension question-answering accuracy between embedding levels 2 and 3 suggests a kind of perceptual limit common to both languages. However, in eye-tracking measures such as First Fixation Duration the contrast between these levels is only significant in German ($t = 4.56$), not Flemish. This asymmetry is consistent with offline ratings suggesting that the cross-serial order is easier to understand (Bach et al., 1986). Indeed, in the longest verb clusters our participants read, the profile of early fixation durations across the two languages is qualitatively different: German readers slow down along the verb cluster, while Flemish readers do not.

To interpret these findings, we express a verb-raising analysis for both constructions in an MCS formalism (Stabler, 1997). Under this analysis, German and Flemish clusters receive isomorphic syntactic derivations. But during incremental processing, a top-down parser would traverse these derivations in different orders. These two traversals give rise to different memory requirements. In particular, the nested order requires that expectations for predicted verbs be stored across longer sequences of parser operations (cf. Rambow and Joshi, 1994). Such a memory effect could account for the slowdown that we observe in German but not Flemish.

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Does frequency win over syntactic complexity? Evidence from a neglected garden path

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Keywords: Relative clauses, Noun-Clausal-Complements structures, syntactic complexity, Eye-tracking.

Relative clauses are complex, since they contain a filler-gap dependency, with a well-known modulation (object-relatives harder than subject-relatives). A *that*-relative like 'the claim that John made (is false)' is temporarily ambiguous with a Noun-Clausal-Complement structure like 'the claim that John made (a mistake)' . Since the Noun-Clausal-Complement contains no gap, it should be simpler. However, relatives are much more frequent: each noun can be modified by a *that*-Relative, but only a small subset of nouns can take a Clausal Complement. So, *that*-Relatives and Noun-Clausal-Complements are the ideal situation to contrast effects of frequency and of syntactic complexity. If frequency wins, the temporary ambiguity should be resolved in favor of the *that*-Relative analysis, while the Noun-Clausal-Complement analysis should be chosen if syntactic complexity is avoided.

We ran two eye-movement monitoring experiments (28 participants each). In Experiment 1, Italian participants read 24 object-*that*-Relatives (1a) and the corresponding Noun-Clausal-Complements (1b). Noun-Clausal-Complements and *that*-Relatives differ only in critical area 3. In Experiment 2, participants read subject-*that*-Relatives (2a) and the corresponding Noun-Clausal-Complements (2b). In both, we manipulated within items whether the sentence was a relative or a Noun-Clausal-Complement and each set of sentences only differed in region 3.

	1	2	3	4	5
(1a)	Il progetto che	il sindacato	sosteneva fra	gli operai	irritò la Confindustria
	the plan that	the Union	supported-IND among	the workers	annoyed the entrepreneurs

"The plan that the Trade Unions supported among the workers annoyed the entrepreneurs"

(1b)	Il progetto che	il sindacato	sostenesse	gli operai	i r r i t ò l a Confindustria
	the plan that	the Union	supported-SUBJ	the workers	a n n o y e d t h e entrepreneurs

 "The plan that the Trade Unions would support the workers annoyed the entrepreneurs"

	1	2	3	4	5
(2a)	Come sempre	l'insinuazione che	creava	scandalo	veniva dai giornali
	As usual	the insinuation that	created-IND	scandal	came from the press

"As usual, the insinuation that fabricated a scandal came from the press"

(2b)	Come sempre	l'insinuazione che	creassero	scandalo	veniva dai giornali
	As usual	the insinuation that	created-SUBJ	scandal	came from the press

"As usual, the insinuation that (they) should fabricate a scandal came from the press"

Experiment 1: at region 3, first pass fixations and total times did not differ, but Noun-Clausal-Complement caused significantly more regressions than object-that-Relatives. Experiment 2: at region 3, first pass fixations and total times were significantly longer in Noun-Clausal-Complements than in subject-that-Relatives and furthermore there were more regressions in Noun-Clausal-Complements. The consistency of measures in critical region 3 in Experiment 2 suggests that subjects are led down the garden path in Noun-Clausal-Complement structures, since they initially go for the relative clause interpretation. The same conclusion emerges from late measures in Experiment 1, as Noun-Clausal-Complement structures requires re-analysis at region 3.

To sum up, frequency seems to win over syntactic complexity. However, Noun-Clausal-Complement are not necessarily easier than relatives, if the standard assumption that nouns take complements is denied and a specific raising analysis of relatives is assumed (cf. Donati and Cecchetto 2011, who defend this view).

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The processing of center-embedded relative clauses in French and Italian

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In French, object relative clauses (RCs) are cued by the complementizer *que,* whereas subject RCs are cued by *qui*; in Italian, the complementizer *che* is the same in both cases. Both French and Italian display object RCs with OSV (like in English) and OVS orders. In Italian OVS object RCs are ambiguous with subject RCs, unless verbal agreement disambiguate them. A previous study in French (Bates et al., 1999) revealed that OSV object RCs are more difficult than OVS object RCs, suggesting that agreement is a better cue than word order in this language (Schelstraete and Degand, 1998). In contrast, a study in Italian observed that children make more errors with OVS than with OSV object RCs (Adani, 2010). Although children and adults may differ, this contrast is surprising as the agreement cue is more salient in Italian than in French and the OVS order is more marked in French than in Italian. To disentangle to what extent the morphological cue in the complementizer/verb and the order of constituents in the RC could affect sentence processing, we compared the processing of three types center-embedded RCs (1a-c) in French and Italian through two self-paced reading experiments on 35 French and 28 Italian adults.

Subject RCs (1a) were read significantly faster than object RCs (1b-c) in both languages. Both in French and Italian, OVS object RCs required longer reading times than OSV object RCs. Such results are in line with the Italian developmental evidence, but not with Schelstraete et al., 1998. However, note that in Schelstraete et al. reading times for the RC verb region (i.e., avait contactées) and for the NP2 region (i.e., le designer) were analysed separately, whereas in our study reading times in the two regions were collapsed.

In French, differences across RCs sentences suggest that the presence of the morphological cue in the complementizer does not facilitate RCs processing (as in Frauenfelder et al., 1980). In Italian, the less marked status of postverbal subjects does not impact on adult preferences. We claim that object RCs are first analysed as subject RCs; the OSV word order facilitates the reanalysis process to a greater extent than agreement on verb in OVS RCs, in line with Langus and Nespor (under review) proposal, under which word order is a more fundamental property of human language (also Fodor & Inoue, 2000).

1a. (Subject relative)   Les top modèles qui avaient contacté le designer après le défilé de mode ont été interviewées.
(The models that got in touch with the designer after the fashion show have been interviewed).

1b. (Object relative OSV)   Les top modèles que le designer avait contactées après le défilé de mode ont été interviewées à la télé.

1c. (Object relative OVS)   Les top modèles qu'avait contactées le designer après le défilé de mode ont été interviewees à la télé.
(The models that (the designer) got in touch (the designer) with after the fashion show have been interviewed).

Question Word Coordinations and the Acceptability of ungrammatical Ellipsis

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The acceptability of flawed antecedents in VP ellipsis has been argued to depend on the ease with which antecedents may be repaired at LF, using the parser's normal repair mechanisms (Arregui et al., 2006) – suggesting distinct processing costs. We investigated *wh*-word coordinations in German, which we take to be backward TP ellipsis (Haida & Repp, 2011). We conducted a speeded acceptability-judgment study with word-by-word presentation testing coordinations of a *wh*-adjunct with a *wh*-word that can be interpreted as an obligatory direct object (=required by the verb) ($Coord_{DO.OBL}$), or as optional ($Coord_{DO.OPT}$), or where instead of wh_{OBJ} a *wh*-subject occurred ($Coord_{SUBJ}$). 50 participants saw 30 critical items and 120 unrelated fillers each. We varied the factors ORDER of *wh*-words and ARGUMENT STRUCTURE [AS] producing 6 conditions (3*x*2 design).

Predictions. $Coord_{DO.OPT}$: the underlying sentences are grammatical under assumptions (a&b). (a) Sprouting, a TP-ellipsis-specific operation, may create an object trace in the ellipsis site if the antecedent does not contain one, and if the sprouted trace is an optional-object trace (Chung, Ladusaw & McCloskey, 1995)–condition (1). (b) An optional-object trace can delete without violating the verb's requirements–(2). $Coord_{DO.OBL}$ and $Coord_{SUBJ}$ are ungrammatical but $Coord_{DO.OBL}$ is easier to repair than $Coord_{SUBJ}$. $Coord_{DO.OBL}$: In (4), the ellipsis site contains an (unbound) undeletable obligatory-object trace. It is interpreted as a definite (Fox, 1999), producing a discourse coherence violation, which requires pragmatic repair. In (3), the antecedent clause misses an obligatory object but in the context of the ellipsis clause (with *wh*-object) sprouting creates the missing object, which yields an interpretable result but is not easily available. (3) demands more processing costs than (4). In $Coord_{SUBJ}$ two subjects compete for the agent role. In (5), repair would involve choosing a smaller antecedent (VP, excluding the agent), leading, however, to an implausible interpretation: the question asks for, but also names, the agent. In (6), the subjects are adjacent in an ungrammatical antecedent for which a meaningful interpretation is unreachable.

Results: Statistical analysis of acceptability ratings and reaction times (acceptance/rejection) revealed main effects for AS and ORDER, and an interaction. AS: $Coord_{DO.OPT}$ was accepted more often than $Coord_{DO.OBL}$, which was accepted more often than $Coord_{SUBJ}$. $Coord_{DO.OPT}$ was accepted faster than $Coord_{DO.OBL}$ or $Coord_{SUBJ}$. $Coord_{SUBJ}$ was rejected faster than $Coord_{DO.OBLIG}$ or $Coord_{DO.OPT}$. AS*x*ORDER: $Coord_{DO.OBL}$: (4) was preferred over, and accepted marginally faster than, (3). $Coord_{SUBJ}$: (5) was preferred over (6). There was no effect for ORDER on the acceptability of $Coord_{DO.OPT}$ but (1) was accepted faster than (2).

Conclusion: Our results confirm our predictions about the ease with which repair mechanisms can be applied, hightlighting the different costs involved in the processing of ungrammatical ellipsis.

1. $Coord_{DO.OBL}$ wh_{ADJ}&wh_{ARG}: was *(what)* und *(and)* wann *(when)* der Bäcker(the_{NOM}baker) gegessen *(eaten)* hat *(has)*.
2. $Coord_{DO.OPT}$ wh_{ADJ}&wh_{ARG}: wann und was der Bäcker gegessen…
3. $Coord_{DO.OBL}$ wh_{ARG}&wh_{ADJ}: was und wann der Bäcker verschluckt *(swallowed)*…
4. $Coord_{DO.OBL}$ wh_{ADJ}&wh_{ARG}: wann und was der Bäcker verschluckt…
5. $Coord_{SUBJ}$ wh_{ARG}&wh_{ADJ}: wer*(who_{NOM})* und wann der Bäcker geschlafen *(slept)*…
6. $Coord_{SUBJ}$ wh_{ADJ}&wh_{ARG}: wann und wer der Bäcker geschlafen…

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Does the parser predict gaps inside islands?: evidence from pupillometry

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Keywords: pupillometry; filler gap dependencies; processing load.

We used pupillometry, which indexes processing load/effort, to investigate the processing of parasitic-gap dependencies. Parasitic gaps are structures in which an illegal gap, in an island, is acceptable as result of a subsequent legal gap (e.g. What$_i$ did the attempt to fix_ultimately damage_ t_i _?). Two theories have been proposed to account for the processing of these structures: processing-based theories assume these constructions are too complex to parse (Pritchett, 1991) and grammar-based theories assume these constructions are inherent within grammar (Phillips, 2006). Based on self-paced reading, Phillips argued that the parser posits gaps in an island when the verb is infinitive and when the wh-phrase is a plausible object of the verb [see A]. This conclusion was based on an immediate slowdown at the verb when the wh-phrase was implausible (e.g. **which students$_i$**). However, a closer inspection of the data actually suggests that the interaction was driven by faster reading times in the infinitive/plausible condition. Thus, the creation of a wh-dependency seemed to facilitate processing.

In this study, sixteen participants' pupil diameter was measured as they heard sentences, such as [A], and we also probed comprehension accuracy [B]. We analyzed a 1.2 second time window at the embedded verb and the following word. The design was 2x2 (plausibility x verb type). Plausibility refers to whether the wh-phrase was a plausible object of the embedded verb (schools vs. students). Verb type refers to whether the embedded verb was infinitive or finite (to expand vs. that expanded). We were interested in whether pupil diameter would corroborate or refute Phillips conclusions, specifically whether implausibility increases or decreases processing load.

(A)The teacher learned **which schools$_i$** the proposal to expand__upon the current curriculum would overburden_t_i_during the year.
(B)Was the proposal to expand the schools?

Comprehension accuracy showed a large effect of plausibility. Performance was significantly below chance for both plausible conditions, indicating a tendency to associate the wh-phrase with the verb even when it was finite. Pupil diameter showed a main effect of verb type (at the verb): infinitive conditions showed a significant decrease in pupil size, suggesting a decrease in processing load. There was an interaction at the following word, primarily driven by finite sentences. Pupil diameter significantly decreased in the plausible condition and significantly increased in the implausible condition. This suggests that plausibility did not have an immediate effect, and that processing load increases in the finite/implausible condition.

Therefore, our data suggests two main differences from what Phillips reported. Participant's created dependencies (1) when the verb was infinitive and the object was implausible and (2) when the wh-phrase was a plausible object of a finite verb. Evidence for the latter comes from offline comprehension performance. Thus, the parser employs a quite active gap filling strategy, as it creates dependencies where it is grammatically impossible to do so. We hypothesize building dependencies reduces processing load, or alternatively, it could represent a "good enough" strategy shift, in which participants tend to rely more on semantics. Thus, our results are more consistent with processing-based theories.

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The origin of surprisal effects during reading: evidence from pupillometry

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Keywords: Reading; Eye tracking; Pupillometry; Sentence comprehension; Surprisal; Computational models.

It has been argued (Levy, 2008) that processing a word in sentence context requires an amount of cognitive effort proportional to the word's *surprisal* (the negative logarithm of its probability given the sentence-so-far). Surprisal values, estimated by any sufficiently accurate probabilistic language model, indeed correlate with word-reading times (e.g., Smith & Levy, 2008).

Two explanations of the surprisal effect have been proposed: the *integration* account (Levy, 2008) and the *preparation* account (Smith & Levy, 2008). According to the integration account, whenever a word is integrated into the mental representation of the sentence so far, a probability distribution over sentence interpretations is updated; the size of this update equals the word's surprisal. In contrast, the preparation account claims that the cognitive system prepares more for words that are more likely to occur, hence, processing these less surprising words requires less cognitive effort.

Here, we use pupillometry (i.e., measuring change in pupil dilation due to cognitive load) to investigate which account is most plausible. Seventeen monolingual, native English speakers read 205 sentences (selected from three unpublished novels) while their eye gaze and pupil size were measured. Surprisal values for each word in the sentence stimuli were obtained by recurrent neural networks (RNNs) and phrase-structure grammars (PSGs).

Mixed-effects regression analyses revealed a significant positive relation between word surprisal and gaze duration. This effect was stronger for the RNN-based than the PSG-based surprisals ($\chi^2 = 7.6$; $p < .01$), closely mirroring the pattern found in a previous self-paced reading study with the same stimuli and models. More importantly, we found a very early effect of surprisal on pupil size: Between 250 ms before until about 100 ms after word fixation, pupil size was significantly larger for words with higher surprisal values ($\chi^2 \approx 6.4$; $p < .02$), but only if those values were estimated by an RNN.

These results do not support an integration account of surprisal since it is unlikely that words are integrated with the current sentence context as early as 250 ms before fixation. Instead, under a preparation account of surprisal, the early effect can result from (form-based) matching between anticipated and (parafoveally) perceived input. Further, whereas the PSG computes surprisal by integrating a word with a syntactic structure, the RNN model generates surprisal estimates by prediction (the first step towards preparation) Therefore, a stronger effect of RNN-based surprisals is expected under the preparation account.

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Pupillometry demonstrates 6-month-olds' representation of phonetic segments

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Keywords: phonetic segments; speech representation; pupillometry

Young infants have detailed representations of speech but it is unclear whether their representations of syllables are structured in phonetic segments (i.e., consonants and vowels). For example, 2- to 4-month-oldsdo not appear toperceive different syllables containing the same onset consonant (e.g., *bi, ba, be, bu*) as inherently more similar than one containing a different consonant (e.g.,*du*; Bertoncini et al., 1988). These results suggest that young infants do not rely on a segmental representation of speech. We exploited the novel technique of pupillometry to investigate whether 6-month-olds represent phonetic segments.

Experiment 1 validates pupillometry as a reliable tool to study infants' perception of speech. Infants were tested in an oddball paradigm. Standard trials (75%) consisted of the same syllable repeated four times (e.g., '*ba-ba-ba-ba*'); deviant trials (25%) consisted of the standard syllable repeated three times and a fourth different syllable (e.g., '*ba-ba-ba-di*'). Pupil diameters were measured by a Tobii eyetracker T60. During each trial, infants saw the same video on the screen. Fourteen infants (5 months 25 days to 7 months 0 day) were included in the analysis. We computed the variation of the pupil diameter (VPD) in reaction to the fourth syllable relative to a baseline taken before the onset of the fourth syllable of each trial. The VPD was averaged in two successive time windows (0-800 ms; 800-1600 ms) following the fourth syllable onset. A 2x2 ANOVA with Condition (standard/deviant) and Time Window as within-subject factors yielded a significant interaction; $F(1,13)=7.19$; $P=.019$. The increase of diameter in the second relative to the first time window was larger for the deviant than for the standard condition.

Experiment 2 asked whether 6-month-olds represent phonetic segments. The procedure was similar to Experiment 1, but there were four equiprobable trial types. The first three syllables were the same for all trials and shared their initial consonants (e.g., *bead-bad-boat*). The fourth syllable was different for each trial type; e.g., *birt, boo, bay* or *due*. If infants represent phonetic segments, and therefore separate initial consonants from the rest of the syllable, they should easily categorize the syllables starting with the same consonant.The trial '*bead-bad-boat-due*' should therefore be the deviant trial relative to the other three types of trials: '*bead-bad-boat-birt*'; '*bead-bad-boat-boo*'; '*bead-bad-boat-bay*'. If this is the case, larger pupil dilation should be found for the syllable starting with a different consonant. Data from fourteen infants (5 months 21 days to 7 months 5 days) were analyzed with a 4 Trial Type x 2 Time Window (0-800 ms/800-1600 ms) repeated-measures ANOVA, revealing a significant interaction $F(3,11)=4.305$; $P=.031$. Post-hoc tests showed that the pupil diameter increased over time for the syllable with a different onset consonant more than in the other three conditions, which did not differ from each other. These results suggest that 6-month-old infants represent phonetic segments and are able to form a category of syllables sharing an initial consonant.

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Pupil Dilation Shows Effects of Discourse on Object Pronoun Processing

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Keywords: pupil dilation; object pronouns; discourse; visual world paradigm

The interpretation of object pronouns is assumed to be constrained by grammatical principles (of Binding Theory). Most research investigating the processing of object pronouns focused on whether these grammatical principles prevent ungrammatical referents (in particular, the subject of the clause) from being considered as the referent of the pronoun (a.o., Nicol & Swinney, 1989; Badecker & Straub, 2002). In this study, we address the novel question whether discourse factors that have been found to influence the processing of subject pronouns also influence the processing of object pronouns. We investigated the effect of order of referent introduction by measuring pupil dilation.

Experiment

Pupil size is a reliable and consistent physiological measure of cognitive load, and has been used to detect effects of syntactic complexity, prosodic information and visual context on sentence processing (a.o., Engelhardt et al., 2010). In a Picture Verification Task, 17 Dutch-speaking adults had to judge a test sentence preceded by an introductory sentence, as in Table 1. We measured pupil size during the task with an Eyelink 1000. Each picture showed two referents, one of them performing either an other-oriented action (match) or a self-oriented action (mismatch). The order of introduction of the two referents was manipulated.

Table 1: 2x2 Experimental design

Introduction order	Visual context
Agent-Patient (AP): Here you see a penguin and a sheep.	Match: penguin hits sheep.
Patient-Agent (PA): Here you see a sheep and a penguin.	Mismatch: penguin hits himself.
Test sentence: The penguin is hitting him with a hammer.	

Results

Pupil dilation, the proportion increase or decrease from the mean pupil size in the first 100 ms of the trial, was analyzed in a 3000 ms window from the onset of the pronoun using *generative additive models* (cf. Tremblay & Baayen, 2010; Wood, 2006). Using model comparisons, the best-fitting model included *Introduction order* over time ($F(5.48,74603)=14.05$; $p<.001$), *Visual context* over time ($F(3.14,74603)=39.16$; $p<.001$), and their interaction over time ($F(4.50,74603)=47.65$; $p<.001$) beside random effects for items and participants: Introduction order AP elicited more pupil dilation than PA, and with Introduction order AP, mismatch pictures elicited more pupil dilation than match pictures.

Our results show that order of referent introduction influences on-line object pronoun resolution. Not only the presence of an ungrammatical referent, but also the saliency of this referent in the local discourse plays a role. This suggests that the grammar does not filter out ungrammatical referents. Rather, during referent selection grammatical principles compete with the same discourse factors that constrain the processing of subject pronouns.

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Anticipatory eye movements are modulated by working memory capacity: Evidence from older adults

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Keywords: anticipatory eye movements; individual differences; older adults; sentence processing; working memory.

Recent theoretical accounts of language processing assume an important role for the prediction of up-coming linguistic input (Altmann & Mirkovic, 2009; Chang, Dell, & Bock, 2006; Federmeier, 2007; Pickering & Garrod, 2007) which is supported by much experimental evidence (e.g., Altmann & Kamide, 1999; DeLong, Urbach, & Kutas, 2005). Little is known about the underlying principles and mechanisms driving such prediction. Here we investigated whether differences in working memory capacity predict the degree of anticipatory sentence processing. We chose older adults for our investigation. Older adults are less likely than younger adults to show prediction-related benefits during sentence processing (Federmeier et al., 2002) but it is yet unclear what cognitive processes underlie this difference. We conducted two visual world eye-tracking experiments and administered two working memory (WM) tests: a non-word repetition task and a backwards-recall digit span task.

Method

Thirty-eight older adults (mean age 68, screened for good hearing and vision, native speakers of Dutch) previewed visual displays containing four objects for four seconds, then a Dutch auditory sentence was initiated which they listened to while continuing to view the display. In the experimental condition of Experiment 1 the declarative sentence contained a verb (e.g., "write") which strongly biased one of the displayed objects (e.g., a letter: the complete sentence being "The boy writes a letter"). The control condition was identical except that the verb (e.g., "look at") did not bias towards any of the objects. In Experiment 2 the same participants received instructions (e.g., "look at the displayed piano" in Dutch) while viewing similar four object displays. Importantly, the articles were gender-marked such that the article agreed in gender only with the target object and thus participants could use gender information from the article to predict the target object.

Results

In both eye-tracking experiments, on hearing the biasing information (verb or article), participants anticipated the target object well before noun onset. We calculated participants' degree of prediction (target fixation proportions divided by the sum of target fixation proportions and averaged distractor proportions) between verb (or article) onset and noun onset. Participants' degree of prediction significantly correlated between both experiments. Degree of prediction also correlated with performance in the non-word repetition task (two-tailed, Exp 1 (verbs): .46, p=.003; Exp 2 (articles): .45, p=.004) and digit span backwards (Exp 1: .33, p=.045; Exp 2: .24, p=.153, one-tailed controlling for hearing: .28, p<.05). All correlations remained significant when age or hearing sensitivity was partialled out.

Conclusion

Predicting which object an interlocutor will refer to next requires the building of online models allowing for arbitrary objects to be linked to unfolding linguistic information, places, times, and each other. Our data suggest that limitations in working memory capacity are a significant source of limitations in language-mediated anticipatory eye gaze in older adults. Moreover, the finding that the linguistic WM task shows stronger correlations with predictive processing than the digit span WM task may be taken as indicative that language-mediated anticipatory eye gaze is modulated by partially distinct underlying WM components.

Interference Effects in Anaphor Resolution: Eyetracking Evidence from Mandarin

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Keywords: reflexives; interference; retrieval; binding; working memory; Chinese; eyetracking

The question whether the human parser resolves a reflexive's antecedent using only syntactic constraints (Principle A) or also relies on non-structural cues is a crucial test for understanding the mechanisms underlying retrieval processes in human sentence comprehension: If syntactic cues have priority in resolving dependencies, the parser should be able to ignore items matching non-structural cues.

There is conflicting evidence on whether, at an early stage of binding, the parser indeed relies on syntactic constraints alone (Sturt, 2003; Xiang, Dillon, & Phillips, 2009), or also uses non-structural information and hence is subject to interference from syntactically illicit antecedents (Cunnings & Felser, 2011; King, Andrews, & Wagers, 2012).

We addressed this question in an eyetracking experiment on Mandarin (n=150). The reflexive *ziji* requires an animate, c-commanding antecedent. In order to investigate whether animacy is used as a retrieval cue, we manipulated animacy of a syntactically accessible (i.e., c-commanding) antecedent (*yundongyuan* vs. *pihuating* in (1)), and of a syntactically inaccessible (i.e., non-c-commanding) antecedent that intervened between the reflexive and the accessible antecedent (*lingdui* vs. *meiti* in (1)).

(1) **Yundongyuan**$_i$/***Pihuating**$_i$ [$_{PP}$zai **lingdui**$_j$/**meiti**$_j$ shijia juda yali de qingkuang xia]
athlete/kayak   when team.leader/media exert great pressure MOD circumstance under

chaoyue le ziji$_{i/*j}$...
outperform ASP REFLEXIVE...

'When the team leader/the media exerted great pressure, the athlete/the kayak outperformed himself/itself...'

If, at an early stage of binding, only syntactic constraints are used, no effect of the inaccessible antecedent is predicted. However, if, at this early stage, the parser also uses animacy as a retrieval cue, we expect an effect of inaccessible antecedent at the reflexive in early measures.

Early measures showed a slowdown at the reflexive when the inaccessible antecedent was animate (first-fixation: t=2.2; gaze: t=2.7). This effect was driven by the conditions with an inanimate accessible antecedent (first-fixation: t=3.2; gaze: t=3.9). No interference effect was observed in the comprehension questions. Similarly, a second eyetracking experiment (n=130) also showed interference effects from animate nouns held in memory while reading.

This pattern can be explained neither by the cue-based retrieval architecture of Lewis and Vasishth (2005) which predicts a speed-up due to misretrieval of the inaccessible animate antecedent when the accessible antecedent is inanimate nor by a purely structure-based account. The results suggest that, in the first stage of parsing, a parallel cue-based retrieval mechanism uses animacy and c-command simultaneously to identify candidate antecedents. In a second step, the c-command cue acts as a filter to decide between the alternatives. When the accessible antecedent is animate, this fully cue-matching target gets enough activation to not suffer interference from the only partially cue-matching inaccessible antecedent. When the accessible antecedent is inanimate, no fully cue-matching target is available and the presence of an animate inaccessible antecedent leads to competition between the two NPs. Subsequently, the c-command constraint eliminates the inaccessible antecedent. In sum, we show that in Mandarin, during the initial stage of parsing, both structural and non-structural cues are deployed to resolve dependencies, but the syntactic cue eventually weighs in.

Individual Differences in Verbal Working Memory Predict Reanalysis vs. Integration Difficulty in Syntax-Semantics Conflict Scenarios

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Keywords: ERP; Working Memory; Individual Differences; Language Processing; N400; P600

Psycholinguistic research has long sought to explain how combinatory processing is shaped by the brain's limited capacity to actively maintain information over time. Most research focuses on systematic processing costs for some linguistic structures over others (c.f. Just & Carpenter 1992, Gibson 1998, Caplan & Waters 1999, Macdonald & Christiansen 199)6. Recent event-related brain potential (ERP) studies report that individuals with high vs. low working memory capacity show qualitatively different effects on the N400 and P600 ERP components in response to syntactically simple sentences. For instance, Nakano, Saron & Swaab (2010) investigated semantic P600 ERP effects and found that anomalous (animacy violation) verb-argument combinations elicited P600 in participants with high verbal working memory span scores, but N400 in lower-span individuals. Furthermore, Bornkessel, Fiebach & Friederici (2004) reported that garden path sentences elicited P600 in high-span individuals but N400 effects in low-span individuals. These findings raise the possibility that N400 and P600 reflect two different functional "options" that arise when the linguistic input is unexpected, with the choice between these options determined in part by individual differences in processing capacity.

We recorded ERPs to "semantic attraction" anomalies (Kim & Osterhout 2005) which are thought to involve a syntax-semantics conflict, while simultaneously and systematically investigating how these individual ERPs varied as a function of multiple cognitive abilities: verbal working memory, spatial working memory, and language experience. Using multiple measures of each construct, we conducted regression analyses to specify which of them best accounted for individual differences in the brain responses to unexpected stimuli. We employed a sample of 60 subjects to obtain reliable correlations with individual capacity measurements. Across all subjects, semantic attraction anomalies elicited P600 effects, while no-attraction anomalies elicited N400 effects (replicating Kim & Osterhout, 2005). Verbal WM predicted both individual subject P600 and N400 effect magnitudes, even when controlling for the effect of spatial WM and linguistic experience. As verbal WM increased, participants showed larger P600 and smaller N400 effects for both the attraction and the no-attraction violations. Spatial WM did not predict N400 or P600 effect magnitude after controlling for verbal WM, suggesting that the individual differences in ERPs are not accounted for by a general form of WM.

We suggest that syntax-semantics conflicts, which are pervasive in language processing, can lead to 1) an attempt to semantically integrate a syntactically licensed but implausible interpretation, reflected in N400 or 2) an attempt to restructure the sentence, reflected in P600, and that the latter restructuring response requires processing resources that are more available in high-capacity individuals than low-capacity individuals. Thus, verbal working memory capacity plays a critical role in the language processing system's management of linguistic information over time, and is at the heart of sometimes-qualitative inter-individual differences in language processing.

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Individual Differences in Incremental Mental Timeline Compatibility Effects for Past- and Future-Tense Sentences

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Keywords: Mental timeline; individual differences; working memory.

Introduction

Recent findings suggest that compatibility between response location and verb tense (or mental timeline effects) affects response latencies for sentence sensibility judgments. Shorter response latencies were observed for past-tense sentences when sensibility judgments were given with the left hand (compared to the right hand), and the opposite pattern for future-tense sentences (Ulrich & Maienborn, 2010). However, the measures of end-of-sentence response times could mask more subtle differences between incremental language comprehension and response preparation. Also, participants' working memory capacity could mediate the mental timeline effect due to individual differences in the ability to offload information to the environment as external spatial indices. We examine these open issues in an experiment similar in procedure to Ulrich and Maienborn. The materials were changed slightly to fit eye-tracking methodology.

Methods

Participants (N=48) read sentences either in the past- (1) or future-tense (2). Of the 96 sentences, 48 were sensible sentences and 48 were nonsense filler sentences. Half of the critical sentences were past tense and half were future tense.

1)　　　/Früher in dieser Woche/faltete/Jennifer/im Wohnzimmer/die Wäsche./
　　　/Earlier this week/folded/Jennifer/in the living room/the laundry./
2)　　　/Später in dieser Woche/faltet/Jennifer/im Wohnzimmer/die Wäsche./
　　　/Later this week/folds/Jennifer/in the living room/the laundry./

Participants were asked to judge whether the sentence refered to the past or future. However, they were also asked to respond only if the sentence made sense. For nonsense sentences participants were supposed to wait until the trial timed out. Their eye movements were recorded and fixation durations were summed in each region (shown above). We analyzed first-pass (the sum of the first fixation durations in a region before exiting the region), regression-path (the sum of fixation durations from first entering a region, including any re-reading of the left context, and before exiting to the right), and total reading times (the sum of all fixation durations in a region). Compatibility effects were considered to be shorter latencies in a region when the tense matched the response location (i.e., past tense-left button). Participants' working memory was also assesed.

Results

We conducted a linear mixed effect model analysis with sentence tense (past/future), response location (left/right), and participants' working memory (high/low) as fixed effects. The model revealed no compatibility effects in first-pass and regression-path times. However, in total reading times we found a reliable compatibility effect in the first region (/*Earlier…*/ vs. /*Later this week*/) and an incompatibility effect in the final region /*die Wäsche.*/ of the sentence. Although these two effects were reliable in the analysis with all participants, we also found that the low-working memory readers showed a compatibility effect for past-tense sentences in the first region of the sentence, while high-working memory readers showed no effect in the past tense.

Discussion

The compatibility effects observed at the beginning of the sentence indicate that mental timeline mapping occurs early in the processing of the sentence; however, it also decays rapidly in the dual-task nature of our procedure as shown by the end-of-sentence incompatibility effect. High working memory readers showed no effect of working memory load at the sentence-initial temporal cue in the past tense condition, suggesting they offload the temporal information to a spatial axis more rapidly than low-working memory readers.

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Cross-domain Structural Priming from Mathematics to Language: Relative Clause Attachment in Italian

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Keywords: Syntactic priming; Arithmetic; Relative-clause attachment; Italian.

Introduction

Scheepers et al. (2011) found cross-domain syntactic priming effects when concurrent mathematical tasks interfere with the processing of relative clause attachment. In English, priming was found with fewer low-attachment (LA) target completions than in the high attachment (HA) priming condition. Priming was weaker for LA than after HA priming equations. To explore cross-domain structural priming we ran two cross-domain priming experiments in Italian during sentence comprehension. Assuming working memory costs drive low attachment and not a principle (Late closure) we manipulated the amount of structural information in the more complex HA expressions and the impact of HA processing in language interpretation.

Methods and Results

In Exp1 prime-target pairs were created (HA priming: 5+(2+1) x2; LA priming: 5+2–3x2; linear: 4+5-2+1). Participants saw a target stimulus, a relative clauses ("Ho visto la figlia della signora che è andata in Egitto", *I saw the daughter of the lady who went in Egypt*) after completing the arithmetic operation and 250ms SOA. A comprehension question with multiple choice answer followed each sentence ("Chi è andato in Egitto?" *Who went to Egypt?*) (High-type; Low-type).

51 participants participated in Exp1. Overall accuracy of the mathematical task was 88% with lower accuracy with high expression (80.5%). Results evidenced a two-way interaction between ARITHMETIC PRIME and ANSWER (F (2,86)=12.499, p=.00002). There was a main effect of priming condition on the proportion of HA prime with an increase in High interpretation in the sentences (mean of HAnswer = 3.9; mean of LAnswer = 2.6) (p<.01). Interestingly, priming effect was significant only for HA interpretation. There was no difference in comprehension in LA priming condition (mean of HAnswer = 4.0; mean of LAnswer = 3.4).

In Exp2 we added parenthesis in LA condition and redundant parenthesis in HA (HA: 5+((2+1) x2); LA: 9-2-(3x2)). 45 participants participated in Exp2. HA accuracy increased (95.8%). There was no difference in accuracy between HA and LA (p=.11). Interestingly, there were no effects of priming with any increase of High interpretation after high math prime.

We found a main effect of Experiment (F (1,85)=22.025, p=.00001) since accuracy was higher in Exp2 (95.7% vs 87.9%). We found an interaction between ARITHMETIC PRIME and Experiment (F (2,170)=6.1635, p=.00261) since accuracy increased in High expressions in Exp2 compared to Exp1 (95.8% vs 80.6%) (p=.000003).

Conclusions

Mathematical equation structures affected relative-clause attachment in a subsequent sentence-comprehension task and priming effects were found only for complex HA. This is similar to English supporting the idea of a universal operational character for HA. Furthermore, priming effects were visible only in HA condition in Exp1 with no redundant parenthesis. This task has greater complexity indexed by lower accuracy since less information is given and interference of the low reading is higher. More specified expression even if complex does not induce any priming effect.

A domain general level of abstraction for language and maths is visible only in the complex HA condition reviling an operational character of the interference processes.

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Lexical Boost in Passive Priming: No Evidence for Strategic Effects

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Keywords: sentence production; structural priming; lexical boost

The production of actives vs. passives is notoriously harder to prime than that of dative alternation structures, and this seems to be especially true for German (Loebell & Bock, 2003; own attempts). In two sentence generation experiments carried out in German, we tried to boost passive priming by verb repetition between prime and target.

In Experiment 1, we presented transitive primes and targets in two animacy conditions (inanimate vs. animate theme, causes were inanimate). In mixed blocks, prime structure (active vs. passive) and lexical boost (same vs. different verb in prime and target) were manipulated. GLMMs revealed an overall prevalence of active responses ($p < .001$), an effect of prime structure ($p < .001$), no simple effect of lexical boost ($p = .19$), but an interaction of prime structure and boost ($p < .05$). There were more passive responses after passive primes than after active primes and this effect was stronger in same than in different verb trials. Animacy had an independent effect, resulting in more passive responses with animate than with inanimate themes. As the found priming effect was quite substantial (14.1% in no-boost conditions and 25.7% in boost conditions), we wanted to make sure that it was not due to strategic effects such that verb repetition attracted the participants' attention to the prime-target relation.

In Experiment 2, the very same materials were used in a blocked design. One group of participants responded to different verbs in primes and targets in the first block and same verbs in the second block. For the other group of participants the sequence of blocks was reversed. GLMMs documented a prevalence of active responses ($p < .001$), again, significant priming ($p < .001$), a boost effect with more passives in the verb repetition block than in the different verb block ($p < .05$), an interaction of prime structure and boost (6.3% priming difference in no-boost and 28.5% in boost conditions, $p < .001$), but no effect of block order, neither simple nor in interaction with another factor. As in Experiment 1, animacy had an independent effect on responses ($p < .001$). We conclude that the lexical boost manipulation did not induce strategic effects in the no-boost trials.

To summarize, we found evidence for structural priming of active vs. passive responses in German as well as evidence for a lexical boost. These effects are accounted for by the activation of combinatorial nodes and their links to individual verbs in the lexicon (Pickering & Branigan, 1998). We found no evidence that the lexical boost attracts attention to the prime-target relation and therefore enhances structural priming in general.

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Do Italian 3- and 4-year-olds have abstract passive syntax?
Evidence from syntactic priming

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Evidence that English children produce more passives after hearing passive primes suggests that they have a representation of abstract passive syntax by 4 years (Bencini & Valian, 2008).

However, studies in other languages with a more flexible order (e.g., Russian: Vasileya & Waterfall, in press; Spanish: Gámez et al., 2009) do not provide similar evidence for abstract passive syntax: In these languages, children exposed to passives tend to produce structures that emphasise the patient (e.g. OVS), showing repetition of thematic emphasis (Bernolet et al., 2009).

It is possible that children may acquire the passive structure relatively late in languages with a flexible word order, in which other (less complex) structures can realise the same discourse function.

To test this, we investigated the production of periphrastic passives in Italian children (n=36; aged 3;6-4;6 years). Italian has a flexible word order, in which left dislocation (e.g. il re, lo spinge la tigre/the king, him.Cl pushes the tiger) fulfills the same discourse functions as the periphrastic passive (e.g., topicalising the patient).

In Experiment 1, 12 children were asked patient-focused questions ("What is happening to the XPATIENT"?) to describe transitive actions.

In Experiments 2 and 3, we used a syntactic priming paradigm: Children (n=12 in each experiment) alternated listening to active and passive primes (within participants), and describing unrelated target transitive pictures as part of a picture-description game (Messenger et al., in press).

We used both morphologically transparent venire-passive (E2: il re viene spinto dalla tigre/'the king comes pushed by the tiger') and morphologically ambiguous (between passive and copular-adjective structures) essere-passive (E3: il re è spinto dalla tigre/'the king is pushed by the tiger') primes.

In Experiment 1, patient-focused questions elicited left dislocations (65%) and no passives. In contrast, in both priming experiments, passive primes elicited significantly more (adult-like) full passive responses than active primes (strict score analysis: E2: 20% vs 4%; E3: 11% vs 1%, ps < .05); however, they did not elicit more left- dislocated responses than active primes (E2: 4% vs 7%; E3: 9% vs 6%, ps > .1).

These findings suggest that Italian children master the use of clitic left-dislocations by the age of 4 and preferentially use this structure to foreground the patient in spontaneous production (Experiment 1).

However, at this age they already possess an abstract representation of passive syntax, which extends to both venire- and essere-passives, although they have not fully mastered its morphology and thematic role mappings (as manifested in some production of reversed passives and morphosyntactic errors) (Experiments 2 and 3).

We conclude that the existence of flexible word order, and in particular the availability of less complex structures that can fulfill the same discourse functions as the passive, is not necessarily associated with late acquisition of passive syntax.

Additionally, our results show that priming effects in children in languages with flexible word order are not necessarily primarily associated with repetition of thematic emphasis rather than constituent structure.

Syntactic priming in two-year-old children

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Keywords: syntactic priming; abstract syntax; language acquisition.

Introduction

There is an ongoing debate about the abstractness of young children's syntactic representations. Syntactic priming studies show evidence of abstract syntactic representations in production as early as three years of age (e.g. Shimpi, Gámez, Huttenlocher, &Vasilyeva, 2007). Another debate centers around the mechanism behind syntactic priming, especially whether it is based on short-lived activation or longer-lived implicit learning (cf. Pickering & Ferreira, 2008). This study extends the syntactic priming paradigm for use with German-speaking two-year-old children to shed light on two questions: Can we find evidence for abstract syntactic representations in two-year-olds? Is syntactic priming short-lived or longer-lived?

Experiment 1

In Experiment 1, older two-year-olds (2;7 to 2;11) described pictures with optionally transitive verbs. Pictures showed a girl named Emma and children were asked what she was doing. For example, children described a picture of Emma eating cheese as "essen" ("eating", intransitive infinitive), "isst" ("eats", intransitive conjugated), "Käse essen" ("eating cheese", transitive infinitive), "isst Käse" ("eats cheese", transitive conjugated) etc. Children first described 6 baseline pictures without prime sentences. 12 primed picture descriptions followed: First, the experimenter produced a prime sentence with a transitive or intransitive infinitive, for example, "Baby kitzeln" ("tickling a baby") or "laufen" ("running"). Then, children described a target picture with an optionally transitive verb. Prime and target sentences shared no content words. Children were primed to use the transitive infinitive structure: They produced reliably more transitive infinitive responses following transitive infinitive (21.1%) compared to intransitive infinitive primes (8.9%) or the baseline (6.7%). Transitive conjugated responses did not increase, suggesting that transitive infinitive primes did not merely prime the message (i.e. producing an action and a patient/theme), but the syntactic structure. This suggests that older two-year-olds possess abstract syntactic representations. The data also show preliminary evidence for implicit learning: Priming was marginally stronger in the second compared to the first half of the experiment.

Experiment 2

In Experiment 2, younger two-year-olds (2;0 to 2;6) performed the same task and showed no priming effect: They did not produce more transitive infinitive responses following transitive infinitive (10%) compared to intransitive infinitive primes (16.7%) or the baseline (4.4%). We thus find no evidence for abstract syntactic representations in children this young. However, children did react to the priming manipulation: They produced numerically more noun responses following transitive (25.6%) compared to intransitive primes (15.6%) or the baseline (17.8%). This increase in noun responses could stem from failed attempts to produce messages with action and patient/theme or to produce transitive structures.

Conclusions

The study presents novel evidence from production suggesting that abstract syntactic representations develop (or strengthen) during the second year of life. In addition, the results from the older two-year-olds support an implicit learning account of syntactic priming since priming increased over the course of the experiment.

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Separable effects of lexical association and plausibility on the N400

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Keywords: Semantic reversal anomalies; N400; lexical association; plausibility; German; ERP study.

Abstract

The processing of so-called "semantic reversal anomalies" (SRAs; e.g. *The hearty meal was devouring...* (Kim & Osterhout, 2005)) has long been a hot topic in psycholinguistics and neurolinguistics. These anomalies are instructive for a better understanding of the N400 component because they induce integrative processes and are affected by lexical association.

In SRAs, one or several NPs take on an implausible role (e.g. "hearty meal" as Agent of "devour") even though they would be a highly plausible filler for another role of the same verb (e.g. Theme). SRAs engender only a P600 but no N400 in English and Dutch (e.g. Kim & Osterhout, 2005; Kolk et al., 2003; Kuperberg et al., 2003) and this has been used to argue for a primarily lexical view of the N400, i.e. that N400 amplitude reflects the degree of lexical preactivation (rather than, for example, semantic integration) (e.g. Brouwer, Fitz, & Hoeks, 2012).

Strikingly, however, SRAs in languages with a less strict word order (e.g. German, Turkish) do engender an N400 effect in spite of a close semantic relation between the lexical items (see Bornkessel-Schlesewsky et al., 2011, for empirical findings and a detailed account of the cross-linguistic differences in terms of how strongly sequence-dependent interpretation in a given language is). Thus, in a language such as German, the N400 also appears to reflect semantic integration.

The present ERP study aimed to directly compare the influence of these two factors (association and integration) on the N400 by examining German SRAs with either a high (1a/b) or a low (1c/d) degree of semantic association between the arguments and the verb. Sentences were presented using rapid serial visual presentation and participants (n=22) judged their plausibility on a 4-point scale.

(1) Example sentences from the present study (word-by-word English translations of German originals)
      a. *...that the author*(NOM) *the novel*(ACC) <u>*writes*</u>   HIGH-ASSOC   PLAUSIBLE
      b. *...that the novel*(NOM) *the author*(ACC) <u>*writes*</u>   HIGH-ASSOC   IMPLAUSIBLE (=SRA)
      c. *...that the author*(NOM) *the novel*(ACC) <u>*knows*</u>   LOW-ASSOC   PLAUSIBLE
      d. *...that the novel*(NOM) *the author*(ACC) <u>*knows*</u>   LOW-ASSOC   IMPLAUSIBLE (=SRA)

ERP results revealed an influence of both association and plausibility on the N400 (300-600 ms post onset of the verb; confirmed to be unaffected by potential spillover effects from previous phrases), but with a differential latency: association effects were observable from 300 ms onwards, while plausibility effects did not begin to emerge until 450 ms post critical word onset. Crucially, the later plausibility effect was independent of the degree of lexical association.

These findings provide compelling evidence for independent – and successive – effects of lexical association and semantic integration on the N400. We argue that the latter property was masked in many previous studies of the N400 in languages such as English or Dutch, which do not show integration-based N400 effects due to the strongly sequence-dependent nature of sentence interpretation.

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Individual differences in syntactic interference effects: Electrophysiological evidence

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Keywords: ERP; agreement attraction; individual differences; morphosyntax, language comprehension.

Language processing in many languages requires the integration of grammatical features between the subject noun phrase (NP) and verbal inflections. A significant amount of research on subject-verb agreement processing has shown that English speakers experience processing difficulty when the subject NP contains conflicting cues about grammatical number. Agreement processing in both comprehension and production becomes more difficult and error-prone when a plural noun is embedded in an otherwise singular NP, relative to when both nouns are singular . This phenomenon ('agreement attraction') shows that the plural feature of an embedded NP interferes with the normal processing of subject-verb agreement. However, little is known about the neurocognitive correlates of attraction interference, nor what factors relate to the degree of interference an individual shows. Previous research has found mixed results regarding the role of cognitive resources such as working memory in individuals' susceptibility to attraction in production, and no work has investigated this in comprehension.

We used event-related potentials (ERPs) to investigate neurocognitive aspects of individual differences in attraction interference during agreement comprehension. We focus specifically on amplitude modulations of the P600 ERP component, which is reliably elicited by agreement violations. ERPs were recorded while participants read English sentences which contained a complex subject NP where the second noun was either singular or plural, and which contained a verb that either agreed or disagreed with the subject ("The winner of the big trophy/trophies is/*are…"). The monolingual English-speaking participants completed additional behavioral tasks assessing lexical processing speed (RT in a lexical decision task), working memory (operation span), English proficiency, and cognitive control (flanker task).

Preliminary results show a reliable P600 effect to agreement violations, but with reduced amplitude following plural nouns (i.e., an attraction effect). Individual differences in attraction effect sizes over midline electrodes (i.e., the difference in P600 magnitude between the singular and plural attractor conditions, averaged over electrodes Fz, Cz, and Pz) were investigated with regression models. A multiple regression with lexical processing speed, proficiency, cognitive control, and working memory as independent variables predicted a majority of variance in individuals' attraction effect sizes (adjusted-R^2=.72, p=.003). Consistent with some language production research, there was no unique relationship between working memory span and attraction effects during comprehension. Instead, partial correlations revealed that larger interference effects were associated with faster lexical processing and poorer cognitive control. The effect of cognitive control suggests that improved inhibitory control mechanisms may facilitate individuals' ability to suppress the misleading local plural information, whereas the effect of lexical processing speed suggests that certain processing advantages (e.g., faster lexical recognition) can actually lead to increases in syntactic interference by facilitating incorporation of the local noun's plural feature into the morphosyntactic representation of the sentence. By contributing novel methods for quantifying ERPs, we show that a coalition of linguistic and non-linguistic factors conspire in shaping individuals' syntactic processing abilities, and moreover, that ERPs provide an excellent tool for studying individual differences in the neurocognition of language.

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The N400 Component of the ERP:
Insights from an Attractor Network Model of Semantic Processing

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Keywords: N400; ERP; semantic processing; network model; connectionism; implicit prediction error.

Introduction

The N400 component of the event-related brain potential (ERP) is widely used in research on language and semantic memory. Although the component's relation to semantic processing is well-established, the specific computational mechanisms underlying N400 generation are currently not clear. Relating N400 amplitude modulations to parameter variations in implemented computational models of meaning might advance a mechanistic understanding of the N400. A first proposal in this direction was made by Laszlo & Plaut (2012) who related N400 amplitudes to semantic activation in a model of ERPs during reading. Here, we examined the correspondence between N400 amplitudes and two model parameters: Semantic activation, as proposed by Laszlo & Plaut (2012), as well as network error, conceptualized by McClelland (1994) as implicit prediction error that he suggested to generate the N400.

Methods

We used an attractor network model with 30 input units representing word form that map onto 2526 semantic feature units representing word meaning according to semantic feature production norms, and simulated a number of N400 effects obtained in human empirical research: influences of semantic priming, lexical frequency, semantic richness, and repetition, as well as influences of frequency and semantic richness on repetition effects.

Results

Cross-entropy error values were consistently in the same direction as N400 amplitudes. Like N400 amplitudes, error values were larger for low frequency words, larger for words with richer semantic representations, and decreased for semantically related target words as well as repeated words. Furthermore, the repetition-induced decrease was stronger for low frequency words, and for words with richer semantic representations. In contrast, there was less of a correspondence between semantic activation and the N400. Like N400 amplitudes, activation was larger for words with many semantic features. However, activation also increased with frequency, repetition and semantic priming which is opposite to well-established N400 results, and may be more in line with increased activation facilitating lexical and semantic decisions.

Discussion

Our results suggest an interesting relation between N400 amplitudes and error values in connectionist models of meaning. In psychological terms, error values in connectionist models have been conceptualized as implicit prediction error, and we discuss the possibility that N400 amplitudes may reflect this implicit prediction error in semantic memory (McClelland, 1994). In line with such an account, N400 amplitudes seem to crucially depend on the similarity between information that is expected based on occurrence probabilities extracted from previously experienced regularities across levels of representation (e.g. semantic context, relations between words, word frequency…) and the actually observed information.

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Syntactic Indeterminacy Effects on Semantic Integration
- An ERP Study in Korean -

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Goal

Using violation paradigm, we investigated the ERP amplitudes for semantic mismatches between (i) adjective and noun, and (ii) object noun and verb in Korean. The goal of the study is to obtain new ERP evidence/ accounts illuminating the semantic integration processes in the comprehension of head-final structures.

Experiment 1

The structure of the baseline sentences was 'Noun$_{subject}$ + **Adjective** + **Noun**$_{acc-object}$ + Adverb + **Verb**', from which sentences for three types (A-N, N-V, and double) mismatch conditions were derived. ERPs were recorded at the noun, adverb, and verb position while 15 native speakers of Korean (m.=7, f.=8) read total 410 sentences (68 targets per each condition plus 138 fillers) presented word by word.

Noticeably, the N400 component usually standing out at the noun position in case of A-N mismatch (cf. Hagoort, 2003; among others) was completely missing; instead, a delayed N400 was evoked at the adverb position, and further a N400-like negativity indicating the wrap-up at the sentence final verb position. In both N-V and double mismatch conditions, in contrast, the biphasic N400 / P600 ERP pattern was observable at the verb position, which is comparable with results from previous studies on other languages (cf. Zhang et al., 2011).

Experiment 2

Why 'no N400' at the noun position of the semantically mismatched A-N construction? We reasoned that the A-N$_{acc}$ sequence in Korean could be extended to a relative clause 'A-[t$_i$ N$_{acc}$ V$_{rel}$]-N$_i$', where A might be integrated not with the first noun(N$_{acc}$) but with the second one(N$_i$). Probably this kind of syntactic indeterminacy has caused the observed 'no-N400 effect'. In order to test this hypothesis, we changed the critical noun into 'no more extendable' topic by (i) replacing the case marker(ACC→TOP) and (ii) transforming the verb argument structure into pre-nominal relative clause, resulting in the construction '[Noun$_{rel-subject}$ + t$_i$ + **Verb**$_{rel}$] + **Adjective** + **Noun**$_{topic-i}$ + …..'. Three mismatch conditions were the same as those of experiment 1, and another 15 Korean speakers (m.= 8, f.=7) took part in the experiment, with ERPs being recorded only at the topic noun.

The results of the N-V and double mismatch condition were basically the same as those of experiment 1. But interestingly, we found a clear N400 component evoked by the critical topic noun in the A-N mismatch condition. This corresponds to our scenario concerning no-N400 (or a 'delayed' N400) effect in the equivalent condition of experiment 1.

Concluding Remarks

Putting together, the present study demonstrates that the grammatical information contained in the case marker provides an important clue for phrase structure building and semantic integration in head-final languages. Furthermore, our results speak against N400 accounts based exclusively on lexical-semantic pre-activation which would predict an increased N400 amplitude for the A-N mismatch irrespective of the availability of an alternative analysis.

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Will Japanese Readers Bury the Survivors of an Air Crash?
ERP and Oscillatory Neural Dynamics during Semantic Anomaly Detection

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Keywords: electroencephalography; event-related potential; theta oscillation; Japanese; language comprehension; semantic anomaly

Background

Failure to detect semantic anomalies is taken as evidence that shallow processing has occurred, however its nature is poorly understood. We have employed ERP methodology to investigate this further. Sanford et al. (2011) conducted an auditory ERP study and found that whilst easy-to-detect anomalies resulted in an N400 followed by a Late Posterior Positivity (LPP), hard-to-detect anomalies only resulted in an LPP. However, Bohan et al. (2011) found that visually presented hard anomalies resulted in an attenuated N400 effect when they were detected. One goal of this research is to investigate this discrepancy. In order to see whether there are differences in neural dynamics between the processing of easy-to-detect and hard-to-detect anomalies more in detail, we performed the time-frequency analysis by using wavelet transformation.

Furthermore, since most ERP anomaly detection studies are in English it is not clear if non-European languages are processed similarly. A second purpose is to examine the applicability of previous findings to Japanese, which has differences from English including orthography and constituent order.

Methods

Native Japanese speakers read 95 hard-to-detect anomalies and 40 easy-to-detect anomalies. For example:

(Hard) The temperature suddenly rises and falls at a change of season, and we have to be careful with our clothes. It is going to be the (hottest / coldest) this spring today, so *thick* clothes would be good.

(Easy) Web check-in greatly shortens time needed when travelling by plane. Manami had already checked in online, thus she did not have to go to the (elephant / airport) before other passengers.

In hard anomalies, a critical word (*thick*) is related to the overall context but locally anomalous when it is preceded by 'hottest,' but not by 'coldest.' However, in easy anomalies the critical word (*elephant*) does not fit the story at all. Participants judged whether sentences were anomalous and asked to identify anomalies.

Results & Discussion

Detection rates were 98% for easy and 72% for hard anomalies. The analyses were conducted comparing detected and non-anomalous controls. Firstly, ERP analyses showed that only easy-to-detect anomalies elicited N400 and LPP waveforms. Secondly, the N400 activity was reflected in the wavelet analyses with increased theta band power 300-600ms after critical word onset for easy-to-detect items, but not for hard-to-detect anomalies. Thirdly, the phase synchrony analyses indicated that easy-to-detect anomalies resulted in synchronization, while hard-to-detect anomalies led to de-synchronization, which further reflects the differences in the amount of information interaction between these anomalies.

In conclusion, easy and hard anomalies are processed differently, with easy anomalies resulting in an N400, LPP, and the enhanced theta activities. We support Sanford et al. (2011) but do not find evidence to support Bohan et al. (2011) regarding an N400 in hard-to-detect anomalies. Finally, our cross-linguistic comparison suggests that easy and hard anomalies are processed similarly in Japanese and English.

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Rapid activation of subphonemic feature information in reading aloud

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Keywords: subphonemic processing; visual lexical processing; masked priming; ERPs; reading aloud

Introduction

Reading aloud studies show that phonology is activated during visual lexical processing (Timmer, Vahid-Gharavi & Schiller, in press). The level of detail contained in such representations is, however, not yet well understood. Ashby, Sanders and Kingston (2009) found processing of subphonemic feature information (voicing) as early as 80ms after presentation of visual targets in English. Yet it is unclear whether this was an effect of voicing in target consonants or of vowel length: in English, voicing in final stops is confounded with length of the preceding vowel (e.g. 'ee' is longer in 'feed' than in 'feet').

The present study investigated subphonemic processing in Dutch, in which final voiced stops are 'devoiced'. To the best of our knowledge, this is the first study to use ERP measures to investigate subphonemic activation in Dutch visual word processing. If an effect of voicing congruency is found, this is evidence for processing of subphonemic feature information in final consonants. Further, because Dutch voiced and voiceless final stops are ambiguous phonetically, this would suggest category-level, rather than purely phonetic, processing.

Procedure

ERPs from 20 native Dutch speakers were recorded during a masked priming reading aloud task. Participants produced 3-5 letter Dutch words ending in (underlyingly) voiced or voiceless stops. Primes, which were presented for 48 ms, were nonwords that were identical to targets, except for the final letter, which matched in voicing (*voice* condition), place of articulation (*place* condition) or differed in both voicing and place (*controls*).

Results

The first negative-going waveform (N1), which peaked at around 25-75 ms, revealed consistent effects of voicing, with less negativity across the entire scalp in the voice condition compared to controls; place was evident only over the posterior brain region. An effect of voice appeared again across the entire scalp in P1 (125-175 ms), but there was no effect of place. An effect of place seemed to emerge later, at P2 (400-500 ms), with greater positivity for place compared to controls. This late modulation is probably due to speech preparation. Reaction times were analysed using linear mixed effects regression modeling. The model revealed a highly significant effect of condition, with log transformed naming latencies shorter in the voicing condition, compared to controls.

Discussion

The present results suggest very early (25-75 ms) processing of subphonemic feature information in visual lexical processing. This replicates and extends earlier findings (Ashby et al, 2009). Since final voicing is ambiguous phonetically in Dutch, processing seems to be categorical, rather than purely phonetic.

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Shared Competition Processes in Sentence Production and Comprehension
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Keywords: Sentence production; Sentence comprehension; Relative-clauses; Competition resolution.

Previous research suggests that language production and comprehension share lexical and grammatical knowledge (Bock et al., 2007). However, these tasks are widely assumed to differ in their component processes, e.g., word retrieval vs. word recognition, as reflected by clearly distinct production and comprehension models proposed in the literature. Here we challenge this assumption by investigating whether sentence production and comprehension share competition mechanisms.

Experiment 1 compared the production and comprehension of relative clauses (henceforth, RCs) known to differ in comprehension difficulty due to competition:
(a) The director that the movie impressed received a prize. (high-competition)
(b) The movie that the director watched received a prize. (low-competition)
Conflicting cues in (a) lead to competition: animate and inanimate nouns cue an agent and patient role respectively but the structure and subordinate verb cue the opposite roles (Traxler et al, 2002), whereas the animacy configuration in (b) easily activates the appropriate noun roles. The comprehension task used word-by-word self-paced reading. The production task asked participants to complete the initial fragment of (a)-(b) (e.g. The director that the movie...).

Results demonstrated parallel competition effects in production and comprehension. Lower accuracy and longer planning and reading times at verb positions, were found for the high-competition than the low- competition sentences in both tasks. Furthermore, the processing times from each task correlated with the degree of competition for an item, as measured by the number of alternative interpretations or verb plans that could be entertained (as determined by a stem-completion task). This suggests that alternative plans/interpretations compete in a similar manner for production and comprehension.

To further investigate the nature of competition mechanisms in both tasks, we manipulated semantic similarity using a previously known picture-based relative-clause elicitation task (Experiment 2), and a reading task in picture contexts (Experiment 3). Previous studies show that RCs with two animate nouns are described with passives like (c), whereas RCs with nouns of different animacy are described with actives like (e). They argue that during planning, animate entities in (c) compete with each other due to high similarity thereby influencing production choices (Gennari et al, 2012). Experiment 2-3 tested whether the degree of similarity between the picture entities (as determined by normings) influences production and comprehension.
(c) The girl being kicked by the boy. (high-similarity)
(d) The man being bitten by the dog. (medium-similarity)
(e) The ball that the boy is kicking. (low-similarity)
Results revealed that the degree of noun-noun similarity predicted the proportion of passive RCs produced (Experiment 2) and the RCs' reading times (Experiment 3).

Taken together, these results provide strong evidence for shared semantic and similarity-based competition in production and comprehension.

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Is Event Apprehension Language-Specific? A Comparison of Spanish and German

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Keywords: event apprehension; language production; eye tracking; cross-linguistic analysis; language-specificity

This study compares gaze movement patterns of native speakers of German and Spanish, while they describe causative events, depicted in photo-realistic stimuli (e.g., agent drawing a house on a piece of paper). The cross-linguistic comparison involves the way in which the *agent* of these actions, i.e. the subject of the sentences, can be described: Spanish allows the omission of explicit reference to the subject of a non-passive clause in certain cases, whereas in German subjects of sentences always have to be overtly realized (at least in active voice). Studies on sentence production, using eye tracking, have concluded that usually every referent is fixated shortly before being named, even in contexts in which referents are "given" (van der Meulen et al., 2001). Here, we examine what the cross-linguistic difference between Spanish and German implies for visual processing of event scenes, when information has to be extracted rapidly and presentation duration is varied so as to give four conditions (100-300-500-700ms). All subjects were instructed to describe the events, or, to at least mention the elements of the scenes that they recognized, i.e. the action, agent and/or object depicted.

Our analyses focus on the placement of the *first* fixation on either the *agent* or the *action* in the scenes, allowing us to shed more light on how the demands of language production interact with, and perhaps bias, information uptake and scene apprehension in the given task. In other words, we investigate the extent to which the placement of first fixations is influenced by linguistic structure (see also Bock et al, 2004). So far, studies that look at event apprehension or the interrelation between visual and linguistic processing taking into account cross-linguistic differences are scarce.

Results show differences in gaze behaviour between the four presentation duration conditions, and an interaction between presentation duration and language. With respect to the language production data, Spanish speakers have less overt reference to agents in their event descriptions. This linguistic difference between Spanish and German correlates with the eye tracking data, specifically, the placement of first fixations. Findings indicate differences in attention allocation to the two elements of the scene (agent and action), during early stages of event apprehension and message planning. In our discussion, we will shed light on the interrelation between visual and linguistic processing from a cross-linguistic perspective.

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Planning for Others: Predictions about Your Upcoming Utterance Affect the Timing of My Utterance

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Keywords: language production; coordination; turn taking; forward models; prediction.

Interlocutors generally avoid overlapping speech. Pickering and Garrod (in press) argued that this is possible because predictive production processes are recruited during comprehension. Indeed, listeners can anticipate the end of a speaker's turn quite accurately (De Ruiter, Mitterer, & Enfield, 2006).

Unlike turn taking (where predictions are computed by the interlocutor who is currently comprehending), our experiment was designed to test whether the speaker who is producing a sentence preamble predicts aspects of a not-yet-produced completion. If interlocutors predict aspects of each other's utterances via production processes, anticipating another's words should have similar effects on production as anticipating one's own words when planning ahead.

In two experiments (N=24 each), we asked pairs of speakers to describe events that involved two (e.g., The <u>policeman</u> chases the <u>monk</u>) or four entities (e.g., The <u>policeman</u> chases the <u>monk</u> with the <u>basket</u> and the <u>sailor</u>). Sentence preambles (NP+V) were held constant, whereas the length of the object NP varied (short vs. long). Participants either produced the full sentence (SELF), stopped after the verb (NO; e.g., The policeman chases) or stopped after the verb while their partner continued (OTHER). The latter manipulation was randomized in Experiment 1, blocked in Experiment 2; this had little effect on the core findings, so we report combined analyses.

Since we were interested in the mechanism underlying successful coordination, we discarded participants who overlapped with their partner on more than 10% of the trials in the OTHER condition (2 in Exp. 1, 9 in Exp. 2). All remaining overlapping trials were also removed from the analyses. Speakers began their utterances later when the event was complex (M=1106ms) than when it was simple (M=1052; B=58ms, SE=6ms, t=8.99). This effect did not interact with condition and it was likely due to differences in the visual complexity of the pictured events.

Since there was no evidence that speakers planned material following the verb before utterance onset, we focused on the duration of the sentence preamble. These analyses revealed a significant interaction between completion length and condition, such that the effect of length was larger in the SELF (long: 1006ms, short: 961ms) than in the NO condition (long: 1108ms, short: 1101ms; B=38ms, SE=17ms, t=2.28). Importantly, the effect of completion length was also larger in the OTHER (long: 1091ms, short: 1054ms) than in the NO condition (although the interaction was only marginally significant; B=29ms, SE=17ms, t=1.72).

We interpret this as evidence that speakers predicted the length of their partner's completion in the OTHER condition, and were affected by this prediction while producing the preamble, just as they were affected by the length of their own planned completion in the SELF condition. This provides support for Pickering and Garrod's (in press) hypothesis that prediction of another's utterances is based on production processes.

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Interface of linguistic and non-linguistic information during audience design

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Keywords: Language production; reference; audience design; visual context.

Research suggests that the addressee's prior contributions to the conversation (specifically, verbal feedback) play a critical role in the speaker's audience design (e.g., Clark & Wilkes-Gibbs, 1984). But less is known about how speakers accommodate the addressee's needs during *one-shot* exchanges.

When referring to an entity for the first time, speakers may consult various sources of information; e.g., speakers may decide to identify a man as *the rockstar* when the referent has visible properties associated with the expression (e.g., having an electronic guitar). But if the man was identified as a rockstar in the previous linguistic context speakers may also call a man without such an attribute *the rockstar*. How do speakers use the visual and linguistic context to assist the addressee?

One possibility is that when the referent has no visible attributes associated with a character role (*rockstar*), speakers are less likely to use such role names (relative to more basic terms, e.g., *man*) when the addressee hasn't heard a prior reference to the role name than when s/he has. This is because subordinate-level expressions without immediate antecedents are hard to interpret if the referent lacks relevant attributes (cf. Perner et al., 2011). However, if the visible attributes (having a guitar) are present, whether the addressee heard prior reference may play less of a role, because the addressee can make use of the visual features to identify the referent.

After listening to a context sentence (1), speakers described an action carried out by a toy character, who was introduced in the sentence. The addressee couldn't see the picture and had to act out the description using the toys. The toy character either possessed visual attributes associated with the role given in the context sentence (having an electronic guitar for "rockstar") or not (no guitar), and the context sentence was either heard by both the speaker and the addressee or the speaker only. We scored the choice of expressions for the toy character.

When the referent possessed relevant visual attributes (having a guitar), speakers repeated the role names (*rockstar*) given in the context sentence equally often regardless of whether the addressee heard the context sentence or not. In contrast, when the visual attributes were absent, speakers repeated the roles less frequently (and used more basic terms) when the addressee did not hear the context sentence than when s/he did. Furthermore, speakers produced significantly more pronouns when the addressee heard the context sentence than not, suggesting that speakers avoided pronouns when the linguistic antecedents were unavailable to the addressee.

Thus, speakers take into account identifiability for the addressee: they produce referring expressions that would allow addressees to make use of visual or linguistic context for identifying the referent. We argue that such highly controlled conceptual planning enables speakers to produce easy-to-understand referring expressions without verbal feedback from their addressee.

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What Do Speakers Represent about Others' Utterances?
Comparing Simultaneous and Asynchronous Production.

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Keywords: language production, joint action, shared representations.

Joint action studies have shown that representations of others' actions can influence the planning and execution of one's own actions, possibly because they are represented in a similar format (Sebanz, Bekkering, & Knoblich, 2006). Pickering and Garrod (in press) argue, similarly, that others' utterances (perceived during "on-line" comprehension or imagined "off-line") can be covertly represented using language production processes. Therefore, beliefs about another speaker's utterances might influence own concurrent production. We tested this prediction in two experiments

In Experiment 1 (N=40), pairs of participants described transitive events in separate sound-proof rooms. Through color codes ("start naming the picture with the character presented in red/blue/grey"), participants were instructed to produce a passive, an active or no sentence. In addition, given that both participants saw both their and their partners' instruction, it was possible (though not required) for the participants to determine what their partner would be responding on any given trial.

Thus, participants produced their description under the belief that their partner in the other room was producing the same description (SAME), a different description (i.e., starting with the other character, thus producing the sentence in the opposite voice, DIFFERENT) or that their partner would not describe the picture (as there was no grey character, NO).

Onset times were greater in the SAME than the NO condition (B= 20ms, t= 3.11, p< .01), and in the DIFFERENT than the NO condition (B= 17ms, t= 2.63, p< .05). Onset times were comparable in the SAME and DIFFERENT conditions (t<|1|). Utterance duration was longer in the DIFFERENT than the SAME (B= 18ms, t=2.42, p< .05) or the NO condition (B= 17ms, t=2.24, p=.06). The SAME and the NO condition did not differ on duration (t<|1|).

The first experiment did not distinguish between the belief that one's partner is preparing an utterance, and the belief that he or she is articulating an utterance. Therefore, in Experiment 2 (N=18) participants performed the same task under the belief that their partner would prepare the same, different or no utterance, but would withhold articulation until a go-signal appeared on the screen (visible to both participants). We expected similar results if speakers covertly imitate the whole production process and not just articulation. Interestingly, we found similar results for onset times (SAME vs. NO: B= 45ms, t= 2.91, p< .01; DIFFERENT vs. NO: B= 38ms, t= 2.43, p<.05; SAME vs. DIFFERENT: B= 8ms, t<|1|); for durations, we observed a similar trend, though it did not reach significance (all t's≤|1|).

In summary, we provided evidence that (a) utterance preparation processes are inhibited by the belief that another person is speaking (Exp. 1) or preparing to speak (Exp. 2) and that (b) articulation is less efficient when speakers believe that their partner is uttering (though perhaps not merely preparing) an incongruent sentence (Exp. 1). Thus, it seems that representations that another is about to speak can be formed quite quickly, but more specific representations (i.e., specifying the voice of the sentence) might take longer, at least in this particular task. Overall, these findings are consistent with Pickering and Garrod's (in press) proposal that production processes are recruited to represent others' utterances.

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The Relationship between Language Production and Verbal STM: The Role of Stress Grouping

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Keywords: verbal short-term memory; stress grouping; speech production; acoustic correlates of stress

Intuitively it makes sense that there might be some degree of overlap between the processes that underlie speech production and verbal STM. For example, during normal conversation we often need to store sections of the speech code we have planned while waiting for a chance to articulate it. Similarly, holding onto verbal material in STM, such as a phone number or a shopping list, requires the generation and maintenance of a sound-based representation. The current study sought to investigate the relationship between the language system and verbal STM by focussing on the linguistic property of prosody. Specifically we investigated the effect of stress grouping on verbal STM performance. In two serial recall experiments, auditory lists of six nonsense syllables were presented with either a trochaic stress pattern (STRONG-weak), an iambic stress pattern (weak-STRONG), or in monotone. The acoustic correlates that carry stress were also manipulated in order to examine the relationship between input and output processes during recall. In Experiment 1, stressed and unstressed syllables differed in intensity and pitch but were matched for spoken duration. Significantly more syllables were recalled in the trochaic stress pattern condition than in the iambic and monotone conditions which did not differ. Given that English is a Germanic language which favours trochaic groupings both lexically and in continuous speech our data suggest that prosodic characteristics specific to language processes can influence STM performance. In Experiment 2, spoken duration and pitch were manipulated but intensity was held constant. No effects of stress-grouping were observed, suggesting that intensity is a critical acoustic factor for trochaic grouping. In addition, we investigated the similarity of verbal STM to normal phonological encoding processes by performing detailed acoustic analyses of participants' speech output, during recall. Such fine-grained analyses of participants' responses have typically been the concern of phoneticians and are not commonly undertaken in the memory literature. To our knowledge this study is the first to use such a method to investigate the relationship between memory performance and phonological processes in speech production. In the acoustic analysis of speakers' speech output, correctly recalled syllables were analysed for their mean intensity, duration and pitch. Significant differences were found between stressed and unstressed syllables on all measures demonstrating that participants had indeed reproduced the intended stress groupings in both experiments. Furthermore participants generated the correct stress patterns by manipulating acoustic correlates in the same way in both experiments demonstrating that their speech output was not identical to the auditory input. These data challenge the idea of a language-independent STM store and support the notion of separable phonological input and output processes.

Fundamental Frequency as a Parameter for the Evaluation of Speech Planning in Adults

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Keywords: speech planning; fundamental frequency; working memory; reading; picture description.

Abstract

This paper establishes fundamental frequency (f0) and working memory (WM) capacity as crucial parameters for testing scope and flexibility of speech planning in adults. Despite mixed results of previous research on both, scope and flexibility of speech planning in adults, there is a growing body of evidence supporting the notion of a rather global (Prieto, D'Imperio, Elordieta, Frota & Vigário, 2006) and flexible planning depending on linguistic (phrase length) and cognitive (WM) constraints (Wagner, Jescheniak & Schriefers, 2010).

In laboratory phonology the f0-downtrend over utterances is often used to gain an estimate of the amount of preplanning. Participants are expected to start with a higher phrase initial pitch accent, when the upcoming phrase is longer (Prieto et al., 2006). Since former studies using f0 as parameter employed reading experiments only, it is crucial to account for critiques claiming that no planning is needed, when the to-be-planned material is already prepared and given.

Therefore, in the current study semi-spontaneous speech was elicited in a picture description task (PD) in addition to two different reading experiments. Participants had to describe 20 depicted scenes with simple sentences of varying length, such as *Lama Linu/Lama Leonora giesst die Blume* (Lama Linu/Lama Leonora is watering the plant). Furthermore, a simple sentence reading task (R1) served as control condition and was followed by a reading task where subjects were prevented from planning by presenting the crucial parts of the sentences one after another, i.e. Lama… Linu…is watering the plant. (R2). In addition to the experiments, each participant had to solve the reading-span task.

Results of 19 native speakers of German indicate that in both tasks, PD (difference between conditions: 0.5 semitones) and R1 (0.83 st.) but not in R2 (-0.12 st.), speakers consistently start with a higher initial pitch accent, when the upcoming phrase is longer (lmer (pMCMC): R1 < .001; PD <.001; R2 = .35). Furthermore, a main effect for WM in R2 indicates that subjects cope differently with suppressed planning depending on their individual WM-capacities. That is, speakers with lower WM-capacity produce higher initial f0-peaks (lmer pMCMC < .001) indicating that speakers with higher WM-capacities might conduct online-adjustments of the f0-curve during production, whereas speakers with lower WM-capacities potentially start with a high f0-peak in order to avoid online-adjustments during production. These different strategies suggest a flexible adaptation to the demands of language production.

The present study provides evidence that f0-variation as a function of phrase length is a systematic variation and a very robust effect that is observed also in tasks with semi-spontaneous speech like PD were the language-material was not prepared at all. The claims of a global and flexible rather than a local and fixed scope of planning are further supported by the present data.

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Can Acoustic Salience Alone Enhance Discourse Memory?

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Keywords: prosody; pitch accenting; discourse; recognition memory

Pitch accenting enhances memory for items in a discourse. When listeners hear stories in which L+H* accents mark items with contrastive focus, they are better able to remember the role of the specified item in the story, compared to when it receives a non-contrastive H* accent (Fraundorf, Watson, & Benjamin, 2010).

One explanation for this finding is that listeners attend more to L+H* than H* accents due to their greater pitch movement, duration, etc., resulting in better memory. Another possibility is that the memory benefit for L+H* accents is due to the learned association between L+H* and contrastive focus in American English. We tested the basis of the memory benefit using speech produced with novel prosody created by resynthesizing natural speech with a pitch contour inverted around the mean F0. Thus, contrastiveness was marked by an *inverted* L+H* accent having the degree of pitch movement typical for L+H* accents, but with a steep falling-rising F0 trajectory rather than the expected rising-falling trajectory.

Sixty participants heard thirty stories and answered true-false questions about them. Half heard stories with naturally-produced prosody, and half heard inverted-pitch versions. Each story contained two contrast sets (e.g., *English*/*Scottish knight* and *jousting/archery*). During the story, one item from each set was specified as a focused constituent and received either a non-contrastive or contrastive accent (*The **English** knight won…*). At test, participants answered true-false questions mentioning the (correct) focused item, the (incorrect) contrast item, or an (incorrect) unmentioned item (e.g., *The English/Scottish/Welsh knight won.*). If enhanced memory is due to acoustic salience, participants in both the Normal and Inverted conditions should have better memory for sets from stories that mark the focused item with a contrastive accent. Thus, if *English* was heard with a contrastive accent, participants should more easily recall that it was the English knight who won, resulting in more "true" responses on focused-item questions and possibly more "false" responses on contrast-item questions. However, if knowledge of the English-specific mapping between L+H* and contrastive focus is necessary, there should be no benefit for items from stories using the inverted contrastive accent.

Accuracy rates were comparable across conditions; inverted prosody did not negatively affect overall comprehension. For focused items, a multi-level logit model revealed a marginal interaction between prosody condition and accent: participants in the Normal condition showed the L+H* benefit, but participants in the Inverted condition showed no benefit for inverted L+H* (z=-1.73, p=.08). For contrast items, prosody condition and accent interacted, with participants in the Normal condition performing equally on items from stories using both L+H* and H*, and participants in the Inverted condition performing worse for items from stories with an inverted L+H* (z=1.95, p=.05). The elimination of the L+H* benefit on correct items and the penalty of L+H* on contrast items in the Inverted condition suggest acoustic salience is not responsible for the memory benefit for contrastively accented words. Thus, these data suggest that language-specific knowledge of the mapping between a pitch accent and its pragmatic meaning is needed for enhanced discourse comprehension.

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PRO: A Computational Model of Referential Overspecification

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Keywords: Reference, overspecification, computational modelling.

Speakers frequently overspecify by producing referring expressions with more conceptual information than necessary to identify an object (Pechmann, 1989; Belke & Meyer, 2002). However, it is unclear what psychological processes underlie overspecification.

Concept selection is the focus of many computational reference generation algorithms (Krahmer & Van Deemter, 2012), the most influential being the Incremental Algorithm (IA) (Dale & Reiter, 1995). It claims that overspecification occurs because speakers select distinguishing properties in order of preference. Consider (1a), where a speaker refers to a target presented with two distractors. Because colour is preferred to size (Pechmann, 1989), the IA predicts that the speaker first selects "black", but because this is not fully distinguishing, they add "small", resulting in the overspecified expression "small black candle" (rather than the minimal "small candle").

1a. **Size fully discriminating condition**
   Target: small black candle; Distractors: large blue candle, large black candle
   Results: "small black candle" 82%; "small candle" 17%; "black candle" 1%
1b. **Colour fully discriminating condition**
   Target: small black candle; Distractors: large red candle, small blue candle
   Results: "small black candle" 8%; "small candle" 0%; "black candle" 92%
1c. **Size or colour fully discriminating condition**
   Target: small black candle; Distractors: large red candle, large blue candle
   Results: "small black candle" 17%; "small candle" 4%; "black candle" 79%

Assuming (contra Dale and Reiter's original proposal) that the colour-size preference is probabilistic, the IA makes quantitative predictions about the frequency of overspecification. If speakers select colour before size in x% of expressions in (1a) (resulting in x% overspecification and 100-x% minimal expressions), they should also do so in (1b) and (1c), resulting in x% minimal expressions and 100-x% overspecification in (1b), and x% colour-only and 100-x% size-only expressions (but no overspecifications) in (1c).

Participants described the target in (1a-c) so another participant could select it. The results, presented in (1a-c), did not support the IA: The predicted match in percentages did not occur (e.g., 82% overspecification in 1a but 92% minimal expressions in 1b) and speakers frequently overspecified in (1c). Statistical model testing using multinomial distributions showed that the fit of the IA to the data was quite poor.

We developed the Probabilistic Referential Overspecification (PRO) algorithm, which assumes that speakers always first select the property that is fully discriminating (size in 1a, colour in 1b). If two properties are fully discriminating (1c), then the first property is probabilistically selected according to preference. Next, speakers add the second property, with the probability of adding it depending on its preference. This model predicted percentages for all expressions within 2% of the observed frequencies and accounts for speech repairs where speakers initially underspecify, but subsequently add the second property.

In a second study, we manipulated colour and category (e.g., candle vs. bed) rather than colour and size. PRO matched the data to within 3% of the observed frequencies.

We conclude that speakers first aim to find a fully distinguishing expression and may subsequently overspecify when they add other properties depending on their preference.

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Discourse and grammatical effects on pronoun resolution in Greek

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This paper aims at exploring the interplay of discourse and grammatical effects on pronoun resolution in Greek. A well-known discourse constraint related to pronoun resolution is the so-called Right Frontier Constraint (RFC) (Asher & Lascarides, 2003). The RFC dictates the possible attachment and reference sites of a new segment under processing. Briefly, the RFC allows as possible attachment/reference points of a new segment a) the previous utterance and b) any utterance that is in a subordinating relation with it. In (1) the new segment π4 can be related to either π3 or to π1 which is in subordinating relation, *elaboration*, with π3 (fig. 1). Therefore, the subject pronoun, *pro/he* in π4 can refer only to the referent, *the waiter*, in π1, and not to *the man* in π2, since π2 is not in the Right Frontier (RF).

(1) Ten minutes ago **the.masc.sg waiter.masc.sg** served at table 3 (π1). **The.masc.sg man.masc.sg** asked for a glass of water (π2) and the.fem.pl girls.fem.pl asked for a beer (π3). After a while ***pro*/he** made.3sg a phone call (π4).
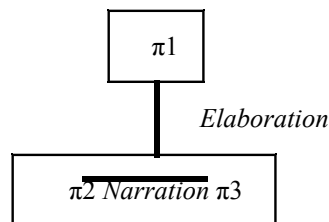
Figure 1. The representation of discourse relations for (1).
Horizontal lines indicate coordinating and vertical ones subordinating relations.

We conducted an off-line questionnaire study, following (Holler & Irmen, 2006), in which we investigated whether pronoun disambiguation in Greek is constrained by the RFC and whether this preference is affected by the type of the pronoun, null or overt. There were six experimental conditions: in the first and second conditions both referents lie in the RF, in the third and fourth only the first referent lies in the RF, while in the fifth and sixth only the second referent lies in the RF. In each dyad of conditions, the pronoun was either null or overt.

The test items contained a short text consisting of four πs similarly to (1). The pronoun (null or overt) appeared in the fourth π. The first possible referent for the pronoun was introduced in the first π, while the second possible referent in the second π. The third π contained an NP which cannot be a referent for the pronoun due to its number marking. The questionnaire consisted of 36 experimental items, 6 per condition, and 14 fillers. The short texts were followed by questions asking for the referent of the pronoun. The two possible options were given and the participants had to circle one of them.

Preliminary results showed that NPs that lie outside the RF are not considered as possible referents for the ambiguous pronoun. When the RFC does not provide cues for pronoun disambiguation (conditions 1 & 2), recency affects pronoun resolution. Moreover, the presence of an overt pronoun seems to override the RFC.

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Alternatives on demand: processing d-linked phrases in sluice structures

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Wh-phrases like *which students* in *Which students did you see?* are appropriate only if *d-linked* to context, i.e., if a salient set of students is discourse-accessible (Pesetsky, 1987). Such phrases access the discourse representation immediately (Frazier and Clifton, 2002, 2005). This study investigated how the parser resolves globally ambiguous sluice structures with d-linked phrases, e.g. (1), to determine whether the retrieval process was subject to discourse and structural economy constraints, and, if so, at what processing stages. Two constraints are proposed to interact during retrieval of d-linked antecedents: an immediate structural *Object Bias (OB)* resolving sluices to the object of the matrix clause (Carlson et al, 2009; Poirier et al, 2010) plausibly restricting the focus of attention to focus-marked positions, followed by a discourse-economy constraint, *Alternatives on Demand (AD)*: *when interpreting a d-linked phrase, favor discourse alternatives given by previous discourse.*

Experiment 1 tested the prediction that comprehenders prefer to resolve ambiguous *which* phrases (1) to antecedents that avoid positing discourse-new alternatives, e.g., disjunctions like *Bill or Sue*, when in the object position. Indeed, participants (N=32) took the disjunction as the antecedent when in object (Object-Or: M=83%, SE=3) more often than when in subject position (Subject-Or: M=55%, SE=4), z=3.30, p<0.05.

Experiment 2 probed whether these results are due to either (i) the phrasing of the responses or (ii) the pronoun *one* in the *wh*-phrase. As before, there were more resolutions to the disjunction on Object-Or (M=90%, SE=2) than on Subject-Or (M=65%, SE=3) conditions, z=4.07, p<0.001. Furthermore, the effect of pronoun was greater when the disjunction was in subject position (d=4.86) than in object position (d=2.78), z=-3.33, p<0.001, suggesting that the parser utilizes additional information when discourse and structural biases conflict.

Experiment 3 used self-paced reading to investigate how the parser manages conflict between structural (OB) and discourse (AD) preferences when resolving d-linked phrases. Participants (N=36) read sentences like (3), which manipulated the position of the disjunction (Subject vs. Object) and how the *which* phrase was disambiguated. If the parser searches for antecedents via cue-based retrieval mechanisms with limited focus of attention (e.g., Lewis & Vasishth, 2005), then pronomimal continuations with limited cue information (*one/of them*) of *which* phrases should elicit greater processing costs than continuations that specify a complete NP (*guest*), when OB and AD conflict (3b.i,ii). Analysis of residual reading times revealed a significant reading penalty when the structurally preferred location for antecedents lacked overt alternatives for both pronominal continuations over NP counterparts, but that cue-rich plural pronouns (*of them*) elicited an earlier and sustained effect (regions 7–8) compared to the effect for ambiguous pronouns (*one*), which only appeared in region 8. In sum, the parser seeks an object antecedent (OB), only showing a penalty when accommodating discourse-new alternatives (AD).

When interpreting d-linked sluices, the parser is sensitive to both structural and discourse pressures during retrieval, but may prioritize the former in early stages. While resolving structures with fully ambiguous pronouns may be temporarily delayed, they are subject to similar online retrieval pressures as structures with biased pronouns.

Materials

(1) **Experiment 1: Questionnaire study**
    a. A guest talked to Bill or Sue, but I don't remember which one.   (Object-Or)
    b. Bill or Sue talked to a guest, but I don't remember which one.   (Subject-Or)
(2) **Experiment 2: Questionnaire study**
    a. A guest talked to Bill or Sue, but I don't remember which / which one.   (Object-Or:Null/One)
    d. Bill or Sue talked to a guest, but I don't remember which / which one.   (Subject-Or:Null/One)
(3) **Experiment 3: Self-paced reading study**
    a. $|_1$ A guest $|_2$ talked to $|_3$ Bill or Sue, $|_4$ but I don't $|_5$ remember which …   (Object-Or)
    b. $|_1$ Bill or Sue $|_2$ talked to $|_3$ a guest, $|_4$ but I don't $|_5$ remember which …   (Subject-Or)
    $|_6$ *(i.) one / (ii.) of them / (iii.) guest* $|_7$ it was $|_8$ in the end.

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Discourse Structuring Potential of Optional Object Marking in Turkish

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Keywords: Turkish, differential object marking, indefinites, anaphora, discourse prominence, discourse processing

Background

The Optional *pe*-marking on indefinite object NPs in Romanian has been shown to increase their referential persistence in the subsequent discourse (Chiriacescu & von Heusinger, 2010). In Turkish as well indefinite direct objects are optionally marked with accusative-case. Previous studies attributed backward-looking discourse effects to the marker (e.g., Enç, 1991; Kelepir, 2001). Yet, various contexts do not produce these effects (von Heusinger & Kornfilt, 2005; U. Özge, 2011). We address whether these unaccounted cases involve any forward-looking discourse effects similar to Romanian.

Production and Comprehension Study

A story-completion study tested whether optional accusative on an indefinite object, compared to its zero-marked version, increases the likelihood of its re-mention in the upcoming discourse. We constructed unreal news-extracts composed of two sentences. Sentence-1 set the context and Sentence-2 introduced two referents, namely the NP1-Subject and the NP2-Object. The case marking on the NP2-Object was manipulated between accusative versus zero. All verbs were agent-theme-goal verbs (e.g., host somebody in a program, assign somebody to a position). Thirty-three online adult participants were asked to add one-sentence continuations to 30 news-extracts (12 test-items, 18 fillers) (c.f., Kaiser & Trueswell, 2008).

The responses were coded as to which Referent-Type was chosen in the upcoming discourse (NP1-Subject, NP2-Object, Both, Other). As a measure of the discourse prominence, we calculated the proportion of each Referent-Type in all references, per Case (Accusative/Zero) and per Participant. Descriptive statistics for individual items showed that for some of the items, participants were more likely to pick up NP2 in their continuations when the NP2 was marked in the accusative case whereas for some other items NP2 was more likely to be picked up when it was zero-marked. Closer look at the verbs and their arguments in the accusative-promoting items revealed that the verb in these items seemed to assign more causal-power to NP1-Subject referent compared to NP2-Object referent (e.g., invite somebody as a guest) while it was the opposite for zero-promoting items (e.g., accept somebody as a guest). We grouped these items as SubjCausal verbs and ObjCausal verbs (Verb-Type). ANOVA revealed an effect of Referent-Type, which was due to NP2-Object bias and a Case by Verb-Type interaction. To see if there was an effect of Case on the re-mention of NP2-Object, ANOVAs with Case was conducted for each Verb-Type. For SubjCausal verbs, NP2-Object was selected more often when NP2-Object in Sentence-2 was accusative-marked rather than zero-marked. For ObjCausal verbs, NP2-Object was selected more often when NP2-Object in Sentence-2 was zero-marked rather than accusative-marked.

In a comprehension study, we used the same material with an additional Sentence-3, depicting an action performed by an ambiguous agent. We asked 79 participants to choose whether NP1-Subject or NP2-Object performed the action. ANOVA revealed an NP1-Subject bias. ANOVAs with Case factor conducted for each Verb-Type revealed NP2-Object was selected more often when NP2-Object in Sentence-2 was accusative-marked rather than zero-marked for SubjCausal verbs. There was no effect of Case for ObjCausal verbs.

Summary and Conclusion

There was an NP2-Object bias in Production-Study but an NP1-Subject bias in Comprehension-Study, which converges with previous findings (Arnold, 2001). The accusative-case significantly increased the probability of NP2-Object to be re-mentioned in the upcoming discourse during language production and comprehension only for SubjCausal verbs. This corroborates that the discourse effects of optional case marking is not absolute but may depend on verb type in some languages (von Heusinger & Kaiser, 2011). We suggest that the pattern is observed in SubjCausal condition because the participants interpreted the marker as a highlighting strategy that overrides the default prominence of the subject referent.

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Free Indirect Discourse and Perspective Taking

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Keywords: Discourse processing; reference resolution; free indirect discourse; perspective taking

The ability to track different perspectives is an important but controversial aspect of language comprehension. Our research investigates the phenomenon of ***free indirect discourse (FID)***, which hinges on the ability to recognize perspective-shift. FID presents characters' speech/thoughts without explicit quotes or embedded clauses (ex.1b,2b). A key question is how readers recognize FID. Narratologists have identified various cues to FID (Fludernik, 1993; Bortolussi and Dixon 2003). We investigated two known cues: (i) evaluative adjectives (ex.1b) and (ii) adverbials of doubt/possibility/certainty (ex.2b, a.k.a possibility-adverbials). Our **first aim** is to test whether these cues have reliable effects on comprehension in naïve readers. Our **second aim** is to explore their cognitive mechanisms. We chose evaluative adjectives and possibility-adverbials, because (i) the former involve emotional/evaluative judgments (*poor girl, stupid guy*), encouraging readers to put themselves in characters' shoes/assume their perspective (cf.emotional mirroring/empathy), while (ii) the latter involve levels of certainty/knowledge-states (*probably, perhaps*). Thus, their processing may be different. Specifically, we predict that *perspective-taking abilities should correlate with sensitivity to evaluative adjective cues, but not adverbials of possibility.*

People read sentences with/without FID-triggering cues (ex.(1,2); 16 targets, 30 fillers), designed so that processing the FID-cue affects pronoun resolution in sentence2. In **plain sentences**, the pronoun is ambiguous, but in **sentences with FID triggers**, if people recognize that the cue signals FID, they should interpret the pronoun as object-referring. After reading each sentence, participants (n=36, 19 female) indicated, on 6-pt scale, who the pronoun refers to (e.g. "*Who was sick?*" Mary 1 2 3 4 5 6 Kate). Afterwards, they completed Hegarty & Waller's (2004) *Perspective Taking/Spatial Orientation Test*.

(1a)-Plain   Mary looked woefully at Kate. She was sick.
         she=Mary/Kate
(1b)-FID   Mary looked woefully at Kate. *Poor girl;* she was sick.   she=Kate?
(2a)-Plain   Luke glanced at Tom warily. He'd put toothpaste in the shampoo bottle again
         he=Luke/Tom
(2b)-FID   Luke glanced at Tom warily. He'd *probably* put toothpaste in the shampoo bottle again.   he=Tom?

Results

Both evaluative adjectives and possibility-adverbials resulted in pronouns being more likely to be interpreted as referring to objects than 'plain' sentences did (p's<.05)—***subtle cues to FID have clear effects on pronoun resolution.*** To explore perspective-taking and FID, FID-Sensitivity-Scores were calculated for each participant (difference between their average plain-sentence rating and average FID-sentence rating). We find that (i) sensitivity to **evaluative adjectives** correlates with spatial-perspective abilities (p<.05), but (ii) there is no correlation between sensitivity to **possibility-adverbials** and spatial perspective-taking performance (p>.7).

In sum, ***better spatial perspective-taking ability is correlated with increased ability to use of evaluative adjective cues, but not possibility-adverbial cues***. A person's willingness to interpret evaluative adjectives as reflecting the opinion/beliefs of a story character is related to their ability to conceptualize spatial perspectives/orientations. The absence of a correlation for possibility-adverbs suggests spatial perspective-taking mechanisms are not recruited when processing adverb cues.

Conclusions

Seemingly subtle cues, namely evaluative adjectives and possibility-adverbs, have clear effects on discourse processing (shown by pronoun resolution). Furthermore, people's sensitivity to evaluative adjectives only is positively correlated with spatial perspective-taking abilities, suggesting that different FID-triggers may rely on different linguistic or cognitive processes.

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Modeling the Role of Background Knowledge in Memory for Texts

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Keywords: Memory, Text memory, Knowledge, Bayesian Modeling, Probabilistic Modeling

Beginning with the seminal work of Bartlett (1932), but especially since the widespread adoption of schema-based accounts of text memory in the 1970's, there has been close to a broad consensus that our memory of any coherent body of language is based on querying a memory representation of its gist, or general topical content, and also that the nature of this gist representation is strongly dependent on our prior experiences and background knowledge. Despite the agreement on these general characteristics, computational models that afford precise empirical predictions about which words will and will not be remembered from any given text (where we use *text* to refer generally to any coherent body of language) have not been forthcoming. This is likely due to the formidable challenge of providing realistic models of the gist of naturally occurring texts. In this paper, using a Bayesian model of coarse-grained statistical patterns across spoken and written language, we infer a probabilistic representation of the gist of arbitrary texts. This provides us with precise predictions about exactly what words will be remembered, whether veridically or erroneously, from any text. We then compare these predictions from data collected from a recognition memory experiment where adults read natural everyday texts.

In more detail, we use the Latent Dirichlet Allocation (LDA) model — a now widely used hierarchical Bayesian language model whose usage for modeling semantic representations is described comprehensively by Griffiths, Steyvers, and Tenenbaum (2007) — to infer a probabilistic representation of a text's gist. LDA represents the coarse-grained statistical structure of language in terms of a large number of unigram distributions, often referred to as topic distributions as they intuitively represent discourse topics such as *football*, *trains*, *alcohol*, and so on. Using Bayes' rule, we can describe any arbitrary text as a probability distribution over the space of possible mixtures of these topic distributions. This essentially provides a probabilistic representation of the text's gist. Furthermore, as it is straightforward to determine how compatible any given word is with this representation, we can make precise predictions about what words will or will not be remembered, whether veridically or falsely, from any text.

In a recognition memory experiment, 66 native English speakers read five 250-300 word texts that were randomly sampled from the British National Corpus. Overall, the probabilistic model predicted recognition memory performance at correlations values of over 0.75. This is dramatically higher than models based on text characteristics such as frequency of occurrence of individual words or co-occurrence statistics.

The novelty of this work is that it describes and validates a precise computational account of our memory for texts. While the role of a text's gist and how gist is dependent on background knowledge is widely held to be an essential component in our memory for texts, computational models of this phenomenon that provide precise item level predictions have not been developed. The aim of this work has been to provide such a model and to validate it using a sizable body of behavioural data.

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Perspective-taking during Text Reading

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Keywords: text reading; eye-tracking; perspective-taking; theory of mind

The ability to take other people's perspectives into account is an essential part of theory of mind (ToM) reasoning. Previous research investigating ToM reasoning in adults has shown conflicting results, with some researchers finding evidence of immediate perspective-taking while others observed egocentric errors indicative of an early self-centred stage in processing (see Apperly, 2010, for an overview). Most of this research involved the use of interactive tasks that required perspective-taking in order to complete the task. However, much less research has been devoted to perspective-taking in reading even though being able to understand a character's perspective is often crucial for comprehension. According to the search-after-meaning theory (Long & Brooke Lea, 2005), making inferences, including perspective-taking, is a top-down process that will only show up in later, more integrative measures.

We present result of two eye-tracking experiments examining the time-course of perspective-taking during normal text reading. Experiment 1 (N=32) investigated whether individuals can make inferences spontaneously while reading narratives. Example:

> (1)   It is 9am and the professor arrives at the department and goes into his office. He empties an apple and a pear from his bag. He leaves the apple on his desk but puts the pear in his desk drawer, out of sight. The cleaner knocks on the door and enters the room. The professor/cleaner thinks to him/herself, "I wonder if that pear/apple is juicy" and then starts putting papers away.

While both the *pear* and the *apple* can be possible referents for the professor, the cleaner only has knowledge about the *apple*. Hence, if one were to calculate the cleaner's perspective on-line, we would expect immediate disruption when she comments about the *pear*. This is the pattern we found, with processing difficulties already apparent in early processing measures such as first-pass regressions on the target word.

Experiment 2 (N=32) investigated whether perspective-taking was affected by the use of quotation marks, contrasting quoted speech to non-quoted speech/statements:

> (2)   … The cleaner thinks, "I'll be careful with the apple/pear whilst cleaning the desk." vs. The cleaner is careful with the apple/pear whilst cleaning the desk.

We again found evidence of early disruption (e.g. in first-pass duration) when the cleaner commented on something she should have no knowledge of, indicating that the reader had kept track of the character's knowledge base. In addition, we found continuing disruption (e.g. in first-pass regression on the spill-over region) for the non-quoted speech condition, indicating that the readers experienced stronger and/or longer-lasting difficulties with inaccuracies in more factual statements. This could be related to differences in depth-of-processing between quoted and non-quoted speech. Together, our results demonstrate that perspective-taking can happen immediately during text reading and is not relegated to a later stage of processing.

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Differences in comprehension strategies for discourse understanding by native Chinese and Korean speakers learning Japanese

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Keywords: comprehension strategy, discourse understanding, Japanese, Chinese, Korean.

Comprehension strategies

Native Chinese and Korean speakers are often classified together as Japanese learners with Chinese character (hereafter, *kanji*) backgrounds. Although the Korean language shows a great similarity in grammar to the Japanese language, kanji are seldom used in modern Korean written text. Conversely, Chinese grammar is different from Japanese, but Chinese texts are almost all written in kanji. Since native Chinese and Korean speakers have quite distinct language backgrounds, the present study assumed that these two linguistically-diverse populations of Japanese learners may reflect different strategies to understand the Japanese language. Therefore, Chinese and Koreans were selected for structural equation modeling (SEM) multi-group analysis in order to depict the causal relationships of second language (L2) lexical and grammatical knowledge to discourse understanding.

Method

The *pair-matched sampling* method was utilized for selecting 80 pairs of native Chinese and Korean speakers learning Japanese in their countries (university undergraduate students), by matching four characteristics of (1) age, (2) gender, (3) duration of Japanese language learning, and (4) scores for Japanese reading comprehension (i.e., no differences in these characteristics between Chinese and Koreans). Japanese language ability of these 80 pairs was measured by three constructs, grammar knowledge (three tests of morphological inflections, local dependency, and complex structure, consisting of 36 questions), lexical knowledge (four tests of word categories of function words, Chinese-origin words, Japanese-origin words, and loanwords, consisting of 48 questions) and discourse understanding (three tests of intentional expressions, co-referential resolution and causal relations, consisting of 36 questions). All these constructs were investigated by multiple-choice questions (one correct answer out of four choices).

Results

The SEM multi-group analysis converged to a proper solution with excellent fit [$\chi^2(64)$=79.322, *p*=.094, *ns.*; GFI=.914; AGFI=.852; CFI=.973; RMSEA=0.039, *p*<.05] which guarantees direct comparison of both Chinese and Korean groups within the same model. Chinese speakers displayed a significant causal relation directed from lexical knowledge to discourse comprehension (beta=.78, *p*<.001) while they showed no significant causal relation directed from grammatical knowledge to discourse comprehension (beta=.15, *ns.*). These results indicate that Chinese speakers rely heavily on their lexical knowledge for discourse understanding. The correlation between lexical and grammatical knowledge was very high (*r*=.91, *p*<.001), suggesting a mutually-related fashion of acquisition. In contrast, Korean speakers showed significant causal relations directed from both lexical (beta=.40, *p*<.001) and grammatical (beta=.52, *p*<.001) knowledge toward discourse understanding. A correlation between lexical and grammatical knowledge was relatively high (*r*=.70, *p*<.001). The results suggested that Korean speakers use a balanced approach of lexical and grammatical knowledge for discourse understanding. In sum, by controlling multiple characteristics of Chinese and Korean speakers learning Japanese, the present study depicted the contrast between the two first language (L1) linguistic backgrounds, showing a clear strategic difference toward L2 Japanese discourse understanding. Chinese rely on the lexical knowledge while Koreans use a balanced approach.

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Effects of Typography and Image Informativeness on Memory for New Words

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Keywords: word learning; multimedia; sentence processing.

Learning new words in context is an important area of research in psycholinguistic processing, and little work has been done to extend these findings to multimedia learning. As a follow-up from recent findings that typography (bolding) aids memory in multimedia and that highly informative (salient) areas in imagery draw attention (Palmer-Landry & Christianson, 2012), we investigated the effects of bolding and pictorial information availability (labeling) on memory for novel (non)words. The current study examined the effects of memory using implicit, eyetracking data to demonstrate cognitive processing of multimedia displays with image and typographical manipulations. Participants (N=52) were visually presented with two short sentences which were manipulated to have the nonword repeated either in the sentence or not and to have the nonword bolded or not. When the nonword was not repeated in the sentence, it was replaced with a categorical synonym (see example sentences token set below). These sentences were always situated underneath a nonce image, which depicted the nonword as a never-before-seen object. In one condition, the image had a label on it, and the other condition had no label.

David jumped when the **nuli** zipped by. The **nuli** was very fast and loud.
David jumped when the **nuli** zipped by. The **bird** was very fast and loud.
David jumped when the nuli zipped by. The nuli was very fast and loud.
David jumped when the nuli zipped by. The bird was very fast and loud.

Linear mixed effects analyses from this 2 (bold vs. no bold) x 2 (nonword repeat in sentence vs. nonword repeat on image) factorial experiment revealed that greater accuracy in an offline image-nonword association task was predicted by longer total dwell time on the image (main effect, $p<.01$), quicker reaction time (main effect, $p<.05$), and their interaction ($p<.01$). Placing the nonword on the image also improved accuracy (main effect, $p<.05$). Although there was no main effect of typography, the interaction of typography and nonword repetition was marginal ($p=.07$), indicating that when subjects saw the nonword encoded on the image, bold typography boosted association accuracy. Participants were given a working memory task and then re-tested on the image-nonword association task (a delay of about 12 minutes). Although marginal, results of the re-administered post-test showed the same interaction of typography and information availability: repeating the nonword on the image when the type was bold helped boost memory accuracy, thereby demonstrating persistent effects on memory ($p=.07$). Participants with lower working memory capacity were more influenced by bolding.

This study is one of the first to systematically explore incidental word learning within multimedia environments. The combined effects of online (eye movement) and offline (memory) measures have strong implications that readers form stable, perseverant mental representations of word meanings by using both image and sentential informativeness for word learning.

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Cross-Linguistic Differences in Implicit Language Learning

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Implicit learning is generally characterised as a domain-general associative learning mechanism that will acquire any contingencies between attended stimuli. Many aspects of a first and second language are assumed to be acquired implicitly, but many linguistic approaches also propose that learning is constrained by prior linguistic knowledge (deriving either from Universal Grammar or, in the case of second language acquisition, from the first language). This view predicts that only certain contingencies in the input will be acquired.

Here we investigate the contribution of linguistic constraints on adult implicit language learning using a miniature linguistic system and a reaction time methodology. We examined acquisition of agreement between novel determiners and their accompanying nouns. Native English-speaking participants were first introduced to four novel words (*gi, ro, ul, ne*) and told that they correspond to English 'the' except that two of them (e.g. *gi* and *ro*) were used with near objects, and two of them (e.g. *ul* and *ne*) with far objects. What they were not told was that determiner usage also depended on an additional 'hidden' regularity. In the first experiment animate objects took *gi* and *ul*, and inanimate objects took *ro* and *ne*. Noun phrases were presented visually (e.g. *gi dog, ro chair, ul zebra, ne car*) and participants had to indicate by button presses first whether the noun was animate or not, and second, whether the determiner meant near or far. After a period of training, violations of the agreement regularity were randomly introduced (e.g. *ro elephant, gi book*). A detailed post-experiment questionnaire showed that most participants were unaware of the correlation between determiners and noun animacy yet their animacy decision times were significantly slower for noun phrases that violated the regularity than those that did not. This is a genuine generalisation of the semantic regularity because novel determiner-noun combinations were used in the critical test items. This experiment therefore demonstrates implicit learning of a semantic-based generalisation.

However, subsequent experiments showed that for native English speakers the effect was not obtained when the hidden regularity concerned whether the object makes a sound, is long or flat, or whether the noun is written with one or two capital letters (in all cases the task required a decision with respect to the relevant dimension). Thus, animacy appears to be available to implicit learning in this domain in a way that other distinctions are not. In contrast, when Chinese participants performed the same tasks with Chinese nouns there was implicit learning in all cases except when the regularity concerned the number of strokes in the Chinese character (note that only the long/flat distinction mapped onto actual Chinese classifiers). We propose that implicit learning in this domain is constrained by unconscious language-specific expectations about the kinds of semantic categories that are likely to form the basis of agreement between a grammatical morpheme and the following noun. We will discuss the possible basis for this in terms of general accessibility of different conceptual distinctions and specific first language influences.

Implicit Learning of Verb Selectional Preferences

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Keywords: Implicit learning; Second Language Acquisition; Vocabulary Acquisition

Most implicit learning research to date has focused on form-level regularities, e.g. in strings of letters or syllable strings. Some recent research has shown that regularities involving meaning can also be learned implicitly, e.g. the use of semantic information to guide visual attention, or learning arbitrary sequences of semantic categories. However, it is still not clear to what extent meaning can participate in implicit learning of natural language. On the one hand, it has been claimed that referential word meaning is essentially learned explicitly . On the other, intuition suggests that grammatical and collocational aspects of words may be known and acquired implicitly .

The present research examined implicit learning of selectional preferences of novel verbs using a false memory paradigm as an indirect test of learning. Selectional preferences are a word's tendency to co-occur with words of certain semantic classes in a given role, e.g., *drink* is followed by words denoting LIQUID as direct object. In Experiment 1 participants first read sentences, some of which contained one of four novel verbs, and indicated whether the novel verb meant roughly 'increase' or 'decrease' (e.g. "Nightingale worked tirelessly to improve public health and POWTER the status of nurses" - POWTER means increase). Unbeknown to them, novel verbs regularly took either an abstract or a concrete noun as a complement (cf. MOUTEN the *calcium*). In a subsequent surprise test phase participants saw verb-noun pairs, and were asked whether these pairs had appeared in the training (e.g. *POWTER the greatness*). Although all of the words presented in the test had appeared in the training individually, most of them did not occur together. Crucially, half of the new combinations followed the pattern of selectional preferences from training, the other half violated it. We found that pairs that followed the pattern were erroneously judged as familiar significantly more often than those that did not. This was the case even for participants for whom no conscious knowledge of the regularity could be elicited in a post-test task. An analysis of confidence judgements confirmed that knowledge of the semantic regularity was affecting responses unconsciously. Experiment 2 replicated this laboratory experiment in an internet-based version using a large, and highly heterogeneous, participant sample. Experiment 3 showed that the false memory effect could still be obtained when the nouns in the test phase were semantically dissimilar to those that occurred with the nonwords in training, showing broad generalisation of the abstract/concrete regularity. Experiment 4 showed that explicitly instructed participants did not differ from implicit groups in their performance on the false-memory task, suggesting that even when participants have conscious knowledge they do not use it strategically when judging familiarity, confirming that false memory effects provide an indirect measure of learning.

We conclude that implicit learning of generalizable knowledge of selectional preferences is possible. Even if awareness is required for establishing initial form-meaning connections (in this case increase/decrease meanings), tuning of meaning through usage can occur unconsciously.

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Learner-Driven Computations in Speech Processing: Effects of Sleepon Word Identification and Grammar Learning

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Keywords: Sleep; speech processing; word identification; grammar learning.

Extensive evidence suggests that memory and learningare improved when a period of post-learning consolidation separates training and testing. Sleep-related consolidation has been suggested to be particularly advantageous for processes that involveabstraction of structure and has been shown to promote grammar learning in artificial languages (Gomez et al., 2006). But is the effect of sleep on language learning specific to particular processes, or is it general across all aspects of language acquisition?

In a landmark paper, Peña, Bonatti, Nespor andMehler (2002) tested participants' learning of an artificial language that distinguished learning to identify words from continuous speech from learning statistical dependencies among elements within those words. They found that participants could use the statistical information within the speech to identify words, but could not generalise the structure to recognise novel but consistent grammatical forms. We extended Peña et al.'s (2002) study by training participants on the language, then testing them on word identification and generalisation 12 hours and 24 hours later.

There were two consolidation conditions: sleep-first and wake-first. The sleep-first group were trained at 9pm, then tested at 9am the next day, and retested at 9pm. The wake-first group were trained at 9am, tested at 9pm, and retested at 9am the next day. Sleep was recorded using actigraph technology.We tested word identification by comparing preference for words to part-words, where part-words appeared in the speech but were incompatible with the structure of words in the language. We tested generalisation of structure by comparing preference for novel words to part-words, where the novel words conformed to the language structure.

For word identification, we found that performance gradually improved from the testing to retesting phase, regardless of whether participants slept or were awake. However, for generalisation we found a significant interaction between testing phase and wake-first or sleep-first group, indicating that generalisation was improved onlyby sleep. After sleep, participants' word identification is not yet close to ceiling but grammar acquisition has already commenced. Thus, sleep-dependent alterations to language processing result in simultaneous word identification and grammar acquisition.

Peña et al. (2002) interpreted their results as demonstrating separable processes required for word learning and grammar acquisition, and concluded that grammar learning only proceeds once words have been identified. Our results instead demonstrate that grammar acquisition can be performed in parallel with word identification, but relies on facilitation of abstract structure within the learner as a consequence of sleep.

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Morphophonological Schema Learning

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The present paper investigates the types of generalizations extracted by learners from a miniature artificial lexicon. The ultimate goal of this work is learning-theoretic phonology: ultimately we want to be able to predict which generalizations will be supported by a given perceptual or production experience and which other generalizations will lose strength as a result of that experience.

Rule-Based Phonology (Albright & Hayes 2003 inter alia) suggests that knowledge of grammar consists largely of knowledge of rules. A rule describes a change and the context in which that change has been observed and should be carried out. By positing rules as the basic type of linguistic generalization, Rule-Based Phonology assumes that human language learners automatically compare pairs of morphologically related wordforms and split them into a change and a context. Such a comparison process was also traditionally assumed in the domain of visual scene perception but has been famously shown to be extremely fallible in change blindness experiments. We show that forms are also not automatically decomposed into change and context in phonological learning even if wordforms sharing a stem are consistently placed next to each other in time to make comparisons easier.

In the present study we presented human learners with miniature artificial languages featuring an alternation between [k]-final singulars and [tʃi]-final plurals. This alternation is known as velar palatalization. The present experiment held constant the set of examples of velar palatalization (…k-SG / …tʃi-PL) and examples of stop retention (…{t;p}-SG / …{t;p}i-PL) and varied the numbers of examples of …tʃ-SG / …tʃi-PL. If learners automatically decomposed related word pairs into change and context, tʃ→ti would provide support for 0→i (which is at best irrelevant for the choice between k→ki and k→tʃi) and at worst competes with the palatalizing rule k→tʃi (as confirmed by simulations using Albright & Hayes' 2003 Minimal Generalization Learner). Thus examples of …tʃ-SG / …tʃi-PL should make learning velar palatalization harder. However, we show that adding examples of …tʃ-SG / …tʃi-PL makes learning palatalization easier: the probability of producing a plural ending in [tʃi] rather than [ti], [ki] or [pi] from a singular ending in [t], [k], or [p] is increased when examples like butʃ-SG / butʃi-PL are presented in training.

The result is consistent with learners extracting a schema like "plurals should end in [tʃi]" (Bybee 2001). We show that schemas of the right level of generality can be extracted from the lexicon by means of conditional inference trees. Given the segment inventory of the language we can determine the possible segment sequences. However, only some of these sequences will be overattested in plural forms. We can then use phonological features of sequences as predictors of their type frequency in plurals in a conditional inference tree and show that schemas can be automatically read off the induced tree. The resulting schema set is shown to be able to account for the crucial patterns in the experimental data.

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The role of feature-based statistics in categorization and basic-level naming of visual objects: evidence from connectionist simulations

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Keywords: concepts; semantics; conceptual structure account; connectionist simulations; object processing

When we see an object, understanding what it is requires the activation of conceptual knowledge from the visual input. Several accounts of conceptual processing propose that perceptual input maps onto distributed, feature-based semantic representations (Cree, McNorgan & McRae, 2006; McRae, de Sa & Seidenberg, 1997; Randall et al., 2004; Tyler & Moss, 2001, Tyler, Moss, Durrant-Peatfield & Levy, 2000). For such theories, statistical characteristics of features are held to play an influential role in how conceptual knowledge is computed. However, the importance of different kinds of conceptual knowledge may vary depending on the context. For example, if something has *fur* and *legs* it is most likely to be a living thing, but this knowledge does not differentiate between similar concepts (e.g. between *lion* and *tiger*). For this we need information which distinguishes between similar concepts (e.g. *stripes*). The conceptual structure account (CSA; Tyler & Moss, 2001; Tyler et al., 2000) claims that the statistical characteristics of features influence processing, but in different ways for unique identification (e.g. naming objects at the basic level) and category-level identification (e.g. living/non-living decision).

To test this prediction, we implemented connectionist simulations of object processing using three-layer attractor network models. The first and second layers of the models corresponded to perceptual input and semantic feature representations respectively (following similar modelling approaches; e.g. Cree et al., 2006). Given the non-arbitrary relationship between visual properties of objects and some semantic features (e.g. *is green*, *is round*) we used input representations that reflected real perceptual properties of objects, which were calculated from pictures of 411 concepts (Taylor et al., 2012). The final output layer was built separately for each task; for domain decision it contained two nodes corresponding to living/non-living judgments, and for basic-level naming each of the 411 output layer nodes corresponded to the basic-level names. We investigated the role of two semantic feature statistics calculated from the norms; distinctiveness (i.e. how specific a feature is to particular concepts) and correlational strength (how consistently pairs of features co-occur across concepts).

We found that strong correlations between features facilitated their activation on the semantic layer, consistent with feature-based accounts of meaning, earlier simulations of word meaning, and behavioral data (McRae et al. 1997; Taylor et al. 2012; Devereux et al., under review). We found that semantically confusable concepts were more difficult for the model to name at a basic level. Consistent with the claims of the CSA, the role of distinctiveness differed across tasks, with distinctive features facilitating basic-level naming but not domain decision, reflecting the fact that distinctive features are required to differentiate between very similar concepts. Moreover, concepts with relatively more strongly correlated distinctive features were facilitated in basic-level naming, but inhibited in domain decision. These results show the same pattern of effects for distinctiveness and correlation of distinctive features in naming and domain decision as the behavioural data of Taylor et al. (2012), and provide a mechanistic, computational level account of how feature-based statistics differentially influence tasks which make different processing demands on the conceptual system.

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Island Cost Calculation

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Keywords: island; cost; threshold; distance; island repair; island repayment.

Claim

Island cost is calculable by adding the costs of three levels of complexity.

Prediction

Assume the following costs, which have empirical and conceptual grounds. Consider wh-movement.

(1) a. Islands: object (Obj) = 0, adjunct PP (AdjP)/subject (Subj) = 1, complex structure (Com) = 2
    b. Movers: argument (Arg) = 0, adjunct (Adj) = 1
    c. Move Types: covert movement (Cov) = 1, overt movement (Ov) = 3

For (1c), Ov involves at least three Spell-Outs (SO): Subj moves and undergoes SO, and vP and CP phases involve SO. The following cumulation is expected. The data are from English and Japanese.

(2) a. Obj + Arg + Cov   = 0 + 0 + 1 = 1   g. * Subj + Arg + Ov = 1 + 0 + 3 = 4
    b. Subj + Arg + Cov = 1 + 0 + 1 = 2   h. * AdjP + Arg + Ov = 1 + 0 + 3 = 4
    c. AdjP + Arg + Cov = 1 + 0 + 1 = 2   i. * Com + Adj + Cov = 2 + 1 + 1 = 4
    d. Obj + Arg + Ov   = 0 + 0 + 3 = 3   j. * Com + Arg + Ov = 2 + 0 + 3 = 5
    e. Com + Arg + Cov   = 2 + 0 + 1 = 3   k. * AdjP + Adj + Ov = 1 + 1 + 3 = 5
    f. AdjP + Adj + Cov = 1 + 1 + 1 = 3   l. * Com + Adj + Ov   = 2 + 1 + 3 = 6

Cost 4 is the threshold for the system breakdown. As to Japanese, the acceptability is: 2a > 2b = 2c > 2e = 2f > 2i, where α > β indicates that α is more acceptable than β.

Experiment and Result

The testees (77 students; age 18-22; native speakers of Japanese) are asked to choose a worse example in a pair. The result was unexpected: 2a < 2b < 2c = 2e > 2f > 2i. To explain this, we need to modify the costs.

(3) a. Islands:
          (i) Land Cost: Obj/ComObj = 0.5, AdjP/other Com = 1, Subj = 2
          (ii) Distance from C: Obj/ComObj (very far) = 2, AdjP (far) = 1, Subj (closest) = 0
      b. Movers: ObjArg = 0, SubjArg = 0.5, Adj = 1
      c. Move Types: Cov = 1, Ov = 3

Subj island is the most expensive. Obj island has the highest cost since it is far from C. It relates to Kluender's (2004) idea that "linear distance between filler and gap alone produces extra verbal memory storage costs."

For a supplementary power point, go to YouTube and search for kojiarikawaandrew. For my related article, go to:
https://docs.google.com/open?id=0B_zwP22k4AYgNFhZU1E4Unc0Y1E, and
https://docs.google.com/open?id=0B_zwP22k4AYgTHhTTXFPV1RZYVk.

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Multimodal Interaction in a Model of Visual World Phenomena

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Existing computational models of the Visual World Paradigm (VWP)have simulated the connection between language processing and eye gaze behavior,and consequently have provided insight into the cognitive processes underlying lexical and sentence comprehension. Allopenna, Magnuson and Tanenhaus (1998), demonstrated that fixation probabilities during spoken word processing can be predicted by lexical activations in the TRACE model of spoken word recognition. Recent computational models have extended this work to predictfixation behavior during sentence processingfrom the integration of visual and linguistic information.

Recent empirical investigation of word level effects in VWP support claims that language mediated eye gaze is not only influenced by overlap at a phonological level (Allopenna,Magnuson &Tanenhaus,1998) but also by relationships in terms of visual and semantic similarity. Huettig and McQueen (2007) found that when participants heard a word and viewed a scene containing objects phonologically, visually, or semantically similar to the target, then all competitors exerted an effect on fixations, but fixations to phonological competitors preceded those to other competitors. Current models of VWP that simulate the interaction between visual and linguistic information do so with representationsthat are unable to capture fine-grained semantic, phonological or visual feature relationships. They are therefore limited in their ability to examineeffects of multimodal interactions in language processing.

Our research extendsthat ofpreviousmodels by implementing representations in each modality that are sufficiently rich to capturesimilarities and distinctions in visual, phonological and semantic representations.Our starting point was to determine the extent to which multimodal interactions between these modalities in the VWP would be emergent from the nature of the representations themselves, rather than determined by architectural constraints. We constructed a recurrent connectionist model, based on Hub-and-spoke models of semantic processing, which integrates visual, phonological and semantic information within a central resource. We trained and tested the model on viewing scenes as in Huettig and McQueen's (2007) study, and found that the model replicated the complex behaviour and time course dynamics of multimodal interaction, such that the model activated phonological competitors prior to activating visual and semantic competitors.

Our approach enables us to determine that differences in the computational properties of each modality's representational structure is sufficient to produce behaviour consistent with the VWP. The componential nature of phonological representations and the holistic structure of visual and semantic representations result in fixations to phonological competitors preceding those to other competitors. Our findings suggest such language-mediated visual attention phenomena can emerge due to the statistics of the problem domain,with observed behaviour emerging as a natural consequence of differences in the structure of information within each modality,without requiring additional modality specific architectural constraints.

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Computational Models of Reading: Cascaded or Thresholded Processing?

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Keywords: visual word recognition; cascaded processing; thresholded processing; computational models of reading; Dual Route Cascaded (DRC) model; stimulus degradation.

The functional architecture of highly successful computational models of reading consists of different levels of processing that get activated when a letter string is presented. How these levels should be organized is a critical issue in visual word recognition. At one extreme is the idea that information processing takes place in a series of serially organized discrete stages (Sternberg, 1969); in models that assume such a thresholded processing, activation has to reach a threshold in a level (i.e. processing has to be ended) before passing to the next one. At the other extreme is the idea that activation propagates in a cascaded fashion (McClelland, 1979); in cascaded models, as soon as activation accumulates in a level, it spreads immediately to the adjacent one.

Despite widespread acceptance of the idea that visual language processing is cascaded, a significant amount of evidence demanding a different interpretation (i.e. thresholded processing) has been recently documented in reading experiments involving factorial manipulation of variables; to date, the most of these studies focus on the *Dual Route Cascaded* (DRC) *model* (Coltheart et al., 2001). In these experiments, the psycholinguistic variable of interest (e.g. letter string length, orthographic neighborhood size (N), word frequency and lexicality) has been manipulated together with the stimulus quality (SQ). Briefly, SQ and the other variable have been shown to exert additive effects on skilled readers' latencies, i.e. the effects of letter string length/N/word frequency/lexicality have the same amplitude for degraded and clear stimuli. Critically, interactions between the two factors are on the contrary simulated by the DRC model, i.e. the amplitude of the effect of letter string length/N/word frequency/lexicality is significantly different for clear and degraded stimuli.

In order to eliminate the mismatches with the human performance, a reformulation of the DRC model has been pointed out (e.g. Besner & Roberts, 2003). In general, it has been suggested that thresholding the letter level, rather than allowing it to cascade, provides a simple way to allow the DRC model to fit the additive effects produced by human readers.

The present research aims to expand the current understanding of visual word recognition in healthy skilled readers and, in particular, to investigate the cascaded processing in the DRC model. From one hand, a new variable that might play a role when stimuli are degraded – the Total Letter Confusability (TLC) – will be introduced. Since the letters comprising the stimulus in input are difficult to identify when degraded, the visual similarity between the different letters might influence letter identification, i.e. one might expect more similar/confusable letters to suffer more when degraded than less similar/confusable letters. On the other hand, the role of the TLC in reading experiments involving factorial manipulation of variables will be analysed in order to determine whether and how its effect can explain the additivities observed. The implications of these findings on theories of visual word recognition and computational models of reading will be discussed.

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When Two is Faster than One: Evidence from the Picture-Word Paradigm

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Keywords: Picture-word paradigm; Word Production, Morphology.

Introduction

In studies using the picture-word paradigm, target pictures with two identical objects are responded to faster than pictures with only one object. This effect appears to be independent of the grammatical number of the distracter word and was observed both in German and in Dutch (Schiller & Caramazza, 2003; 2002). The presence of such an effect is inconsistent with the singular-as-default hypothesis (Schriefers, Jescheniak, & Hantsch, 2002).

Method

To investigate the mechanisms underlying the effect of the number of target we conducted three experiments using the picture-word paradigm. In these experiments we manipulated orthogonally the number and the gender of both target and distracter words.

Results

Results showed that the advantage for the plural form is shown also by Italian and Spanish speakers (Experiment 1).

This effect is present also when only one object is presented and participants have to name it using the singular or the plural noun according to the color of the frame surrounding the target (Experiment 2), thus ruling out any causal role of perceptual and attentional factors.

The effect of the number of the target appears to be strictly related to the picture-word paradigm (Experiment 3): indeed, it does not occur either when the target is presented without the distracter word or with a string of non-alphabetic symbols.

Conclusions

To account for these results we propose that the effect of the number of the target occurs at the pre-lexical level and that the presence of an additional stimulus, the distracter word, activates the semantic feature corresponding to the quantity, thus facilitating the production of the plural form.

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An Erp Study of Hemisphere Asymmetries during Processing of Grammatical Gender Agreement

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Keywords: hemisphere asymmetries; grammatical gender agreement; VF methods.

Visual half-field presentation methods have been used with behavioural and ERP techniques in order to investigate cerebral hemispheric differences. These methods can reveal initial hemisphere-specific computations, taking advantage of the fact that stimuli briefly presented to the right or left of a central fixation point are initially/preferably processed by the contralateral hemisphere. Up to now, most of the language studies with lateralized presentations have focused on how each hemisphere could activate and integrate lexical and semantic information to shape comprehension. However, this technique has not been equally exploited for the study of hemispheric asymmetries in syntactic analysis.

The present study used the visual half-field presentation technique to investigate the hemispheric contribution to gender agreement processing. Three hundred and twenty Spanish word pairs made of an article and a noun were selected. While articles were presented at fixation, nouns were presented in the right or left visual field. Moreover gender agreement (between the article and the noun) and the noun gender markedness (marked nouns ending in –o for masculine, e.g., *lago*, "lake", and –a for feminine, e.g., *silla*, "chair"; versus unmarked nouns with a final letter that is not informative of grammatical gender, e.g., *reloj*$_{masculine}$, "watch") were manipulated. Participants were asked to judge the gender agreement in each word pair in a manual response task.

Consistent with the well-established left-hemisphere superiority for syntactic processing, responses were faster and more accurate with nouns presented to the right (left hemisphere) as compared with the ones to the left. Moreover, the agreement condition showed higher accuracy and shorter responses than the disagreement condition, and there were fewer errors with marked nouns, as compared to unmarked ones.

ERPs showed a clear hemispheric asymmetry concerning agreement and markedness effects in the two analyzed time-windows: 350-500 and 500-750 ms after target onset. The left hemisphere (right visual field) showed the main effect of agreement and markedness in both time windows; with the disagreement condition showing more negative amplitudes than the agreement one, and the marked nouns exhibiting a greater negativity than the unmarked nouns. In contrast, the right hemisphere (left visual field) only showed a significant main effect of agreement in the early time window. This agreement effect also reached significance in the second time window but only for marked nouns.

These results show that the processing of syntactic information follows different time-courses for the two hemispheres. While the left hemisphere was sensitive to both lexical and morphological gender information at an early stage of processing, morphological marks would not affect agreement computations in the right hemisphere until a later stage (i.e., 500-750 ms).

Who Cares about Grammatical Gender? ERPs Show Exhaustive Access for French Homophones Despite Gender Priming.

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Grammatical gender is a pervasive feature of many natural languages, providing coherence among grammatical elements. Several studies have examined whether grammatical gender plays a role in lexical access. Some have claimed that gender restricts activation to candidates that match in gender with the preceding determiner or adjective (Spinelli & Alario, 2002). Subsequent work has challenged this claim (Spinelli.,Meunier & Seigneuric, 2006). Moreover these studies have used behavioral measures whereas work using ERPs has shown differences in the time course of lexical access as a function of target word properties (Van Petten, & Kutas, 1987). Herein, we provide evidence from two cross-modal priming experiments in French, one measuring RTs and the other ERPs, which confirm that lexical access is not constrained by grammatical gender. Primes were auditorily presented non-homographic French homophones preceded by a definite determiner (eg. la pique /la pik/ "the spear" which has the homophonic mate le pic /lə pik/ "the peak"). All homophones had a dominant and a subordinate meaning but only the subordinate meaning was presented, as specified by the gender of the determiner (eg. /la pik/). A 2 x 2 design was used: auditory Primes were either the subordinate homophone or a frequency matched control (/la pik/ vs. /la tas/ "the spear vs. the cup") and visual Targets were associated to either the dominant or subordinate meaning of the homophone (montagne/lance "mountain/lance"). Prime-Target SOA was zero milliseconds. In Experiment 1, RTs for lexical decisions to target words were recorded. In Experiment 2, ERPs were recorded and a go/no-go task was used in which participants responded to probe items (city names). Both experiments showed activation of both the dominant and subordinate meaning of the homophone following the gender-specified subordinate homophone prime. In Experiment 1 this was shown by a significant reduction in RT to both types of target following subordinate primes whereas in Experiment 2 it was shown by a significant reduction in the N400 component as well as in a later 500-800 ms window to both types of target. No interactions were found. Indeed, our ERP results reveal that independent of whether gender appropriate or not, both meanings of homophonic primes are immediately activated and affect the cortical response to subsequent targets. Our ERP results also belie the findings from previous ERP work in sentential context showing that the N400 effect to the contextually inappropriate meaning of a homophone is delayed (Van Petten & Kutas, 1987). To conclude, our results support models that purport an exhaustive account of lexical access and provide unequivocal evidence from complementary techniques that grammatical gender does not play a role in the early stages of lexical access in French.

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Activating Gender Stereotypes: A Life-Span Perspective

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Keywords: gender stereotypes; children; adults; elderly; life-span.

Research suggests that information about stereotypical gender associated with certain occupations and characteristics is incorporated into speakers' representations, and that such information is difficult, or even impossible, to suppress during language processing (Cacciari & Padovani, 2007; Oakhill, Garnham, & Reynolds, 2005). However, most, if not all, of the research on gender stereotypes to date has been conducted with young adults. The mechanisms underlying the processing of stereotypical information in other age groups are still unknown. The present study employs a paradigm adopted from Oakhill, Garnham, and Reynolds (2005), and four groups of participants (32 eight-year-old children, 34 ten-year-old children, 26 young adults, and 28 cognitively preserved senior adults) to investigate the activation of gender stereotypes in Italian from a life-span perspective.

Based on the norming conducted with 133 eight- and ten-year-old children, nine role nouns associated mostly with males, and nine mostly with females were chosen. The 18 role nouns (plus 12 fillers marked for semantic gender, e.g., *amico/amica* "friend") were used with all participants. Participants heard a word denoting an occupation (prime) associated either with masculine stereotypical gender (*camionista* "truck driver"), or with feminine stereotypical gender (*insegnante* "teacher"). 250 ms later, participants heard one of six kinship terms (three masculine and three feminine, i.e., *sorella* "sister", *fratello* "brother", *madre* "mother", *padre* "father", *moglie* "wife", *marito* "husband"). The task was to decide if prime and target could describe the same person. The word pairs were stereotypically congruent (*camionista – padre, insegnante – madre*), or incongruent (*camionista – madre, insegnante - padre*). Based on existing research, we expected all four groups of participants to exhibit faster decision times on congruent rather than incongruent targets.

Repeated measures ANOVAs with decision times as a dependent variable conducted with each participant group showed that across all age groups, participants were faster when the target was preceded by a stereotypically congruent than incongruent prime, for both masculine and feminine stereotypes ($ps < .01$).

Our findings imply that (1) gender stereotyping is almost adult-like by the age of seven, and (2) the processing pattern, observed in young children, continues into adulthood and old age relatively unchanged. Critically, the current investigation employed an implicit measure (reaction times), rather than an explicit off-line one as in almost all studies conducted to date with children and the elderly. As such, this is the first study that investigates on-line processing of gender stereotypes from a life-span perspective, using a broad range of ages.

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Feedback as a Strategy for Overcoming Automatic Gender Stereotypes

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Keywords: stereotyping; gender; feedback

Stereotypical gender information is automatically evoked when certain role names and professional terms are read. As a consequence, people expect surgeons to be male and nurses to be female. Such inferences are difficult to suppress and result in processing difficulty when violations of stereotypical gender are encountered. In a series of three studies, we investigated feedback as a form of stereotype reduction training. We hypothesised the feedback would create an awareness of stereotyping and facilitate control over the immediate activation of gender stereotypes. Specifically, we compared the value of individual performance-related feedback versus group-consensus feedback in lowering gender stereotype biases.

The basic task was a judgement task devised by Oakhill, Garnham and Reynolds (2005). Across 3 blocks of trials participants were presented with word pairs comprised of a role name with stereotypical gender and a kinship term with definitional gender e.g. Surgeon/Mother. The task was to decide as quickly as possible whether both terms could refer to one person. Importantly, the three experiments differed only in Block 2 where the type of feedback was manipulated.

In Experiment 1 feedback was based on the participants' performance, simply indicating whether they were 'Correct' or 'Incorrect' after each response. In Experiment 2 feedback consisted of a statement informing participants of their accuracy and the (fictitious) percentage of participants in a previous experiment that agreed or disagreed with their choice. If participants deemed gender incongruent trials to be incorrect (thus succumbing to stereotype biases) they would receive feedback indicating that a very high percentage of previous participants *disagreed* with their response thereby highlighting their comparatively strong personal tendency to stereotype. In a third, control, experiment no feedback was given.

Stereotype activation on gender incongruent word pairs was most succesfully reduced in Experiment 1 with accuracy increasing significantly across all 3 blocks (+14.5% from Block 1 to Block 3). In Experiment 2 a smaller but significant improvement was also found (+9.7%).However in the Control experiment there was no significant improvement across blocks (+0.83%). Results suggest the use of individual performance related feedback is highly effective in reducing the gender stereotyping effect in this judgement task. The positive influence of group-consensus feedback should also be noted.

The reaction time data showed a similar pattern with the biggest decrease in reaction times to gender incongruent word pairs (– 412ms from Block 1 to Block 3), followed by Experiment 2 (– 308ms). However, there was also a significant improvement in the Control experiment (– 238 ms) suggesting that faster reaction times across blocks in each of the experiments were due, at least to some extent, to practice effects. .

Our findings provide further support for the malleability of stereotype biases. Creating awareness of stereotype tendencies through providing feedback on behaviour is a valuable method of reducing activation of gender stereotypes, though further research is needed to investigate what cognitive or motivational changes underlie such effects, and to determine whether such training can produce longer term reductions in stereotyping.

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Grammatical Gender Processing in L2 Speakers of Spanish:
Does cognate status help?

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Keywords: Language processing, grammatical gender, bilingualism, eye movements

Spanish speakers use grammatical gender marking on articles (*la* and *el*) to facilitate the processing of upcoming nouns (Lew-Williams & Fernald, 2007). Conversely, L2 learners of Spanish for whom grammatical gender is absent in their L1, do not behave like native Spanish speakers (Lew-Williams & Fernald, 2010). Here we ask whether sensitivity to grammatical gender in the L2 is modulated by the cognate status of nouns. Cognates share form and meaning in two languages (e.g., *guitar* in English and *guitarra* in Spanish). Past research demonstrates that bilinguals activate in parallel orthographic, phonological, morpho-syntactic and semantic codes of cognates in the two languages (Duyck et al., 2007; Migdley, Holcomb & Grainger, 2011). Given this, it is possible that L2 learners of Spanish may more easily access and use grammatical gender information when words are cognates compared to non-cognate words.

Monolingual Spanish speakers (Granada, Spain) and English-Spanish participants were recruited. The L2 speakers were further divided into two groups (highly proficient and less proficient) based on the results of a standardized Spanish grammar test (t(18)=8.90, p <.001). Data were collected using the Visual World Paradigm. Participants saw displays with 2-picture visual scenes in which objects matched in gender (same-gender trials (1)) or mismatched (different-gender trials (2)):

      (1) PERA–TARÁNTULA/PEAR$_{FEM}$-TARÁNTULA$_{FEM}$
      (2) PERA–MICRÓFONO/ PEAR$_{FEM}$-MICROPHONE$_{MASC}$

Pictures were concrete objects, half masculine and half feminine gender, in turn broken down into half cognates and half non-cognates. Words were embedded in the preamble *Encuentra el/la* (Find the). On different-gender trials, participants are expected to orient their eyes towards target items more quickly than on same gender trials, because it is here that information encoded in the article becomes informative.

Paired sample t-tests comparing the proportion of looks to cognate targets at intervals of 100ms windows (from 100ms to 700ms) revealed that at the 400ms window, the monolingual speakers oriented their eyes sooner on different gender trials than on same gender trials (t(23)= 3.26, p = 0.003). Non-cognate targets revealed a similar pattern of result (300ms window, (t(23)= 2.07, p = 0.054); 400ms window, (t(23)= 3.70, p = 0.001). The findings indicate that monolingual speakers of Spanish use information on the articles to facilitate the processing nouns. As expected, for these speakers cognate status of words is not a relevant manipulation. Preliminary results for the L2 group (additional data collection currently under way) show that the highly proficient L1 English-L2 Spanish speakers showed a marginally significant difference at the 400ms window (t(9)= 1.99, p = 0.07) and at the 500 ms window (t(9)= 2.03, p = 0.07), but only for non-cognate targets. Cognate targets did not show any facilitatory effect at any of the examined time windows. The lower proficiency group showed no evidence of using gender information. Results for the highly proficient L2 speakers suggest that cognate status of words appears to hinder the use of grammatical gender information during processing.

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Priming Cross-Linguistic Interference in Bilingual Children

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Many researchers argue that bilingual speakers have two separate grammars; others instead contend that grammatical knowledge is stored in language-general format, shared between both languages but deployed selectively according to language context (shared-syntax hypothesis, Hartsuiker & Pickering, 2008). This account is supported by cross-linguistic priming results: when bilinguals hear a construction in one language that is common to both (e.g. passive), their use of that construction in the other language increases.

But if grammatical knowledge is truly language-general, then cross-linguistic interference priming should be possible: i.e., a construction that belongs in only one language (e.g. *adjective-noun* word order in English) should prime its use even in the other (e.g. Spanish, where the grammatical order is *noun-adjective),* regardless of a speaker's language dominance. Using a novel picture-description task with Spanish-English bilingual children, we report the first evidence for the cross-linguistic syntactic priming of ungrammatical productions.

Twenty-four participants (mean age=5.0 years) completed standardized receptive vocabulary tests (PPVT; TVIP) and two Spanish noun-modification tasks. **Task1.** In the monolingual Spanish elicitation task modeled on Nicoladis (2006), participants viewed 20 arrays of images where the central image differed from the surrounding ones in 'modifier' (e.g. 'open' vs. 'closed' 'books'); the experimenter described the surrounding images and then asked the child to name the central image. **Task2.** A bilingual picture-description task was used to investigate syntactic interference priming. Participants met a Spanish-monolingual puppet, trapped inside a computer after giving a queen unsatisfactory gifts. Importantly, she liked the object kind (e.g. apple) but not its particular property (e.g. color); thus, participants needed to listen to the English-speaking experimenter's descriptions (i.e. prime sentences) of the unsatisfactory gifts to recommend the correct gift to the puppet in Spanish. The first block (12 items) used predicative constructions as neutral primes ("That apple was green") to obtain a baseline for the bilingual language context; the second block (12 items) presented *adjective-noun* as target primes ("It was a green apple"). Slides containing a distracter object (e.g. red strawberry) and the target object (e.g. red apple), both contrasting in adjectival dimension with the gift described in the prime (e.g. green apple), followed the auditory stimulus.

In **Task1,** participants rarely produced the English *adjective-noun* order in Spanish elicited productions (*M*=4.7%, *SE*=1.5)*,* suggesting near-mastery of Spanish noun modification. In **Task2,** use of *adjective-noun* order in neutral-prime block (*M*=21.9%, *SE*=6.9) was significantly less than in the adjective-noun prime block (*M*=41.2%; *SE*=7.4; β=1.48, *z*=4.78, *p*<0.001). We next used the difference between vocabulary scores as an index of English-language dominance: adjective-noun production in Task2 significantly correlated with English-dominance in the neutral prime block (*r*=0.516, *p*<0.02) but not in the *adjective-noun* prime block (*r*=0.242, *p*>0.15), signaling that dominance does not predict susceptibility to interference priming.

These data indicate the *adjective-noun* construction is available in bilingual children's Spanish and lend support to the shared-syntax hypothesis. We discuss the relationship of these findings to spontaneous productions of cross-linguistic syntactic interference in children and adults and consider their implications for the structure of the shared-syntax model.

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Verbal Short-Term Memory and the Acquisition of Grammar by Bilingual Children

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Keywords: child bilingualism; verbal memory; production of grammar.

Previous studies have shown that verbal short-term memory (VSTM) is related to the acquisition of grammar such that children with large verbal memory spans generally produce longer and more complex sentences and perform better on receptive grammar tasks than children with smaller spans, both in mono- and bilingual acquisition (Adams & Gathercole, 2000). While most studies have looked at rather general measures of grammatical proficiency such as sentence length, there is some evidence from adults and children put under memory stress that reduced verbal memory skills impact on the processing and production of subject-verb agreement and word order.

Subject-verb agreement and word order are acquired late by Turkish learners of Dutch, who characteristically produce uninflected verbs in incorrect (non-raised) sentence positions. In this study, we ask whether such problems with subject-verb agreement and verb placement are related to VSTM ability.

A group of 54 Turkish-Dutch 4-year old bilinguals participated in the study. All the children were dominant in Turkish, but they had varying levels of proficiency in Dutch. The following tasks were administered: a Dutch narrative production task, Dutch and Turkish vocabulary tasks, and three serial recall tasks assessing VSTM. The serial recall tasks involved a word recall task and two nonword recall tasks. In the nonword recall tasks, phonotactic probability had been manipulated such that items were composed of high-probability versus low-probability phoneme combinations. Thus, the three VSTM tasks varied in the degree to which recall was supported by long-term knowledge about words or phoneme combinations (word recall and high-probability nonword recall), or whether there was no or only very little support from long-term linguistic knowledge (low-probability nonword recall).

The results show moderate to strong correlations between all the VSTM measures and children's production of subject-verb agreement and verb placement (*r*s between .45 and .61). Moreover, regression analyses show that word recall and high-probability nonword recall account for a significant amount of variance in the production of subject-verb agreement and verb placement, after controlling for Dutch and Turkish vocabulary (R^2 change=.14, p<.05 for subject-verb agreement; R^2 change=.17, p<.01 for verb placement).

These findings suggest that the acquisition of grammatical phenomena such as subject-verb agreement and verb placement by bilingual children involves storage-based learning that, at least in part, relies on long-term linguistic knowledge about words and phonemes (Gathercole, Pickering, Hall, & Peaker, 2001).

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Recency of immersion in L2 environment more important than L2 proficiency in speech segmentation

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Keywords: speech segmentation, prosodic cues, F0, cross-linguistic.

Speech segmentation is a language-specific skill: each language provides different cues for optimally segmenting the continuous speech stream into words. When exposed to a novel language, listeners have been shown to use those segmentation cues that they are familiar with from their native language (L1).

Learning a second language (L2) entails learning to use the prosodic segmentation cues appropriate for that language. Whereas many studies have addressed the influence of the L1 on segmentation of L2 or novel languages, it is yet unclear how L1 and L2 segmentation strategies might compete in highly proficient L2 learners. In order to assess the prominence of L1 vs. L2 prosodic segmentation strategies, this study investigates which segmentation cues take precedence when listeners are exposed to a novel language. It assesses to what extent proficiency in the L2 and recent exposure to the L2 affect the use of L1 versus L2-specific segmentation cues in segmenting novel-language speech.

Participants were (1) native listeners of French, (2) native listeners of English without functional knowledge of French, and (3) native listeners of English with a high proficiency in French as an L2 (assessed with a cloze test) who had lived in a French-speaking country for at least three months. Importantly, all participants were living in the USA at the time of testing. The native listeners of French and the L2 learners of French had been selected to vary in the amount of time elapsed since their last stay in a French-speaking country.

In an artificial language learning experiment, participants were tested on their use of a segmentation cue that matches French but not English prosody, namely a high tone on word-final syllables. The word-final high F0 is expected to be a useful segmentation cue for French listeners, because accented syllables in French occur at the right edge of the Accentual Phrase and are word-final; in non-utterance-final positions, they have higher F0 and longer duration than the corresponding unaccented syllables. It is not expected to be a useful segmentation cue for (monolingual) English listeners, because in English, accented syllables tend to be word-initial, with F0 rise, increased amplitude and, to some extent, increased duration signaling this word-initial prominence.

During a training phase, 30 participants were exposed to a 20-minute speech stream consisting of six trisyllabic words without any phonetic word-boundary cues except the word-final high F0. In the subsequent test phase, they were tested on their recognition of the trained words.

The results showed no effect of French proficiency for the L2 learners. There was, however, a strong effect of recent linguistic exposure: performance increased with decreasing time in the USA since the last stay in a French-speaking country. Surprisingly, the recency of immersion in an L2 environment thus turned out to override L2 proficiency. These results indicate that recent linguistic exposure is a crucial factor influencing listeners' use of prosodic cues in speech segmentation. This suggests that speech-processing routines are much less rigid and more adaptive than previously assumed.

Very Fast Effects of Language on Eye Movement Control are Due to Anticipatory Coarticulation

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We examined a recent claim by Altmann (2011) that language can mediate eye movement control within 100 ms. This result is surprising given data from a large body of visual-world studies, where the earliest effects of speech on eye movements (as reflected by changes in the odds of fixating the target relative to a phonologically unrelated distractor) are typically observed around 150-200 ms after target-word onset.

Altmann reanalyzed data from two studies that utilized a design well suited to examining the earliest effects of speech on eye movements. Participants saw visual scenes including several objects and two potential referents. An accompanying spoken sentence referred to one potential referent for half the participants (e.g., *The man will...*), and to the other potential referent for the other half of the participants (e.g., *The girl will...*). Since each potential referent serves the role of target and (associated) distractor, this design allows one to establish the earliest point in time at which language mediates eye movement control.

Altmann analyzed the first saccade generated after the onset of the noun (as determined by inspecting the speech signal), in 40-ms time bins. Starting in the 80-120 ms bin, participants were significantly more likely to initiate a saccade to the referent of the noun than to the associated distractor.

We hypothesized that rather than reflecting language-mediated effects on eye movement control with lags as short as 100 ms, Altmann's results are due to the processing of anticipatory coarticulatory information in the vowel preceding the target word. We predicted that removing such coarticulatory information would result in substantially slower effects of speech on eye movements, in line with the results of most visual world studies.

In Experiment 1, we employed a design similar to Altmann's, using displays with four pictures of which two were potential referents. A spoken instruction referred to one or the other picture (e.g. *The leaf/foot...is the target*). While we did not find significantly more first saccades to the target than to the associated distractor in the 80-120 ms bin, we did find target advantages beginning in the 120-160 ms bin.

In Experiment 2, we used sentences where the target was preceded by a very brief prosodic break (e.g. *The...leaf is the target*). Importantly, the determiner did not contain anticipatory coarticulatory information related to the noun; it had been recorded in isolation and cross-spliced at the start of every sentence. We did not find significantly more first saccades to the target than to the associated distractor prior to 200 ms after the onset of the noun. First-saccade analyses from both experiments converged with an analysis of fixation proportions over time.

Taken together, our results demonstrate that recognition of a spoken word is facilitated by preceding coarticulatory information. The results also suggest that speech affects eye movement control with a delay of approximately 200 ms.

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Speech rate mediated lexical ambiguity resolution and the role of articulation

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Keywords: spoken word recognition; speech rate; visual-world eye-tracking; electromagnetic articulography

Introduction, Experiments

Phonological variation can cause lexical ambiguity in sentences like "A quick *run picks* you up," when /n/ assimilates to /m/ because of /p/ (e.g.,Gaskell and Marslen-Wilson, 2001). However, few studies have examined the roles of ***speech rate*** and the ***speaker's articulation*** in resolving lexical ambiguity. Our study (i) tests whether interpretation of lexically-ambiguous words is influenced by speech rate, and (ii) compares production and perception, directly addressing the issue of gradience. Previous studies have separately demonstrated gradience in perception and production, but these two kinds of data have not been directly compared. Our research studies both at the same time.

We conducted **(a) a production study** and **(b) a visual-world eye-tracking perception study.** A native English speaker first produced the targets (and fillers), as her articulatory movements were recorded by electromagnetic articulography (EMA), which tracks the motion of articulators (e.g. tongue, lips) in real-time. We used these recordings for the eye-tracking/perception study, where the target sequences (*rate constant; noun+verb*) were spliced into carrier phrases of different speech rates (*fast/medium/slow,* average rates of 5.86 syllables/sec, 4.04 syllables/sec, 2.92 syllables/sec, respectively), as shown in (1). To avoid plausibility/frequency confounds, we used nonwords (e.g.,*Vone/Vome*). Participants (n=24) were taught that the nonwords were aliens names and listened to the sentences (36 targets, 50 fillers); saw pictures of aliens (two of which were critical images , e.g.,*Vone,Vome)*; and clicked on the mentioned alien.

(1) *Every time the waiter brings out a strawberry cheesecake from the kitchen* [Carrier_part1], **Vone peeks** [Target noun+verb] *to see if he can steal a piece* [Carrier_part2].

Results

Eye-movements reveal a main effect of Speech Rate (significant 200-300ms and 1100-1400ms post target-word onset; p's<.05): Participants looked more to unassimilated forms (e.g.,*Vone*) in **fast- and medium-rate conditions**, but in the **slow-rate condition,** they looked more to assimilated forms (e.g.,*Vome*). The listeners may have compensated by perceiving the critical phoneme as more /n/-like because faster rates often lead to a greater extent of coarticulation, thus making an intended /n/ more /m/-like. Thus, we see that real-time processing of lexically-ambiguous forms is guided by speech rate.

In addition, although the speech rate of target noun+verb sequences was constant (medium), natural speech always exhibits variation in articulatory overlap (e.g. between *Vone* and *peeks*). We found a **significant correlation** between **listeners'** **eye-movements** and the extent of **articulatory overlap** (between the onsets of the gestures to their maximum constriction) **between the speaker's tongue tip and lips** (r = -.30, p<.01; eye-movements aggregated 1000-1500ms post target-word onset).

Conclusion

Even with identical acoustic materials, listeners' real-time interpretations of lexically-ambiguous forms are influenced by the speech rate of surrounding words. Importantly, our study showcases the ***role of speech rate in resolving lexical ambiguity*** and is consistent with work on subphonemic variation (Salverda et al., 2007). Our study also provides a direct illustration of gradience on the articulatory level being correlated with gradience on the perceptual level. It demonstrates listeners' sensitivity to subtle articulatory differences, which can be captured by eye-tracking and EMA.

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Long before Short Preference in On-line Sentence Comprehension
- An Eye-Tracking Study in Korean -

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Processing load related to the length and/or order of constituents appears to vary along with the headedness of the language under consideration: Speakers of head-initial languages like English have 'short before long' (S-L) preference (or "end weight", cf. de Smedt, 1994, among others), whereas speakers of head-final languages such as Japanese have 'long before short' (L-S) preference in *sentence production* (cf. Yamashita & Chang, 2001).

In order to gain a more comprehensive picture of the length/order effect in sentence processing in general, the present study investigates the question further in the domain of *on-line sentence comprehension* in another head-final language, namely Korean. Eye-movements of 30 Korean native speakers(m=12, f=18) were recorded while they read sentences composed of a subject, an IO (indirect object), a DO (direct object) and a verb. The length of the objects was varied, using prenominal relative clauses; by permutating IO and DO further, 6 types of targets needed for the following pairwise comparisons were constructed (n=180(30*6)).

(a) short IO - short DO   **vs.** short DO - short IO
(b) short IO - long DO   **vs.** long DO - short IO
(c) short DO - long IO   **vs.** long IO - short DO

First, total gaze durations for the [IO~DO] region have been compared. In the baseline condition (a), in which the lengths of the constituents were identical, the [IO-DO] order turned out to be processed faster than the [DO-IO] order. In (b) and (c), in contrast, reading times for the L-S orders were always significantly shorter than those for the S-L orders. Second, we have extracted first and second pass reading times for the longer constituents in (b) and (c) separately. There were no differences between the first pass reading times in each condition. But second pass reading times of long IO/DO in L-S order were significantly shorter than those of S-L order, both in (b) and (c). This means that the differences in total gaze durations are exclusively attributable to the extra processing costs for re-reading the longer constituents following the shorter ones. Furthermore, the L-S preference appears to be strong enough to win over the general IO-DO preference attested in the baseline condition (a).

In conclusion, the present study provides new experimental evidence supporting the locality based accounts of on-line parsing complexity, according to which processing of more distant dependent entities should be harder(Gibson, 1998; Hawkins, 1994). For processing argument structure of head-final languages in particular, the L-S order allows the distance between verb and arguments to be held much shorter than S-L order, as illustrated in the following:

(L-S): [$_{VP}$ [<u>attributive phrase/clause of length *L*</u> **argument1**] [**argument2**] **V**]
(S-L): [$_{VP}$ [**argument1**] [<u>attributive phrase/clause of length *L*</u> **argument2**] **V**]

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Can Visual Spatial Information modulate Semantic Interpretation of Social Relations Incrementally? Evidence from Eye-Tracking

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Keywords: Semantic interpretation; spatial distance; social relations.

Introduction

Recent studies have investigated the link between spatial distance and social relations. Williams and Bargh (2008), for instance, showed that spatial distance can moderate subsequent evaluation of social stimuli: Participants reported weaker bonds to their family and hometowns after they had been primed with far (vs. close) distance (by marking off two points on a Cartesian plane: far vs. close). In a path-drawing task, Matthews and Matlock (2011) found that participants drew paths *closer* to figures that were introduced as representing *friends* (vs. *strangers*).

Thus, spatial distance and the way people understand social relations appear connected. Could this connection also affect real-time semantic interpretation? In an eye-tracking reading experiment we examined whether spatial distance (close vs. far) can modulate real-time semantic interpretation of German sentences that expressed social relations (friendly (1) vs. unfriendly (2))?

(1) '[*Sandra and her aunt*]$_{\text{NPs-coord.}}$ [*met*]$_{\text{VP}}$ [***cheerfully***]$_{\textbf{ADV}}$ [*in*]$_{\text{PP}}$ [*the elevator*]$_{\text{NP3}}$.' (literal translation from German)

(2) '[*Sandra and her aunt*]$_{\text{NPs-coord.}}$ [*met*]$_{\text{VP}}$ [***grumpily***]$_{\textbf{ADV}}$ [*in*]$_{\text{PP}}$ [*the elevator*]$_{\text{NP3}}$.'

If spatial cues modulate social distance interpretation rapidly and incrementally, spatial distance and social relation interactions should emerge in first pass times at the ADV region (since the adverb expresses social relations). Alternatively, delayed effects could be observed in total time at that region and/or later in the sentence.

Methods

A two-by-two Latin square design crossed spatial distance (close vs. far) and social relation (friendly vs. unfriendly) as factors. Participants (N=32) inspected a visual context, which presented two playing cards either far apart or close to each other for critical trials. Next, participants read a sentence and judged its veracity. Critical items were 48 German sentences, each with two versions (see (1) and (2)). Finally, they saw a picture of two playing cards and verified whether these cards were identical to the two playing cards presented before the sentence.

Results

Data analysis revealed no reliable interaction effect of spatial distance and social relation in first-pass reading times at the ADV region, but instead this effect appeared in the spillover reading measure for this region (*t*-value = -2.26). In addition, a marginal interaction effect at the region after the ADV (PP region) appeared in first-pass (*t*-value = -1.95). Reading times were shorter when sentences about friendly relations were preceded by cards close together (vs. far apart) and vice versa for sentences that expressed an unfriendly social relation.

Discussion

These results are to the best of our knowledge the first evidence of rapid and incremental interaction effects between spatial distance and social relations during real-time sentence interpretation. The present findings argue for highly active visual context effects on language comprehension, even in the absence of referential or lexical-semantic associative links, and highlight the need for multiple (referential and non-referential) mechanisms in informing language comprehension through non-linguistic visual information.

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When is Coercion simply Surprisal?

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Keywords: Coercion; Surprisal; sentence processing; eye-tracking.

Psycholinguistic investigations of coercion have examined expressions in which a verb that semantically selects for an event complement appears with an NP object denoting an entity (e.g., *began the book*). Previous studies demonstrated that sentences containing such expressions are harder to process than control sentences (e.g., *John read the book*), suggesting that comprehenders need to build an event sense of the complement (e.g., *began reading the book*) to satisfy the semantic requirements of the verb. An alternative explanation, however, is offered by surprisal accounts (e.g., Levy, 2008). Specifically, the classical paradigm for eliciting coercion effects involves comparing coercion expressions (1a) with control expressions (1b) that instantiate the preferred interpretation (typically established using cloze tests). It follows, however, that the predictability of the target noun in the control condition is generally higher than it is in the coercion condition (as demonstrated by cloze norming results reported in Traxler et al., 2002). As a consequence, surprisal for the object noun – estimated as the inverse of its log probability – will be lower in control contexts than in the coercion contexts, suggesting that coercion effects may at least partially be explainable in terms of surprisal.

To test this hypothesis, we conducted an eye-tracking experiment in German (N=48) with a 3 x 2 design that crossed the factors verb type (coerced, preferred, neutral) and frequency of object noun (high, low). Crucially, the neutral condition (c) contained a non-coercion verb that was equally unconstraining as the coercion verb (a): Standard coercion accounts predict that object nouns following coercion verbs (a) should be harder to process than following preferred (b) or neutral (c) verbs, independently of word frequency. Surprisal accounts, in contrast, predict that nouns following the more constraining preferred verbs (b) will be faster to process than the equally constraining coercion (a) and neutral (c) verbs. In addition, assuming that low frequency words are less predictable than high frequency words, effects of surprisal may be attenuated for low frequent compared to high frequent target nouns.

Analyses of total reading times in the target region (bold in (1)) revealed an expected main effect of frequency and a main effect of verb-type. As predicted by coercion accounts, participants spent more time reading the noun in (1a) than either in (1b) or (1c). The preferred and neutral conditions did not differ. Analyses of first-pass regressions and regression-path times in the spillover regions (underlined in (1)) showed a different pattern: as predicted by surprisal accounts, there was a main effect of verb-type, with fewer first-pass regressions and shorter regression-path times in (1b) than in either (1a) or (1c), and no significant differences between (1a) and (1c). Our results thus provide evidence for both coercion and surprisal accounts, suggesting that frequently reported effects of coercion in spillover regions may be better explained in terms of surprisal.

(1)
a. Peter began **the book/ the manuscript** on holiday. (coerced, high/low)
b. Peter read **the book/ the manuscript** on holiday. (preferred, high/low)
c. Peter bought **the book/ the manuscript** on holiday. (neutral, high/low)

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What Makes Readers to Commit to (Incorrect) Pre-Head Attachment in Japanese?

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Keywords: Relative clause structure; garden-path sentences; sentence processing; reading; eye-tracking

Previous research demonstrated that comprehenders of head-final languages do not delay associating pre-head arguments until the head is received (Kamide, 2006). As a consequence, readers are sometimes forced to reanalyze a structure due to an incorrect pre-head attachment. It is, however, still unclear what makes comprehenders of head-final languages to commit to pre-head attachment and to experience processing difficulty when a sentence is disambiguated. The current study addressed this issue by testing Japanese relative clause structure such as (1), with which readers initially tend to adopt a main clause analysis and later reanalyze as a relative clause at the relative clause head (*joyuu*, 'actress') (Hirose & Inoue, 1998). We conducted two reading experiments using eye-tracking technique.

In Experiment 1, we manipulated semantic bias of the direct object noun within the relative clause (RC object) for the two alternative analyses; *MC-biased* (biased toward the main clause analysis, (1a,2a)) and *RC-biased* (biased toward the relative clause analysis, (1b,2b)). Also manipulated was the length of the relative clause, which was either with extra adjuncts between the RC direct object and the RC-verb (*long RC* as in (2)) or without (*short RC* as in (1)). The significant interactions between the two factors were found for the first-pass reading times in the spill-over region (*jitto*, 'fixedly') and for the second-pass reading times in the RC-verb region (*koboshita*, 'spilled'). They suggest that participants made the strongest commitment to the main clause analysis in the *long RC* and *MC-biased* condition. We next examined whether the readers' commitment to the main clause analysis occurred simply because there was extra information load by the additional adjuncts in (2) or in fact because the incorrect main clause analysis was maintained for a longer period of time in (2) than in (1).

Experiment 2 thus compared the sentences (2) with those that were lexically identical but different in the word order (the adjuncts preceded the RC direct object as in (3)). We analyzed the relative clause verb region and the following head region combined (*koboshita joyuu-ni*, 'spilled actress') because these regions are identical in (2) and (3). The results from the analysis of right-bounded and regression-path times showed an interaction between *word order* and *semantic bias*. Further analysis showed that the simple effect of semantic bias was significant only when the direct object preceded the adjuncts (2) but there was no such difference when it follows them (3).

The results together demonstrated that both lexical semantics and the duration of how long an initial incorrect analysis was maintained influenced the extent to which comprehenders commit to the incorrect analysis and the cost for structural reanalysis.

Example Sentences

(1a, b) *Akachan-ga (miruku/shanpan)-o koboshita joyuu-o jitto mitsumeta.*
   Baby-NOM [milk/champagne-ACC spilled] actress-ACC fixedly stared at.
   'The baby stared fixedly at the actress who spilled the milk/champagne.'
(2a, b) *Akachan-ga (miruku/shanpan)-o teeburu-de hadeni koboshita joyuu-o jitto mitsumeta.*
   Baby-NOM [milk/champagne-ACC violently on the table spilled] actress-ACC fixedly stared at.
   'The baby stared fixedly at the actress who spilled the milk/champagne violently on the table.'
(3a, b) *Akachan-ga teeburu-de hadeni (miruku/shanpan)-o koboshita joyuu-o jitto mitsumeta.*
   Baby-NOM [violently on the table milk/champagne-ACC spilled] actress-ACC fixedly stared at.

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Context Effects on Listener Eye Movements during Spoken Sentence Comprehension: Speaker Gaze and Experimental Task

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Comprehension of a given sentence depends not just on its linguistic form and content, but also on its wider context. For example, world knowledge, assumptions about information available to an interlocutor, and pragmatic affordances of visible objects have all been shown to facilitate comprehension very rapidly.

In a series of visual-world experiments, we investigated two further aspects of sentence context: the ability to follow a speaker's gaze to what s/he is attending, and the specific comprehension goal. Participants saw videos of a speaker who used German SVO and OVS sentences (NP1–verb–NP2) to talk about depicted characters, e.g. *Der/Den Kellner beglückwünscht den/der Millionär* (The waiter$_{Nom/Acc}$ – congratulates/is congratulated by – the millionaire$_{Acc/Nom}$). The speaker's gaze behaviour was modelled on speech production, where speakers tend to look at objects roughly one second before mentioning them (e.g., Griffin & Bock, 2000).

In all studies, we compared participants' fixations of the NP2 referent when they could see the speaker shift gaze towards it with a condition where the speaker was obscured. In Experiments 1-3, each video was followed by a response template, which required participants to verify a particular aspect of the sentence they had heard (1: the mentioned characters, 2: the sentential patient; 3: thematic role relations). In Experiment 4, the verification task was manipulated within participants (mentioned characters vs. role relations), and the response template preceded the video.

Even before the onset of the NP2, Experiments 1-3 found substantially more fixations of the NP2 referent in the Gaze condition, compared to NoGaze. Thus, comprehenders anticipated upcoming sentence content based on the speaker's attention. In addition, the post-sentence task affected fixations *during* comprehension of identical sentences: Because the initial determiner in OVS sentences (*Den*$_{Acc}$) unambiguously identified the patient, participants in Experiment 2 received the critical information for their task (patient verification) at the NP1. They fixated this character longer and shifted to the NP2 referent later for OVS than for SVO sentences, but also later than for OVS sentences in Experiment 3 (task: verifying thematic-role-relations).

The difference in stimulus ordering in Experiment 4 fundamentally altered the pattern of eye movements during comprehension: Participants now fixated the NP2 referent prior to its mention in all conditions (Gaze and NoGaze), showing eager anticipation in preparation of a quick response. The speaker's gaze affected fixations during NP2, i.e. later than in the previous experiments, with more fixations with Gaze than without.

Our results highlight the importance of task demands for interpreting studies of spoken comprehension, where the experimental task will often define the goal of a specific instance of comprehension (cf. Salverda, Brown, & Tanenhaus, 2011). More generally, we show that comprehension of identical linguistic material is affected by multiple interacting aspects of the context in which it is processed. Speaker gaze is one such contextual cue, and it seems to be highly salient and processed extremely rapidly. In fact, we found very few direct fixations of the speaker. This means that speaker gaze information is available sufficiently early to allow prediction of upcoming sentence content.

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Partial and Consistent Null Subject Languages: a sentence comprehension study on European and Brazilian Portuguese

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Keywords: Null Subject Languages; Partial pro-drop languages; pronoun comprehension.

The Null Subject Parameter allows the classification of languages as Null Subject Language (NSL), which allow the omission of the Subject of a finite sentence, or as non-Null Subject Languages (nNSL), where Subject omission is not allowed. Italian, Spanish and Portuguese, belong to the first group, and English and French, for instance, to the second.

However, the former group is not homogenous since not all languages classified as NSL behave the same way. That variation has led to a sub-division of NSL in, at least, three different classes, following Barbosa (2011): (i) consistent NSLs, like European Portuguese (EP) and Italian; (ii) partial NSLs, like Brazilian Portuguese (BP) and Hebrew; (iii) discourse pro-drop languages, like Chinese and Japanese.

Many studies have compared EP and BP and have identified a weakening of the verbal inflexion (in general terms) in BP, which has led to a decrease in the use of null pronouns (NullP) and a preference for the use over pronouns (OvertP), according to Barbosa, Duarte and Kato (2005), Duarte (1995), and Figueiredo Silva (1996), a.o.. This difference between EP and BP is mainly based on theoretical linguistic descriptions and on corpora data analysis, but has not been supported by language processing studies.

In this presentation we discuss the results of a questionnaire-study where we compared the interpretation preferences for NullP and OvertP in EP and BP.

We tested complex sentences with matrix-subordinate order. The first clause has always two possible antecedents for the null or for the overt pronominal Subject of the temporal subordinate clause (1).

24 EP native-speakers from the University of Lisbon and 24 BP native-speakers from the Federal University of Rio de Janeiro participated in this study.

Our results show, for EP, a preference to select the Subject as the antecedent for the null pronoun (75%; $p<0,001$) and the non-Subject antecedent for the overt pronoun (71%; $p<0,001$). BP data show similar preferences: null for the Subject (68%; $p<0,001$) and overt for the non-Subject (59%; $p=0,002$). There is though a statistical significant difference ($p=0,043$): in EP the non-Subject is consistently retrieved as the antecedent of the OvertP (71%) while in BP this preference is not so straightforward (59%), being the Subject and the non-Subject almost equally selected as the OvertP antecedent.

These results are in accordance with the described tendency of the increase of overt form use (Barbosa Duarte & Kato, 2005) and also confirm the tendency for the loss of the Avoid Pronoun Principle in BP (Duarte, 1995). The higher preference to select the Subject as antecedent of the NullP is also in accordance with data from corpora were NullP tend to retrieve its C-command antecedent (Barbosa Duarte & Kato, 2005).

We believe that the discussion about the nature of the null categories and about the structural position of the Subject in EP and in BP (Barbosa, 2011; Barbosa Duarte & Kato, 2005; Holmberg, 2010; a.o.), which has been fueled mainly with data from corpora, may profit with data from comprehension studies.

(1) *O mecânico trabalhou com o engenheiro quando Ø/ele remodelou o carro.*
The technician worked with the engineer when Ø/he remodeled the car.
Who remodeled the car?

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Affix Priming and the Visual Identification of Complex Words

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Keywords: Affix; stem; visual word identification; masked priming; lexical decision.

Introduction

Several studies have attempted to unveil masked affix priming, but results remain controversial. Significant priming was found by Dunabeitia, Perea and Carreiras (2008) while comparing prime-target pairs that shared a suffix (*brevedad--igualdad*, brevity-EQUALITY) to unrelated, monomorphemic controls (*plumaje-IGUALDAD*, plumage-EQUALITY). The same effect did not emerge in monomorphemic prime--target pairs that shared a non-morphological ending (*certamen-VOLUMEN*, contest-VOLUME vs. *topacio-VOLUMEN*, topaz-VOLUME), thus proving the morphological nature of the phenomenon. However, Chateau, Knudsen and Jared (2002) failed to report prefix priming in English over and above orthographic effects.

Materials and Methods

The present study is a further evaluation of affix priming effects in a masked priming paradigm (SOA = 42 ms) with English materials, where nonword primes and word targets sharing a suffix (towerful-FAITHFUL) were contrasted with both morphological (towerism-FAITHFUL) and non-morphological (towerpak-FAITHFUL) unrelated controls. Three further conditions with monomorphemic targets were set up so as to control for pure orthographic effects (muskach-SPINACH vs. muskful-SPINACH vs. muskesp-SPINACH).

Complex and simple targets were equated for written and spoken frequency, length, number of syllables, N, and bigram frequency. Suffix onsets and the onsets of their non-norphological controls always lay at a syllable boundary. Related and control primes were matched for length, bigram frequency, N, and orthographic overlap with the target.

Results and Discussion

Mixed-effects model analysis revealed a significant effect of relatedness (F[2,2995]=8.09, p<.001) and a significant interaction between relatedness and morphological structure (F[2,2995]=3.57, p=.03). In order to specify the nature of this interaction, further mixed-effects models were fit separately to complex and monomorphemic target data. While no effect emerged in the simple-target conditions, RTs were faster in the towerful-FAITHFUL condition than in both the towerpak-FAITHFUL (β=−.04, t[1507]= −2.31, p=.01) and the towerism-FAITHFUL conditions (β=−.08, t[1507]= −4.42, p<.001).

These results show that affixes determine facilitation in masked priming, lexical decision experiments, similar to what stems do. Therefore, they favor theories of the visual identification of complex words that suggest a symmetry of representation between stems and affixes, and challenge those models where affixes are quickly stripped off and stems serve lexical access.

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The Role of Recent versus Future Events in Child and Adult Language Comprehension: Evidence from Eye Tracking

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Keywords: eye tracking; child language comprehension; visual context; depicted events.

Introduction

Findings from recent eye-tracking studies suggest that adults prefer to rely on recently-seen events over possible future events during sentence comprehension: When the verb in an NP1-VERB-ADV-NP2 sentence was referentially ambiguous between a recent and an equally possible future action, adults fixated the target of the recent action more often than the not-yet-acted-upon object (Knoeferle & Crocker, 2007).

Method

It is unclear whether this recent-event preference generalizes to five-year-olds and whether its time course differs compared with adults. We conducted two eye-tracking studies to examine this issue. Five-year-olds (Exp1, N=24) and adults (Exp2, N=24) inspected a display with a clipart animal (e.g., a horse) and two other objects (e.g., a red and a blue barn). Next, the animal was depicted as performing an action (e.g., the horse galloped to the blue barn). On a third frame, the animal had completed the action and moved to another (center) position, looking straight ahead (i.e., not looking at any of the barns). Together with that third frame, a spoken German sentence referred either to the event involving the recently acted-upon target in the past tense (e.g., *Das Pferd gallopierte gestern zu der blauen Scheune*, literally: 'The horse galloped yesterday to the blue barn') or to an equally plausible future event in the present tense with future meaning (e.g., *Das Pferd gallopiert morgen zu der roten Scheune*, literally: 'The horse gallops tomorrow to the red barn'). While participants listened to the sentence and inspected the last picture frame, we monitored their eye movements.

Results

As expected, <u>adults</u> fixated more often the recent-event target (the blue barn) than the future-event target (the red barn, *ps* < .05). Just as in prior studies, this preference emerged during the verb and lasted until the second noun. Crucially, children showed the same recent-event preference, but subtly delayed (during the post-verbal adverb, *ps* < .002). Temporal information affected neither children's nor adults' visual attention during the adverb. However, as children and adults heard the second noun phrase in the future ('red barn') compared to the past tense ('blue barn') condition, their inspection of the recent-event target diminished and ultimately reversed. This pattern was corroborated by a significant interaction of tense and target objects for the second noun (*ps* < .001).

Discussion

These findings are novel in that they highlight striking similarities in how children and adults direct their visual attention during spoken language comprehension (but see Trueswell, Sekerina, Hill & Logrip, 1999). Just like adults, children relied more on the recent event than on expectations of an event that could happen next. At the same time, this effect was subtly delayed for children (vs. adults). Thus, similar attentional mechanisms underlie (at least some) visual context effects in both 5-year old children and adults but their time course differs.

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When does context shape word meanings?

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Keywords: Context; Semantics; EEG

Words' meanings vary with context. When do context effects arise? The answer to this is critical for deciding between theories assuming that meanings are accessed from a stable mental lexicon and theories that suggest meanings are constructed ad hoc. On the first view, a word form activates an invariant semantic representation, which is subsequently tailored to fit the context (e.g., Evans, 2009; Machery, 2010). On an alternative view, word forms are cues to construct meaning; the information that gets activated is always co-determined by the word and its context (Elman, 2004; 2009; Lai, Hagoort, & Casasanto, 2011).

We investigated when context-induced differences arise during the activation of semantic representations cued by words. We varied the timing of context – i.e., a judgment cue, in relation to the stimulus words. In the word-in-context condition, the judgment cue was given before the word. In word-before-context condition, participants saw the word before they knew what judgment they would need to make. Both the "meaning access" and "meaning construction" views predict that ERPs time-locked to the word should differ depending on timing of the judgment cue. The "access" view predicts differences should arise only after an invariant semantic representation has been activated. The "construction" view predicts that context effects should be detectable at the earliest stages of semantic activation (~200 ms, Diens, 2009).

30 participants made 48 positive/negative and 48 animal/human judgments on 96 nouns, 24 each of 4 types: positive animals (puppy), negative animals (maggot), positive humans (princess), and negative humans (murderer). For one block, the word was presented before the judgment cue (e.g., Animal/human?), and for the other block, the word was presented after the cue. Block order was counterbalanced, and the judgment types and the nouns randomized within each block.

Two analyses were carried out. The first grand averaged ERP analysis asked whether word-in-context differed from word-before-context. ERPs showed negativity (170-450 ms, central-posterior) more negative for word-in-context than for word-before-context. The onset of the negativity was 170 ms, suggesting some context effect at the initial stage of semantic construction. The second EEG classification analysis asked that, within word-in-context, whether EEG patterns differed between affective (positive/negative) context and ontological (animal/human) context. Signals were segmented in 100-ms interval post word onset. Using single-trial multivariate analysis, Support Vector Machine (Vapnik, 2000) classifier was trained to do the binary classification. In word-before-context condition, percentage of correctly classified trials stayed at chance for all intervals (50%), as expected. Remarkably, classification accuracy in word-in-context condition was above the chance across 30 participants in 200-300 ms (54%, p=0.0006, against chance-level). This suggests that semantic representations for the same word in the same brain already differed between "word-in-affective-context" and "word-in-ontological-context", initially.

Context effects are detectable at the earliest semantic stage during word processing, evidenced by both grand-averaged ERPs and single-trial EEG. These findings support a view in which default/invariant word meanings are not accessed from a mental lexicon and later modified by context. Rather, from their inception semantic representations are co-determined by word and its context.

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Default Verb Meanings and Verb Meaning-in-Context:
A Speed-Accuracy Tradeoff Study

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It is well-known that the meaning of a word can change depending on the context in which it is used. There are, however, still open questions regarding key aspects of this process. How long does the resolution of the proper meaning-in-context take? Are context-independent "default" meanings activated prior to integration? Are these default meanings stronger for some verbs than for others? We address these questions using a Speed-Accuracy Tradeoff (SAT) experiment on the resolution of intransitive verbs in the context of their subject nouns.

McElree, Murphy and Ochoa (2006) report on an SAT experiment examining semantic composition in noun phrases, and find that the process is slow, as evidenced by the number of false positive responses to stimuli such as "Water pistols are dangerous" at delays of under 1 second. In contrast, Bicknell *et al.* (2010) find that verb-argument semantic composition proceeds very rapidly, using both ERP and reading time data. Either these differing results stem from differences in experimental designs, or from fundamental differences between verb-argument and noun-modifier semantic composition processes.

To begin addressing this question, we applied the SAT method to a verb meaning-in-context resolution task. Twenty-four participants were presented with stimuli containing a context sentence followed by a semantic probe (e.g. The dawn broke – Something shattered). Each verb appeared in the experiment with two subject nouns that cued different verb meanings. On each trial, participants responded "true" or "false" after one of 8 delays between 200 to 3000 ms following presentation of the probe. We hypothesized that verb-argument semantic composition would proceed faster than noun-modifier composition, but that verbs would nonetheless carry default interpretations and that this would be evidenced by reduced response accuracy at short delays to stimuli such as the example just given.

We analyzed our data using mixed effects logistic models (including participant and verb as random effects on all nested items) with response as an outcome, and an interaction between correct response and response delay as predictors. Response accuracy was significantly lower at shorter delays for false-given-the-context probes, but participants remained accurate in rejecting false-regardless-of-context distractors. We take this processing difference as an indication that verbs do in fact have default meanings activated prior to composition.

We additionally explored whether this process is sensitive to other factors (including imageability, sense dominance, verb-probe distributional associations, and bigram frequency) by including three-way interactions between these factors, correct response, and time. The distributional information provided a marginally significant improvement in model fit, and bigram frequency information provided a significant improvement. From this, we conclude that verbs do carry default meanings; that these default meanings do not appear equitable with any imageable properties of the verbs, and may instead be best captured with distributional information.

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Ambiguous Object Pronoun Resolution in Native Spanish: the Role of Information Structure

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The present study investigated whether two fore-grounding devices (*topicalization* and *focusing*) had the same effect on participants' antecedent choices for ambiguous object clitic pronouns in a questionnaire in Spanish. The results show that while topicalization increases the number of attachments to topicalized antecedents, focusing has the opposite effect (an "anti-focus effect"). These results challenge previous theories of reference interpretation and accessibility.

Previous psycholinguistic work has shown that pronouns are more likely to refer back to prominent antecedents (e.g. Ariel, 1990) and that one factor that affects antecedent prominence is its informational status in the sentence. Interestingly enough, recent studies on the role of information structure on pronoun resolution have yielded contradictory results (e.g. Cowles et al., 2007, for English; Colonna et al., in press, for French and German).

Unlike previous studies that focused almost exclusively on subject pronouns, the present study investigated the effects of topicalization and focusing on object pronoun resolution in Spanish. Thirty-four participants completed a questionnaire in which they were to select an antecedent for an ambiguous object pronoun in sentences like those in (1). The results show a general object antecedent preference in a baseline condition (1a). Crucially, however, subject and object antecedent attachments increased significantly with respect to the baseline condition when these were topicalized (1b,c), evidencing a clear effect of topicalization. Focusing, on the other hand, had the opposite effect: antecedent attachments decreased significantly when these were in a focalized position (1d,e), which evidences an anti-focus effect also attested in French and German subject pronoun resolution (cf. Colonna et al., in press).

(1)   a. Alejandro golpeó a Alfonso antes de que Julia **lo** llamara. Julia llamó a ………
        b. Hablando de Alejandro, él golpeó a Alfonso antes de que Julia **lo** llamara. Julia llamó a ………
        c. Hablando de Alfonso, Alejandro lo golpeó antes de que Julia **lo** llamara. Julia llamó a ………
        d. Fue Alejandro quien golpeó a Alfonso antes de que Julia **lo** llamara. Julia llamó a ………
        e. Fue a Alfonso a quien Alejandro golpeó antes de que Julia **lo** llamara. Julia llamó a ………

These results can be explained in terms of the discourse functions that topicalization and focusing serve: referring to a topicalized antecedent guarantees the continuity of discourse topics and contributes to discourse coherence (Givón, 1983); referring back to a focalized antecedent, which might constitute potentially new information (Erteschik-Shir, 1997), violates continuity and seems to be dispreferred, at least in intra-sentential anaphora. Critically, the discrepancy between these two fore-grounding devices challenges the general idea that antecedent prominence is the single most important factor affecting pronoun resolution. Additionally, the preference to attach object pronouns to preceding object antecedents goes against the hypothesis that discourse coherence stems from topic-continuity. The notion of discourse coherence in terms of resemblance (parallel) relations between two clauses (Kehler, 2002) might better account for our results. Comparative studies with clitic pronouns in French and full pronouns in German are currently underway.

Sentence processing engages domain-general cognitive control: Evidence from cross-task conflict adaptation

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Keywords: Cognitive control; conflict adaptation; sentence processing; garden-path recovery

What do garden-path sentences, perceptually bi-stable figures, and the Stroop task have in common? Although seemingly disparate, they share elements of *conflict* or *ambiguity*. Generally, conflict detection is thought to automatically trigger cognitive control, which regulates mental activity to resolve among competing alternatives: one behavioral consequence of this process is that individuals can better resolve conflict immediately after encountering a preceding conflict (Botvinick, Cohen, & Carter, 2004). However, it is unclear if this behavioral adjustment, called "conflict adaptation," reflects engagement of *domain-general* or *domain-specific* resources, as evidence for cross-domain adaptation is limited. The question of domain-generality has implications for language processing, as cognitive control may be recruited for resolving linguistic conflicts (e.g., garden-path recovery; Novick, Trueswell, & Thompson-Schill, 2005). Using a cross-task conflict adaptation paradigm, we investigate whether adaptation is mediated by domain-general cognitive control. We examine performance adjustments across syntactic and non-syntactic domains (Experiment 1) and perceptual and verbal domains (Experiment 2).

Experiment 1 intermixed a self-paced, word-by-word reading task and the Stroop task to assess adaptation from a syntactic to non-syntactic domain. The reading task included unambiguous sentences and garden-path sentences containing a temporary direct-object/sentence-complement ambiguity. For example:

1. The basketball player accepted the contract would have to be negotiated. (*Temporarily Ambiguous*)
2. The basketball player accepted that the contract would have to be negotiated. (*Unambiguous*)

On Stroop trials, participants identified the ink color of a color word, where word meaning and ink color matched on congruent trials but mismatched on incongruent ones. If ambiguous sentences recruit domain-general cognitive control, performance on incongruent Stroop trials should be better when preceded by ambiguous versus unambiguous sentences.

We found significant cross-task adaptation: incongruent Stroop performance was enhanced when preceded by ambiguous versus unambiguous sentences (higher accuracy: M_{diff}=.03; $t(38)$=2.534, p=.02; faster reaction time: M_{diff}=-17ms; $t(38)$=-2.81, p<.01). This suggests that detecting syntactic conflict promotes *sustained activation* of domain-general cognitive control mechanisms, which facilitates subsequent conflict resolution even on a non-syntactic task.

Experiment 1 demonstrated that cognitive control operates across syntactic and non-syntactic domains. However, both tasks involved verbal components, so it remains uncertain if conflict adaptation extends across verbal/non-verbal domains. In Experiment 2, we intermixed passive-viewing of perceptually ambiguous and unambiguous Necker figures with Stroop stimuli. Consistent with evidence linking perceived reversals of ambiguous Necker cubes with the extent of ambiguity experienced, we found a significant positive correlation across subjects between individuals' number of perceived reversals and magnitude of Stroop-conflict adaptation (r=.41, p=.03). This suggests that performance adjustments are observable across non-verbal and verbal domains and the extent of this adjustment depends on the degree of ambiguity experienced, but that there are important individual differences in the perception of ambiguity.

Together, these findings provide strong evidence for *domain-general* cognitive control. Despite ostensible dissimilarities, syntactic-conflict processing and non-syntactic conflict (Stroop) recruit shared cognitive control resources. Moreover, perceptual ambiguity apparently engages these same resources, suggesting that cognitive control mechanisms are shared by non-verbal and verbal tasks. Thus, sentence processing, sometimes argued to involve purely linguistic functions, appears to recruit general-purpose cognitive mechanisms.

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Eye-Tracking Evidence for an Expected-Utility-Based Model of Syntactic Ambiguity Resolution

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Keywords: Ambiguity resolution; Expected utility; Relative Clauses; Sentence processing.

Swets et al (2008) found that the time taken to read ambiguous regions of sentences is task-dependent, with reading time being longer when disambiguation might aid performance on a subsequent task. We here provide the first explicit model of such task-dependence, using economic concepts that have proved valuable in other domains of cognitive psychology.

Given a choice between options, people are known to combine the value of each outcome with the probability of its occurring (albeit in suboptimal ways; see e.g. the work of Kahneman and Tversky). Furthermore, payoffs and outcome probabilities have been shown to affect time spent in information seeking (Diederich, 2006). We conceptualize reading as information seeking, and explore the impact of potential economic losses and of outcome (interpretation) probabilities on the reading time for ambiguous sentences. We created 24 sets of three relative-clause-containing sentences that differed in ambiguity – e.g. *the [classmate / chihuahua / bike] of the boy that plays catch is in the garden.* 50 participants were then asked to give a 1-7 plausibility rating to the sentences that would be entailed by each interpretation (e.g. the boy/classmate/chihuahua/bike plays catch). We used these ratings to assign a probability to each interpretation of each sentence using Luce's choice axiom.

A separate 24 participants read 24 of the sentences each (one from each set), while their gaze was monitored using a Tobii X120 eyetracker. After each sentence they were asked a disambiguation question (e.g. *who plays catch?*) and had to choose between the two attachment-candidate noun phrases. Points were awarded or lost depending on these responses, with the highest scorer receiving a gift certificate. 20 points were given for each correct answer. The penalty for an incorrect answer varied in blocks (1,10, 50 or 100 points) with the order of the blocks, and their combination with sentences counterbalanced.

English speakers are known to have an NP2-attachment bias for relative clauses. We thus predicted that total reading time for the disambiguating region (e.g. *that plays catch*) would increase as the probability of NP1-attachment (the non-preferred interpretation in the absence of other information) increased, and that this effect would be stronger as the points at stake (and thus the expected loss if the participant were to give the default NP2-attachment response) increased. This was confirmed by mixed effects regression modeling (with participant and sentence included as random effects on intercepts). In line with findings in other domains, the effect of "expected utility" was non-linear, with small losses having a big effect on reading, and additional losses having a diminishing (but still significant) impact.

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Mapping "Easy" and "Hard" Messages onto Language: Conceptual and Structural Variables Jointly Affect the Timecourse of Sentence Formulation

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Keywords: message formulation; sentence formulation; incrementality; eye-tracking.

Sentence formulation requires mapping pre-verbal messages onto linguistic structures. This message-to-language mapping is often evaluated in eye-tracking tasks where speakers describe pictured events (*The dog chased the mailman*). Speakers can begin sentence formulation by quickly selecting the first-fixated character as the sentential starting point (lexical incrementality), or generating a rudimentary sentence plan based on their construal of the event gist before selecting a starting point (hierarchical incrementality; Kuchinsky & Bock, 2010). Lexical incrementality predicts fast divergence of fixations while hierarchical incrementality predicts slower divergence of fixations to the two characters within 200ms of picture onset.

Speakers have some flexibility in their choice of a more lexically or more hierarchically incremental planning strategy (Konopka & Meyer, 2011). Here we tested whether the timecourse of sentence formulation in early (0-200ms) and later time windows (200ms-speech onset) changes with the ease of encoding the event gist (the who-did-what-to-whom event structure) and generating a suitable linguistic structure.

48 eye-tracked speakers described a series of pictures, including 60 two-character target events that elicited descriptions with the preferred active or dispreferred passive construction. In "easier" (more codable) events, the characters performed unambiguous actions (e.g., *hitting*) that were described with a small set of verbs, while "harder" (less codable) events were described with a wider range of verbs depending on speakers' interpretation of the event (e.g., *biting, eating*). The agent and patient characters varied in name agreement. To facilitate production of passives, speakers performed reading task that included a high number of passive sentences mid-way through the experiment.

Event codability influenced early formulation of active sentences (0-200ms): fixations to the two characters diverged more slowly in "easier" than "harder" events, and were only weakly modulated by the ease of encoding the first-mentioned character. In harder events, speakers directed their gaze to the agent verys quickly if it was easy to name and more slowly if it was difficult to name. Thus speakers selected starting points based on early encoding of event gist in "easy" events (hierarchical incrementality) and based on properties of the first-mentioned character in "harder" events (lexical incrementality).

Early formulation of passives was influenced by the ease of assembling a passive structure. Speakers looked first at the *agent* when producing passives before the reading task, but directed more fixations to the *patient* and produced more passives after the reading task (structural priming). This provides the first evidence that priming a dispreferred structure influences gaze during selection of a starting point. In later time windows (200ms-speech onset), speakers fixated characters in the order of mention in "easier" events, but gaze patterns were less consistent in "harder" events. Thus speakers were more confident that they could continue a sentence from their chosen starting point with dispreferred syntax when they encoded the event gist quickly.

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Phonetic Accommodation to Live and Pre-Recorded Partners

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Keywords: phonetic accommodation; phonetic convergence; accent accommodation; speech production

Phonetic accommodation occurs when a talker's speech changes as a function of interlocutor identity (e.g., adopting a Southern accent when speaking to a southerner). Under one account, this occurs because interlocutors prime each other's linguistic representations. Priming at multiple levels of representation between and within each talker increases the similarity of representations as a conversation progresses (Pickering & Garrod, 2004). In the case of accent accommodation, the accented talker's pronunciation of a phoneme activates that representation for the non-accented talker, who becomes more likely to incorporate it into subsequent productions. On this theory, the amount of alignment depends on the degree of coupling between interlocutors. In an interactive activity (e.g., dialogue), interlocutors receive more priming and feedback from one another, leading to greater alignment than in less interactive activities (e.g., monologue).

We examined whether listeners would accommodate an unfamiliar accent, and whether degree of coupling would affect accommodation. Forty-eight female participants completed a referential communication task in which they and a female experimenter took turns giving and receiving instructions. The experimenter produced an accent of American English found in some northern regions of the US (e.g., upstate New York, Washington, Oregon) in which /æ/ raises to [eɪ] before /g/ (e.g., *bag* [beɪg]). Half the participants conversed live with the experimenter; the other half heard recordings of the experimenter taken from live conversations. On each trial, the participant (and experimenter, in the Live condition) viewed a display of pictures representing four words: an –ag-word, an –ack-word with the same onset (e.g., *bag* and *back*), and two unrelated fillers. The giver instructed the recipient to click on a target picture that was highlighted on the giver's screen. The experimenter and participant both said each –ack- and –ag-word 4x during the experiment.

Predictions

If participants accommodate the experimenter's accent, the /æ/ vowel in their productions of –ag-words should raise over the course of the experiment (i.e., acoustic-**F1** should decrease and/or acoustic-**F2** should increase). Additionally, if degree of interactivity determines the amount of accommodation, participants in the Live condition should accommodate more than participants in the Recorded condition.

Results

Interactivity determined accommodation such that Recorded participants *accommodated* the experimenter's and Live subjects *diverged* from that accent. In the Recorded condition, **F1** of –ack and –ag words decreased across the experiment (t=2.5). For **F2**, word type and trial order interacted marginally (t=1.6), such that **F2** increased over the course of the experiment for both word types, more so for –ack than –ag words. In the Live condition, contrary to predictions, **FI** was unchanged and **F2** marginally *decreased* in both word types (t=1.8).

Conclusions

Participants who heard a pre-recorded voice accommodated the accent, whereas participants who conversed live diverged. These results suggest that accent accommodation processes are sensitive to the interactivity of a conversation. While this regional accent only affects –ag words, participants showed some accommodation on both –ack- and –ag-words, suggesting accommodation was not lexically-specific. Finally, the fact that accommodation was greater in monologue suggests that tight coupling is not necessary for alignment.

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Building multiple events: the cost of context retrieval

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Keywords: aspectual coercion, iterativity, type-shifting, self-paced reading

The iterative interpretation of *John jumped for ten minutes* results from composing a punctual verb with a durative adverbial (**Punctual_Iteration**). Real-time comprehension of Punctual_Iteration engenders cost (compare: *John jogged for an hour* (**No_Iteration**)) which has been attributed to a semantic type-mismatch between the verb's meaning (denoting a near-instantaneous event) and the adverbial's meaning (denoting a length of time). Type-shifting has been invoked as the mechanism that repairs the mismatch via insertion of an iteration-operator in the semantic representation, thus creating a multiple-event interpretation (Piñango, Zurif, & Jackendoff, 1999; Dölling 2003).

Recently, it has been proposed that instead of mismatch-repair between verb and durative adverbial, the source of the iterative meaning and processing cost is **the retrieval from the sentential context of an interval-measure** (the source of the multiple-event reading) **required by the lexical-semantics of the adverbial**. This means that not only punctual verbs, but any combination of predicate and durative adverbial that yields a multiple-event reading will engender cost (Deo & Piñango, 2011).

We test this prediction by comparing Punctual_Iteration with Durative_Iteration (durative verbs and "long" durative adverbials).

1. Punctual_Iteration: *Frances jumped for 10 minutes before starting to swim.*
2. Durative_Iteration: *Frances ran for 10 years before starting to swim.*
3. No_iteration: *Frances ran for 10 minutes before starting to swim.*

Crucially, Durative_Iteration contains no type-mismatch, yet the condition requires iteration - periodic jogging for a year, which is predicted to elicit cost on the contextual-retrieval account only, not on the type-mismatch account. On this hypothesis, Durative_ and Punctual_Iteration would be equally costlier than No_Iteration. On the type-shifting hypothesis, Durative_iteration should pattern with No_Iteration.

Study-1: 5-point scale questionnaire testing a) whether all conditions were comparable in terms of acceptability and b) whether iterative reading was equally available in both punctual and durative conditions (n=20). This was achieved through post-hoc questions after each sentence probing iterativity. Four conditions were tested: Punctual_Iteration, Durative_Iteration, No_Iteration, Achievement_Singular (e.g. *Petra detected a bug for 20 minutes*). Results predictably show three conditions patterning within the "makes-sense" range: No_Iteration (mean=4.98), Durative_Iteration (mean=4.82), Punctual_Iteration (mean=4.60), while Achievement_Singular was deemed nonsensical (mean=2.7). Subjects systematically chose the iterative interpretation for Punctual_ and Durative_Iteration.

Study-2 involved a moving-window self-paced reading task testing the cost of interval-measure retrieval (n=25). Planned comparisons show a significant difference, Punctual_Iteration > No_Iteration at the adverbial (e.g., *10 minutes*) (p=0.035), replicating previous work and crucially, a significant difference between Durative_Iteration > No_Iteration also at the adverbial (p=0.048). No difference was found between Punctual_ and Durative_Iteration (p=0.87).

Taken together, our results indicate that the cost from processing Punctual- and Durative-based iteration is best captured by the single mechanism of interval-measure retrieval. Such a mechanism is triggered by pragmatic considerations associated with the predicate+durative adverbial composition. This view bypasses specialized processing mechanisms such as type-shifting while capitalizing on independently motivated processes of contextualization and conceptual-structure mining. These results will be couched within the context of an architecture of processing in connection to the architecture of grammar.

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