Incrementality and Clarification/Sluicing potential

Jonathan Ginzburg[1], Julian Hough[2],
Robin Cooper[3], David Schlangen[2]
[1] Université Paris-Diderot (Paris 7), [2]Bielefeld University,
[3]Gothenburg University
yonatan.ginzburg@univ-paris-diderot.fr

Incremental processing at least as fine grained as word-by-word has long been accepted as a basic feature of human processing of speech (see e.g., [12]) and as an important feature for design of spoken dialogue systems (see e.g., [7,13]). Nonetheless, with a few important exceptions (see e.g., [5]), incrementality is viewed as an aspect of performance, not semantic meaning. Moreover, it seems to entail giving up on compositionality as a constraining principle on denotations. In this paper, we point to a variety of dialogical phenomena whose analysis incontrovertibly requires a semantics formulated in incremental terms. These include cases, above all with sluicing, that call into question existing assumptions about ellipsis resolution and argue for incremental updating of QUD. The incremental semantic framework we sketch improves on existing such accounts (reviewed in [7,8]) on both denotational and contextual fronts: the contents we posit are in fact tightly constrained by a methodological principle more restrictive than traditional compositionality, namely the Reprise Content Hypothesis ([11]), embedded within independently motivated dialogue states ([4]).

(1a) exemplifies the fact that at any point in the speech stream of A's utterance B can interject with an acknowledgement whose force amounts to B understanding the initial segment of the utterance ([1]); (1bi), an instance of an 'abandoned' utterance ([8]), licenses reactions such as (1bii); (1c) exemplifies two types of expressions—filled pauses and exclamative interjections– that can in principle, be inserted at any point in the speech stream of A's utterance; the interjection 'Oh God' here reacts to the utterance situation conveyed incrementally; (1d,e) illustrate that an incomplete clause can serve as an antecedent for a sluice, thereby going against the commonly held assumption that sluicing is an instance of 'S–ellipsis' ([9]):

(1a) A: Move the train . . . B: Aha A: . . . from Avon . . . B: Right A: . . . to Danville. (Trains corpus)
(1b) A(i): John . . . Oh never mind. B(ii): What about John/What happened to John?
(1c) Audrey: Well it's like th it's like the erm (pause) oh God! I've forgotten what it's bloody called now? (British National Corpus)
(1d) The translation is by—who else? —Doris Silverstein (The TLS, Feb 2016)
(1e) A: A really annoying incident. Someone, B: Who? A: Not clear. B: OK A: has taken the kitchen scissors.

Syntactically, we follow [10], in assuming a top-down left-to-right strategy. This builds rooted and connected structures without the need to find underspecified semantics for open nodes nor to re-interpret the whole tree every time it expands. Semantically, we use Type Theory with Records [2] embedded within contexts given by the dialogue framework KoS [4]. In KoS common grounds—known as *dialogue gameboards*—keep track *inter alia* of QUD, Moves (utterances that have been grounded), and Pending (utterances still to be grounded/clarified). Consequently, given an incremental semantics as sketched below, we can propose a lexical entry for continuative particles like 'mmh' or 'yeah', as in (2):

(2) $$\begin{bmatrix} \text{cat} = \textit{interjection} : \text{syncat} \\ \text{dgb-params} : \begin{bmatrix} \text{spkr} : \text{IND} \\ \text{addr} : \text{IND} \\ \text{MaxPending} : \text{LocProp} \\ \text{presupp1} : \text{address(addr,spkr,MaxPending)} \end{bmatrix} \\ \text{cont} = \Big[\text{c1} : \text{Understand(spkr,addr,MaxPending)}\Big] : \text{RecType} \end{bmatrix}$$

As a means of tightly constraining semantic denotations, we adopt the Reprise Content Hypothesis ([3,4,11])— *A fragment reprise question queries exactly the standard semantic content of the fragment being reprised.* This uses the data from responses to clarification questions about a constituent as indicative of its content (e.g., *A: Most students object to the proposal. B: Most students? A: Carl, Max, and Minnie.*) [3,4,11] use such data to argue in favour of witness sets rather than higher order entities as denotations of QNPs.). This can be applied straightforwardly in an incremental setting and indeed offers a stronger constraint than Fregean/Montogovian compositionality which leaves underdetermined which part contributes what.

The denotation associated with the root of the tree is an illocutionary proposition, hence compatible with declarative, interrogative, imperative etc utterances. This gets refined as each word gets introduced using an operation of *asymmetric merge* of record types [2,6]: given two record types $R1$ and $R2$, $R1 \boxed{\wedge\!\!\!\cdot} R2$ will yield a record type which is the union of all fields with labels not shared by R1 and R2 and the asymmetric merge of the remaining fields with the same labels, whereby R2's type values take priority over R1's fields, yielding a resulting record type with R2's fields only in those cases. This enables us to effect a combinatory operation that synthesises function application and unification.

On our account, a referential NP as in (1b) results in (roughly) the content in (3): Thus, B's follow up questions are justified as seeking elaboration of the existentially quantified proposition $\exists QIllocRel(spkr, Q(j))$:

(3) $$\begin{bmatrix} \text{S.cont} = \text{R(spkr,P)} : \text{Illocprop} \\ \text{Q} : \text{Pred} \\ \text{dgb-params:} \begin{bmatrix} \text{spkr} : \text{Ind} \\ \text{j} : \text{Ind} \end{bmatrix} \\ \text{P} = \text{Q(j)} \end{bmatrix}$$

We assume, following [3] that a QNP such as 'Someone' has a content of the form (4a), where q-params constitute descriptive content that, in contrast to the dgb-params, does not require instantiation. Thus, (4b) will lead to roughly (4c) as maximal element of QUD

and the antecedent for a sluice. Given a constructional specification for a sluice as in (4d), deriving from ([4]), and the assumption that QUD gets updated incrementally, the sluice in (4b) is predicted to mean immediately after it is uttered 'Who is that person (that has some as yet uninstantiated property):

(4a) $\begin{bmatrix} \text{q-params: } \begin{bmatrix} \text{restr} = \text{person: Ppty} \\ \text{witness} : \exists(\text{restr}) \end{bmatrix} \\ \text{P : Ppty} \\ \text{cont} = \begin{bmatrix} \text{scope} = \text{P :Ppty} \\ \text{c1} = \text{witness} : \exists(\text{restr,scope} \end{bmatrix} \text{: Rtype} \end{bmatrix}$

(4b) A: Someone— B: who? (4c) QUD: $?\exists x, P[\text{Person(x)} \wedge \text{P(x)}]$

(4d) sluice-int-cl.cont = (whP.rest)MaxQUD.prop[antecedent.x $\mapsto$whP.x] (*The sluice denotes a question (i.e., a function from records into propositions) whose domain is the type denoted by the wh-phrase and whose range is that given by MaxQUD's proposition where the wh-phrase's variable is substituted for that associated with the antecedent.*)

In the extended version of the paper, we explain how exclamative interjections as in (1c) can be handled as well as how scope ambiguity is treated—given data from clarification showing that various scope possibilities *are* computed and can be localized with a single NP, we analyse this as triggering competing hypotheses between independent and dependent uses.

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