# A Distributional Analysis of Laughter Across Turns and Utterances

**Bogdan Ludusan, Maik Wesemann and Petra Wagner**
Phonetics Workgroup, Faculty of Linguistics and Literary Studies & CITEC,
Bielefeld University, Germany
{bogdan.ludusan,m.wesemann,petra.wagner}@uni-bielefeld.de

## Abstract

We present here a study on the use of laughter in spontaneous interactions, examining its distribution across two linguistic levels: utterances and turns. A multilingual corpus of dyadic conversations was employed, containing recordings in French, German and Mandarin Chinese. Laughter was coded based on its position inside the analysis unit and its distribution with respect to the event type and the language was analyzed. The results showed that laughter distribution is modulated by the linguistic level, as well as by the laughter event type. Moreover, differences between languages seem to depend on the analysis level.

## 1 Introduction

Laughter is a pervasive phenomenon, being one of the most often encountered non-verbal-vocalisations occurring in spontaneous interactions (Trouvain and Truong, 2012). Due to its importance, it has been studied in various fields and from different perspectives (for a review of laughter research, see Trouvain and Truong, 2017).

Regarding laughter form, a characterization from different viewpoints was attempted. A great deal of studies have examined its acoustic characteristics (e.g. Bachorowski et al., 2001; Vettin and Todt, 2004), including its acoustic effects on speech (Ludusan and Wagner, 2019a). Another research direction that has received considerable attention is the analysis of where laughter occurs in conversation. Studies have investigated how laughter is distributed at various linguistic levels: topic-level (Holt, 2010; Bonin et al., 2012), turn-level (Gavioli, 1995; Glenn and Holt, 2013), phrase-level (Batliner et al., 2019) or conversational context (Vettin and Todt, 2004; Tian et al., 2016).

While each of these studies present an in-depth investigation of laughter at the analyzed linguistic level, there is no study looking at how laughter is employed across more than one analysis level. Furthermore, the vast majority of these studies focus on one language, leaving open the questions about the cross-cultural aspect of laughter use. The current investigation attempts to partially fill this gap by studying laughter distribution at the utterance and turn level, by means of a corpus containing comparable materials in three languages: French, German and Mandarin Chinese. We aim to compare the distribution of laughter across languages and across laughter types, as well as to uncover whether laughter distribution on one linguistic level is able to inform us about its distribution on another level.

## 2 Dataset

The DUEL corpus (Hough et al., 2016) contains recordings of spontaneous dyadic interactions in three different languages. French (Fr), German (De) and Mandarin Chinese (Zh) speaker pairs were asked to discuss three pre-determined scenarios for up to 15 minutes. The dataset was manually transcribed and hand annotated for disfluencies, laughter and exclamations. The audio was aligned with the transcriptions at the turn, utterance and laughter episode levels.

For the analysis presented here, we employed only the recordings of one scenario, for a more straightforward comparison between languages. The Film Script data was chosen, as it included the most laughter among the three scenarios. In this scenario, the speakers were supposed to come up with the script for a movie, based on an embarrassing moment which may be inspired from real life. We included all annotated dyads, resulting in 10 pairs for the French and German data and 9 pairs for the Mandarin sub-part. 5/10, 3/10 and 4/9 dyads were composed of friends/acquaintances and the vast majority of speakers were students (12/20, 14/20 and 14/18 females). These correspond to almost two hours and a half of recorded data for French and more than two hours of data for German and Mandarin, respectively. We considered here all laughter events, be it laughs or speech-laughs, in line with recent laughter analyses (e.g. Batliner et al., 2019; Ludusan and Wagner, 2019b). This resulted in 590, 999 and 675 laughter events (of which 184, 244 and 303 speech-laughs) for the French, German and Mandarin Chinese parts.

## 3 Analysis

We examined all the turn and utterance instances in our dataset. Turns were defined as being continuous stretches of speech by one speaker, until their conversation partner takes over, while utterances represent maximally a sentence, but can be composed also of only discourse markers (for more details, see Hough et al., 2016). The occurrences containing laughter events were annotated for the position of the events with respect to the linguistic unit. The labelling, as well as the check for consistency of the laughter labels, were done manually by the second author. The four labels employed to characterize the distribution of laughter across turns and utterances are: W, the whole unit is composed only of laughter events; I, one or more consecutive laughter events are found at the beginning of the unit; M, the unit contains speech at its beginning and at its end and at least a laughter event within it; and F, one or more consecutive laughter events are found at the end of the unit.

In general, a unit was assigned one label, but there were cases in which it was labelled with more than one label. For example, a unit in which laughter occurs both at its beginning and at its end, with speech between the two laughter events, would be marked as *IF*. At the same time, several laughter events occurring mid-unit, would count just as one, giving that unit the label *M*. The proportion of units marked with multiple labels was: 8.4%, 10.7% and 8.6% for turns, and 0.8%, 1.7% and 0.1% for utterances.

Once laughter position was annotated at both turn and utterance level we counted the following: how many units were produced by each speaker, how many of these units contained laughter events and how often laughter occurred in each of the four annotated positions. A unit having multiple labels assigned to it counts as an occurrence for each of its labels. We then computed the distribution of laughter across the two levels, in the three investigated languages. All statistical analyses were conducted on a per-speaker basis.

## 4 Results

The total number of turns and utterances, as well as those containing laughter events are presented in Table 1. The table contains also the distribution of laughter within the analyzed units. A visual representation of these results, as a proportion of total units containing laughter events, is illustrated in Figure 1.

| Lv | Lg | T | TL | W | I | M | F |
|---|---|---|---|---|---|---|---|
| | Fr | 1935 | 441 | 137 | 73 | 114 | 158 |
| Tr | De | 1489 | 580 | 134 | 120 | 214 | 178 |
| | Zh | 1680 | 369 | 148 | 47 | 93 | 115 |
| | Fr | 4349 | 580 | 457 | 17 | 25 | 86 |
| Ut | De | 4744 | 933 | 664 | 38 | 57 | 190 |
| | Zh | 4383 | 669 | 536 | 17 | 18 | 99 |

Table 1: Statistics for turn (Tr) and utterance (Ut) levels, in the studied languages (Fr, De and Zh). T represents the total number of units and TL is the number of units that contain laughter events. W, I, M and F denote the position inside the unit where laughter occurs.

We verified the differences in the distribution of laughter (counts) between languages using Pearson's Chi-squared tests. For turns, they showed significant differences between each language pair: De-Fr ($\chi^2 = 19.7, df = 3, p = 1.9 \cdot 10^{-4}$), De-Zh ($\chi^2 = 39.7, df = 3, p = 1.2 \cdot 10^{-8}$) and Fr-Zh ($\chi^2 = 7.8, df = 3, p = .0466$). For utterances, the Fr-Zh comparison did not return a significant difference ($\chi^2 = 2.6, df = 3, p = .4587$), while the other two language pairs did: De-Zh ($\chi^2 = 23.2, df = 3, p = 3.6 \cdot 10^{-5}$) and De-Fr ($\chi^2 = 12.2, df = 3, p = .0066$)

We tested next, using Wilcoxon signed-rank tests, whether significant differences exist between the number of occurrences at different positions inside the unit, within language. First, the results for the turn-level analysis are presented. For German, the only significant differences were those found between initial and mid position ($p = .0012$) and between initial and final position ($p = .0377$). In the French data, significant differences were found between W-I ($p = .0392$), I-M ($p = .0186$) and I-F ($p = .0146$). Also in the Mandarin recordings, the same differences were found significant: W-I ($p = .0021$), I-M ($p = .0308$) and I-F ($p = .0013$). At the utterance level, all position pairwise differences were found to be significant in the German data and all but I-M were significant for French and Mandarin.

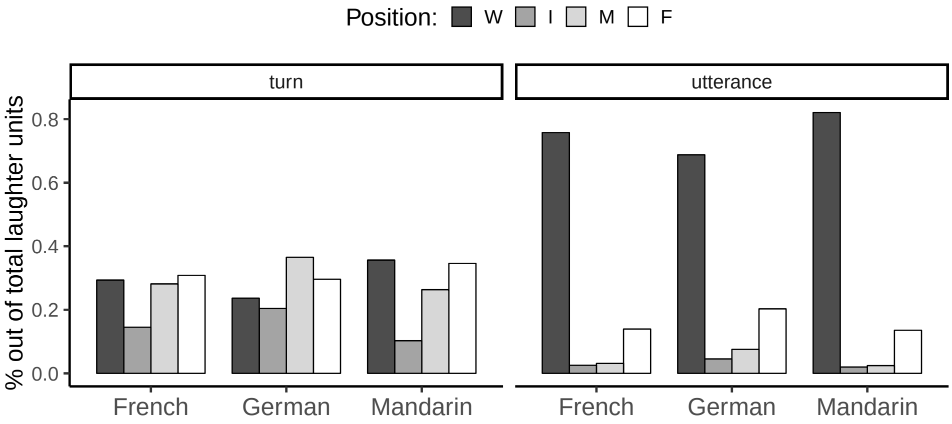


Figure 1: Distribution of laughter according to its position in the analysis unit, at the turn and the utterance level. W, I, M and F denote the position inside the unit where laughter occurs.

Next, we took a look at the type of laughter event used at different positions at the utterance level. The results are shown in Figure 2. One can see important differences between the two types of events: Laughs mainly span the whole utterance, followed at a great distance by utterance-finally. The distribution of speech-laughs is less skewed than for laughs, having considerably more occurrences in other positions than W. All differences between laughter event types were found to be significant (also at the turn level, not illustrated here).

To better understand the link between the two analyzed discourse levels, in terms of the use of laughter, we looked at the position of each laughter event on both levels. Table 2 illustrates where each laughter event at the utterance level is found at the turn level. For each utterance position we present the percentage of events that distribute to each of the possible laughter positions at the turn level.

| Utt pos | Turn pos | French | German | Mandarin |
|---|---|---|---|---|
| W | W | .337 | .241 | .366 |
| | I | .179 | .208 | .114 |
| | M | .199 | .348 | .291 |
| | F | .284 | .203 | .229 |
| I | I | .294 | .421 | .235 |
| | M | .706 | .579 | .765 |
| M | M | 1 | 1 | 1 |
| F | M | .419 | .563 | .576 |
| | F | .581 | .437 | .424 |

Table 2: Percentage of the total amount of laughter events at the given utterance position which are found at that specific turn position.

Verifying the results (counts) with Chi-squared tests, we observed no significant difference for the initial utterance position distribution between languages, while significant differences were found for final position between De-Fr ($\chi^2 = 4.4, df = 1, p = .0361$) and Fr-Zh ($\chi^2 = 3.9, df = 1, p = .0472$). All pairwise language differences for W were found highly significant ($p < .001$).

## 5 Discussion and Conclusions

We presented here a study on the distribution of laughter events at two relevant discourse levels: utterance- and turn-level. We employed comparable data in three different languages, in order to be able to discern patterns that might be used in a language- or culture-independent way. Our results show that the distribution of laughter differs between the two levels, with more important differences between languages at the turn level. This could suggest a more universal way of using laughter at the utterance level than at the turn level. We then analyzed the distribution, at the turn level, of each laughter position at the utterance level. Also here, we observed significant differences between languages, with only the initial position laughter behaving similarly across languages.

These findings may increase our understanding of how laughter is used in spontaneous interactions and shed further light on how speakers employ paralinguistic phenomena in the building of the different discourse levels. We focused here on a quantitative analysis of these aspects, having in mind also their possible application in the field of human-machine interaction. One may envisage frequency information of these phenomena and the correspondence between the investigated discourse levels being integrated in laughter-enhanced dia-


Figure 2: Distribution of laughs and speech-laughs according to their position in the utterance. W, I, M and F denote the position inside the unit where laughter occurs.

logue systems, for increased naturalness.

This investigation has deemed the position of the laughter event to be independent of other aspects. We would like in the future to perform a more detailed analysis of the laughter distribution, taking into account other relevant factors, such as the laughter position with respect to the corresponding laughable. Moreover, we have considered here two different types of laughter events (laughs and speech-laughs), observing that different types of laughter tend to be produced at different positions. It would be interesting to expand this investigation to other types of laughter, as well. Lastly, one could link this distributional data to discourse-level phenomena, for instance turn-taking. A possible research direction to follow would be to analyze whether turn-final or turn-initial laughter may be used to signal these phenomena.

## Acknowledgments

This work was supported by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement no. 799022.

## References

Jo-Anne Bachorowski, Moria J Smoski, and Michael J Owren. 2001. The acoustic features of human laughter. *The Journal of the Acoustical Society of America*, 110(3):1581–1597.

Anton Batliner, Stefan Steidl, Florian Eyben, and Björn Schuller. 2019. On laughter and speech-laugh, based on observations of child-robot interaction. *arXiv preprint arXiv:1908.11593*.

Francesca Bonin, Nick Campbell, and Carl Vogel. 2012. Laughter and topic changes: Temporal distribution and information flow. In *Proceedings of the 3rd International Conference on Cognitive Infocommunications*, pages 53–58.

Laura Gavioli. 1995. Turn-initial versus turn-final laughter: Two techniques for initiating remedy in english/italian bookshop service encounters. *Discourse Processes*, 19(3):369–384.

Phillip Glenn and Elizabeth Holt. 2013. *Studies of laughter in interaction*. Bloomsbury.

Elizabeth Holt. 2010. The last laugh: Shared laughter and topic termination. *Journal of Pragmatics*, 42(6):1513–1525.

Julian Hough, Ye Tian, Laura de Ruiter, Simon Betz, Spyros Kousidis, David Schlangen, and Jonathan Ginzburg. 2016. DUEL: A multi-lingual multimodal dialogue corpus for disfluency, exclamations and laughter. In *Proceedings of the 10th Language Resources and Evaluation Conference*, pages 1784–1788.

Bogdan Ludusan and Petra Wagner. 2019a. No laughing matter: An investigation into the acoustic cues marking the use of laughter. In *Proceedings of ICPhS*, pages 2179–2182.

Bogdan Ludusan and Petra Wagner. 2019b. Laughter dynamics in dyadic conversations. In *Proceedings of INTERSPEECH*, pages 524–528.

Ye Tian, Chiara Mazzocconi, and Jonathan Ginzburg. 2016. When do we laugh? In *Proceedings of the 17th Annual Meeting of the Special Interest Group on Discourse and Dialogue*, pages 360–369.

Jürgen Trouvain and Khiet P Truong. 2012. Comparing non-verbal vocalisations in conversational speech corpora. In *Proceedings of the LREC Workshop on Corpora for Research on Emotion Sentiment and Social Signals*, pages 36–39.

Jürgen Trouvain and Khiet P Truong. 2017. Laughter. In *The Routledge Handbook of Language and Humor*, pages 340–355. Routledge.

Julia Vettin and Dietmar Todt. 2004. Laughter in conversation: Features of occurrence and acoustic structure. *Journal of Nonverbal Behavior*, 28(2):93–115.