The effect of conversation type on entrainment: Evidence from laughter

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Abstract

Entrainment is a phenomenon that occurs across several modalities and at different linguistic levels in conversation. Previous work has shown that its effects may be modulated by conversation extrinsic factors, such as the relation between the interlocutors or the speakers' traits. The current study investigates the role of conversation type on entrainment. Employing dyadic interaction materials in German, containing two conversation types (free dialogues and task-based interactions), we analyzed three measures of entrainment previously proposed in the literature. The results show that the entrainment effects depend on the type of conversation, with two of the investigated measures being affected by this factor. These findings represent further evidence towards the role of situational aspects as a mediating factor in conversation.

1 Introduction

An aspect frequently observed in conversation is the fact that interlocutors become more similar to each other during their interaction, phenomenon called, among other terms, entrainment. It has been seen to occur for different linguistic levels (e.g., syntactic Branigan et al., 2000, lexical Brennan and Clark, 1996; Nenkova et al., 2008, acoustic Pardo, 2006; Levitan et al., 2015), but also with respect to non-verbal behaviour (Edlund et al., 2009). Moreover, entrainment effects can be seen both on the form level (adopting the same structures), and on the temporal level, through an increase in temporal co-ordination between interlocutors.

Different points of view on the mechanisms behind entrainment exist, with some viewing it as an automatic process (Pickering and Garrod, 2004), while others arguing that the occurrence of entrainment depends on social factors (Pardo, 2019). This latter viewpoint seems to be supported by studies finding that various conversation aspects (e.g., the role of the interlocutors in the conversation Beňuš et al., 2014; Reichel et al., 2018, their relation Menshikova et al., 2021) or individual factors (e.g., speaker traits Lewandowski and Jilka, 2019, native language Kim et al., 2011) may modulate or interact with entrainment.

Laughter is one of the most often encountered non-verbal vocalisations in spoken interaction (Trouvain and Truong, 2012a), having a wide range of roles in communication, including social (Glenn, 2003) and linguistic (Mazzocconi et al., 2020). Laughter is a conversational phenomenon and it has been found to be subject to entrainment effects. Interlocutors become more similar in their acoustic realization of laughter, as well as in the timing of their laughter productions (Trouvain and Truong, 2012b; Ludusan and Wagner, 2019). Laughter production may be affected by external factors, such as gender of the speaker or the familiarity of the interlocutors (Smoski and Bachorowski, 2003). However, no evidence exists towards these factors modulating the amount of entrainment in laughter, with previous works investigating these aspects finding no effect of familiarity on the entrainment measures (Trouvain and Truong, 2012b; Ludusan and Wagner, 2022).

We investigate here the effect of one conversation factor, namely the conversation type, on entrainment. We define by conversation type the nature of the interaction, considering it to be either task-based, in which the conversation partners have a specific task to solve during their interaction, or free dialogue, in which interlocutors chat freely about topics of their choice. In particular, we will evaluate the role of conversation type (free dialogue vs. two different types of task-based dialogues) on three measures of laughter entrainment.

2 Materials

Materials from two corpora, the GRASS corpus (Schuppler et al., 2014) and the DUEL corpus (Hough et al., 2016) were used for the experiments.

Dataset	Type	Duration [min]	#Dyads	Gender			Age	#Laughter events
				f-f	f-m	m-m		
GR	free	769	13	4	4	5	30.5	2272
DA	task	103	7	4	2	1	22.7	442
FS	task	104	8	2	5	1	23.1	737

Table 1: Statistics on the datasets used in this analysis: type (free dialogue or task-based), total duration, number of dyads included, gender composition of the dyads (f-f, f-m, or m-m), average age of the speakers, and number of laughter events found in the recordings.

The GRASS corpus (GR) contains both read materials and conversations between two persons. We employed here the latter subset of the corpus, in which the interlocutors (19 dyads), native speakers of Austrian German, were recorded chatting for one hour straight. The interlocutors knew each other beforehand, being either colleagues, friends, family members or couples. They were asked to chat about whichever subject(s) they desired, with some pairs simply continuing the discussion they had before the recording started. This resulted in spontaneous conversations including a wide variety of topics, such as about vacations, local issues, work, family or relationship problems and public figures. The materials were orthographically transcribed and annotated for conversational phenomena, including laughter (both laughs and speech-laughs).

The second corpus, DUEL, contains dyadic interactions between native speakers of three languages: French, German and Mandarin Chinese. Two different scenarios from the German part of the corpus were employed here: Dream Apartment (DA) and Film Script (FS). For the DA scenario, the interlocutors were told they had a large sum of money to design and furnish an apartment they would have to share. In the FS task, they were supposed to come up with the script for a film, based on an embarrassing moment, which could have been inspired from personal experience. The considered materials were recorded by 10 dyads/scenario (which differed between the two scenarios). The dyads were all students, the majority of them being colleagues/friends, but also some pairs consisting of strangers. The corpus was orthographically transcribed and annotated for laughter and other conversational phenomena.

In order to control for the effect the relation between interlocutors might have on entrainment, we did not consider in our analysis the recordings from the GRASS corpus that involved family members or couples. Similarly, we excluded from the DUEL corpus those between strangers. In this way, the dyads from both corpora were either colleagues or friends. Detailed information on the datasets considered in the analyses and their characteristics can be found in Table 1.

3 Methods

We investigated three measures previously employed in the study of laughter entrainment, all of which were computed at the dyad level. They included both temporal-related entrainment measures such as the amount of overlapping laughter produced by the interlocutors and the synchrony of the produced laughter, and form-related ones, namely the difference in intensity between non-consecutive and consecutive laughter produced by the speakers in the dyad. We examined whether the results of these measures varied with the conversation type (free vs. task-based dialogue), while also considering a second analysis level, the conversation class (examining here three classes: GR, DA, FS).

The first measure, the amount of overlapping laughter, was inspired by the temporal alignment proposed by Trouvain and Truong (2012b) as a measure of laughter entrainment. A higher amount of overlapping laughter implies a higher level of entrainment. The measure was determined by counting all events in which the two interlocutors were laughing at the same time. We then applied logistic regression models to test the differences between the various conditions (conversation type/class), by considering the overlapping rate, represented as the pair (overlapping laughter counts, total laughter counts - overlapping laughter counts) as dependent variable of the model and the condition as predictor.

For the synchrony measure, we applied the process described in Ludusan and Wagner (2019). However, since we had recordings of different lengths within and across datasets, we did not split the recordings into a fixed number of bins. Instead,

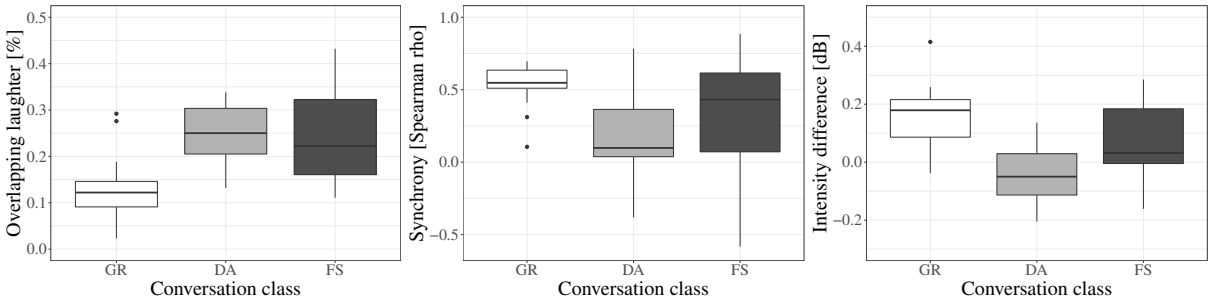

Figure 1: The results of the investigated entrainment measures, with respect to the considered conversation classes: overlapping laughter (left panel), synchrony (middle panel) and form-related measure (right panel). The vertical line represents the median value, the hinges of the boxes the first and third quartiles, and the whiskers going up to 1.5·IQR (inter-quartile range) from the hinges.

we used bins of equal duration – 90 seconds (15 minutes / 10 bins, as in Ludusan and Wagner 2019). We then counted the number of laughter events produced by each speaker in each bin and computed the synchrony, defined as the Spearman ρ correlation coefficient between the vectors composed of the binned laughter counts of the interlocutors in a conversation. Positive values of this measure represent entrainment. These first two measures were computed on the data from all 28 dyads included in the study.

The form-related measure characterizes the similarity of consecutive laughter pairs produced by the interlocutors in terms of maximum speech signal intensity (Ludusan and Wagner, 2022). Consecutive laughter pairs are composed of the laughter event of a speaker either overlapping with or followed within one second, by a laughter produced by their interlocutor (similar to the definition of antiphonal laughter in Smoski and Bachorowski 2003). We then compared the difference in intensity between the laughter events of a consecutive pair ($intD_C$) with the same measure computed between the events of non-consecutive laughter pairs ($intD_N$). Non-consecutive pairs were composed of a laughter event from a consecutive laughter pair, and a randomly sampled laughter produced by the interlocutor, except for the one in the same consecutive pair (see Ludusan and Wagner 2022 for more details). The entrainment measure was defined as: $intD_N$ - $intD_C$, with positive values denoting entrainment. This measure was analyzed for 27 dyads, those which produced at least 5 consecutive laughter pairs.

Finally, there are characteristics which we could not control in the analyzed data and which may influence laughter production and possibly, indirectly, its entrainment. Therefore, we examined any effect that dyad gender composition (two classifications: f-f/f-m/m-m or same/mixed-gender) or age (two measures: absolute age difference or average age of the dyad) may have on the entrainment measure.

For all analyses except for the ones pertaining to the overlapping laughter measure (which employed logistic regression), linear regression models were fitted with the respective measure values as dependent variable and the various factors investigated as predictors. In case the residuals of the fitted models were found to be not normally distributed (by means of a Shapiro-Wilk test), we applied a corresponding non-parametric method: either a Kruskal-Wallis test for the conversation class (three groups), or a Wilcoxon rank-sum test when testing the conversation type (two groups). All statistical analyses were run using the appropriate functions of the R software (R Core Team, 2020).

4 Results

The values of the three investigates measures across the considered conversation classes are illustrated in Figure 1.

For the first temporal entrainment measure – the percentage of overlapping laughter between the interlocutors, a difference can be seen between the free dialogue class (GR) and the two task-based classes (DA, FS). The ANOVA analysis of the logistic model fitted with the overlapping rate as dependent variable and the class as independent variable (Akaike Information Criterion, AIC = 254.2), revealed a significant effect of class ($\chi^2 = 67.3, p = 2.4e^{-15}$). Moreover, the regression model showed that the differences between GR and each of the other two classes were significant: DA ($\beta = 0.752, z = 6.07, p = 1.3e^{-9}$) and FS ($\beta = 0.733, z = 7.08, p = 1.5e^{-12}$). No difference was found between the DA and FS. We also

investigated the effect of conversation type (free dialogue vs. task-based) on entrainment, by using it as predictor in a logistic model (AIC = 252.3). The difference between the two types was found significant ($\beta = 0.740, z = 8.26, p < 2e^{-16}$). We then verified, again by means of logistic regression, whether the age (mean or difference) of the conversation partners or the dyad composition (exact composition or same/mixed) may play a role in the production of overlapping laughter. All but the age difference showed a significant effect, although the fit of these models was worse than that of the models employing the conversation class or type as predictor (the best of these four models had an AIC of 296.5 – lower AIC represents a better model).

For the synchrony measure, the GR interlocutors exhibited a higher synchrony than the dyads in FS and DA. To test these differences, we fitted a linear regression model with the dyad synchrony (Spearman ρ) as dependent variable and the class as predictor. It did not show any significant overall effect of class, and no significant pairwise difference. However, the residuals of the model were not normally distributed and, thus, we applied a subsequent Kruskal-Wallis test. The test confirmed the findings of the linear model: no significant difference between conversation classes ($\chi^2 = 2.33, p = 0.312$). Additional Kruskal-Wallis tests showed no significant effects of age or dyad gender composition. Also the difference between conversation types was not significant, as given by a Wilcoxon rank sum test ($p = 0.339$).

Finally, the form-related entrainment measure, defined as the difference in maximum intensity between non-consecutive laughter and consecutive laughter, was found to be the lowest in the DA, with higher values for FS and GR. The ANOVA analysis of the purposely fitted linear regression model, using the intensity difference as dependent variable and the class as predictor, revealed a significant overall effect of class ($F = 5.50, p = 0.011$), with the difference between the GR and DA reaching significance ($\beta = -0.207, z = -3.30, p = 0.003$). None of the subsequent linear models, fitted with the gender make-up of the dyad and the age measures as predictors, showed a significant effect of these factors. A significant difference was observed also at the level of conversation type, with smaller form-related entrainment effects in the task-based conversations, as given by the ANOVA of the fitted linear model ($F = 7.96, p = 0.009$).

5 Discussion and conclusions

We have seen that two of the investigated laughter entrainment measures, representing both temporal and form-related entrainment, vary with the conversation type and class. This was observed when controlling for the relation between interlocutors. Moreover, other dimensions of variability between the different datasets used (age of interlocutors, gender composition of the dyad) had either no significant effect, or explained the differences in entrainment worse than the conversation type or class.

Another factor of variability may be the fact that the interlocutors in the analyzed corpora spoke different varieties of German and came from slightly different cultures. Yet, evidence from studies that examined laughter entrainment measures cross-linguistically/culturally (Ludusan and Wagner, 2019, 2022), showed no language/culture differences for more distant language pairs (German-Chinese and French-Chinese) than the ones here.

One could assume, instead, that the observed differences may stem from the fact that task-based interactions require a higher cognitive load (and previous studies have shown that a higher cognitive load may impede entrainment Abel and Babel, 2017). However, our results did not show an inverse relation between the level of entrainment and the difficulty of the task. If anything, the findings for overlapping laughter showed the opposite trend, with the interlocutors in the task-based recordings exhibiting more entrainment than those involved in free dialogue. Additionally, some of the values of the other two measures revealed similar trends in task-based and in free dialogue interactions. These results suggest that what is being captured by our conversation type factor differs from cognitive load.

To conclude, our findings represent further evidence for entrainment not being a fully automatic process (Pardo, 2019), but that different factors (here, the conversation type) may influence entrainment and should be taken into account when investigating this phenomenon. As future work, it would be worthwhile to extend the investigation into the effect of conversation type on entrainment to other linguistic levels. This will shed further light on the role of entrainment in human communication and will also allow more realistic implementations of this phenomenon in spoken dialogue systems (e.g., Stoyanchev and Stent, 2009; Duplessis et al., 2017).

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