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Laughter growing up

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Abstract

We present a longitudinal corpus observation of laughter use in child-mother interaction from 12 to 36 months of age from a pragmatic perspective. The main aim of our work is to investigate how laughter use in interaction may be informative about pragmatic development. We observe significant differences in child and mother use of laughter and changes over time as the child grows up, specifically in the frequency, in the pragmatic functions of laughter, and in the response to other's laughter.

1 Introduction

Laughter is a crucial element in our daily interactions since the earliest years of life, emerging around 3 months of age (Nwokah et al., 1994). Laughter is not used only in response to humourous stimuli (Mireault and Reddy, 2016), but also in order to mark incongruities to the interlocutor, to smooth social discomfort (e.g. in moments of embarrassment, when criticising someone, when found to have committed some mistake) or to mark an incongruity between what is said and what is meant, signalling the need to opt for the less literal, and less probable meaning (e.g. irony, scare-quoting etc.) or to show affiliation to the partner. All of its uses need a certain level of pragmatic development and contextual reasoning in order to infer the partner's mental states. It is reasonable therefore to hypothesise that laughter use would change over time, being not only informative about cognitive development, but also about social and pragmatic development, intended as the progressive acquisition of the ability to communicate and understand others appropriately and effectively in a widening range of social contexts and activities while assuming increasingly complex social roles (Hymes, 1972). Until now though, little attention has been devoted to exploring laughter development in interaction.

2 Aim of the current study

We aim to explore the early development of laughter in children, from 12 to 36 months of age, investigating whether this could be an early means informative about communicative, cognitive and pragmatic development. While there is some literature on the development of laughter in response to humorous stimuli, to our knowledge what is missing is a detailed longitudinal study looking at laughter use in natural interaction, whether in relation to humour or not. Our main aim can be broken down into the following questions:

— How does child laughter behaviour relate to adult laughter behaviour? How does it evolve over time?

— Does the child's reaction to others' laughter change over time?

— Is laughter used to serve different functions as the child grows older?

3 Materials and Method

3.1 The corpus

We analysed data from the Providence Corpus (PC) (Demuth et al., 2006), for which audio, video, and transcriptions are publicly available[1]. The PC was compiled during 2002-2005, collecting data from participants in southern New England. It contains longitudinal recordings of 6 monolingual English-speaking mothers and their children from approximately 1 year to 3 years of age during spontaneous interactions at home. For our study we focused on a subset of the PC, looking at laughter behaviour development in 4 children. We analysed 30 minutes of interaction at intervals of 6 months from the age of 12 to 36 months, for a total of 5 time-points per child (5X30mins recordings per dyad), ultimately annotating 297 laughs.

[1]Data can be found in CHILDES database (https://phonbank.talkbank.org/access/Eng-NA/Providence.html).

3.2 Our annotation

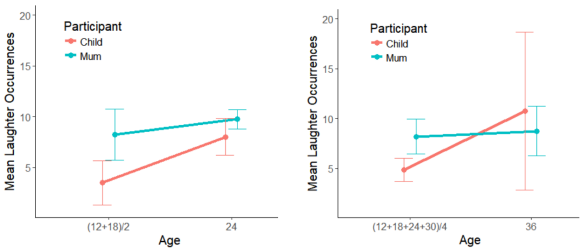
Our annotation is based on the framework for laughter analysis presented in Mazzocconi et al. (2020) and carried out using the software ELAN (Brugman and Russel, 2004). The coding was conducted by the first author. [2] She marked the onset and offset of each laugh, coded the form, the temporal sequence in relation to speech and others' laughs, the laughable it was related to and its position, the partner's response, and the function (following the binary decision tree reported in App. A). The same annotation procedure was applied both for children and mothers. In the current paper we will focus on a small subset of the variables observed.

4 Results

4.1 Frequency of laughter

We ran a logistic regression in order to explore whether *Age* had an effect on the number of laughs produced by children and mothers, treating laughter occurrence as a dichotomous dependent variable for each second of the video analysed. We applied the Helmert contrast which allows us to compare each time point to the average of the previous ones. The formula and coefficients are reported in App. B. We observe a significant difference in the amount of laughter produced by children and mothers overall (p=.001), in that mothers are more likely to laugh than their children independently of *Age*; we also see that laughter production undergoes a significant development and when comparing the last time point (36 months) to the average of the previous ones we observe a significant difference (p<.001). We observe a significant interaction of *Age* and *Participant* in the contrasts (2) and (4), with respective p-value of: <.05 and .004 (Fig. 1a, b). Both interactions indicate that as children get older their laughter productions become as frequent as their mothers'. Interestingly, we observe that the frequency of laughs produced by the mother in interaction with her child over 10 minutes (M=2.13, sd=2.01) is much lower than the one observed in adult-adult interaction: 5.8/10 min (Vettin and Todt, 2004); 21/5 min (Fuchs and Rathcke, 2018); 45/10min, 26/10 min, 5/10 min (Mazzocconi et al., 2020).

[2] Verifying the inter-annotator agreement on this classification for child interaction is ongoing.



(a) Laughter production at 24months in contrast to earlier timepoints - (Contrast 2).

(b) Laughter production at 36 months in contrast to earlier time-points - (Contrast 4).

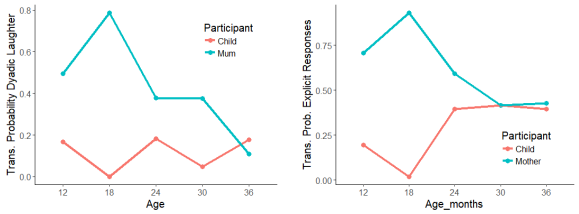
Figure 1: Number of laughter occurrences in mothers and children over time: each time-point illustrated on the right of the x-axis is compared to all the preceding time-points analysed.

4.2 Response to others' laughter

We studied the response to other's laughter annotating for two variables: dyadic laughter and explicit response to other's laughter.

4.2.1 Dyadic laughter

With the term dyadic laughter we refer to laughs either starting shortly after (antiphonal laughter) or with the same onset time (coactive laughter– only 3 in our corpus) of a laugh from the partner. We observe an overall significant difference in the production of dyadic laughter in mothers (19%) and children (12%) (McNemar's χ^2= 40.76, df= 1, p<.001). We then calculated the probability of dyadic laughter occurring from one participant over the total of the laughs produced by her partner (i.e. transitional probability -TP, see formula in App. C1). This is overall higher in mothers (41%) than in children (9%) (McNemar's χ^2= 17.9, df= 1, p<.001) - Fig. 2a. In order to explore whether a developmental trend in dyadic laughter could be observed, we divided our *Age* time-points (12, 18, 24, 30, 36 months) into 3 periods: one relative to the second year (12 and 18 months), one relative to the third year (24 and 30 months) and one relative to the beginning of the fourth year (36 months) of child development. We conducted a Wilcoxon test at each time-window comparing mothers' and children's TP of laughing in response to the partner's laugh. Results show a significant difference in the window relative to the second year (W= 3, p=.004), which disappears in the third (W= 16, p=.2) and the fourth year (W= 4.5, p= 1). This is visible in Fig. 2a, where at 36 months of *Age* children and mothers come to similar values, respectively 13.2% and 10.9%. While in children we do not observe a



(a) Dyadic Laughter (b) Explicit response

Figure 2: Responses to each other's laughter: children and mothers. - Transitional Probabilities (TP).

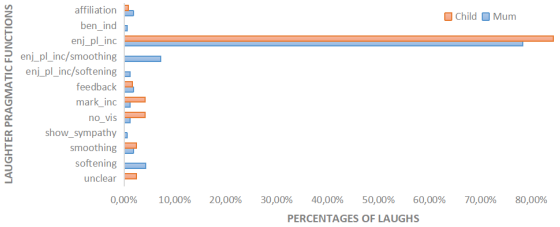


Figure 3: Laughter functions in children and mothers

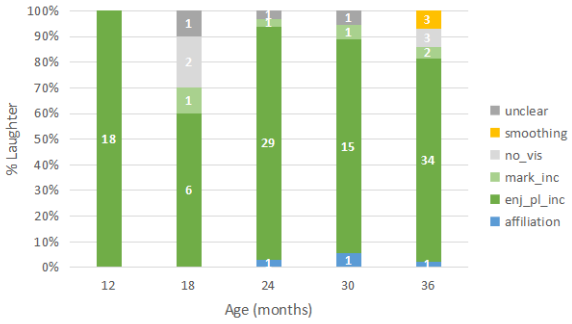


Figure 4: Laughter functions in children and mothers

significant difference in the production of dyadic laughter over time, we see a marked decrease in dyadic laughter productions from mothers, even though the statistical analysis did not show a significant difference when comparing the second year and the beginning of the fourth (W= 19, p= .059).

4.2.2 Explicit response to others' laughter

We then observed the reactions to other's laughter productions, not only when they were constituted by laughter, but also when constituted by other positive expressions (smile, exclamation) or by a clear orienting reaction (look). We calculate the TP of *explicit response* to laugh over the total number of laughs produced by the partner (see App. C2 for the calculation formula). The other two categories were *implicit response* (the partner simply continued her activity/behaviour) and *no response*. In Fig. 2b we see children's and mothers' responses to each other's laughter to be very different at 12 months (mothers much higher than children); values get closer around the age of 24 months, and then come to almost identical values at 30 and 36 months (Mother: 30 months 41.6% and 36 months 42.8%; Child: 30 months 41.5% and 36 months 39.5%). In order to conduct statistical tests, we divided *Age* in 3 windows: second, third and beginning of the fourth year of children's development. We conducted a Wilcoxon test to compare child and mother explicit responses to the partner's laughter within each window. We observe a significant difference between mother and child during the second year (12 and 18 months) (W= 57.5, p=.007), which then disappears during the third (W= 30.5, p=.9) and the beginning of the fourth year (W= 8, p=1). In mothers we see a significant change between the second and the third year (W= 9, p=.01), which is absent between the third and the beginning of the fourth (W= 15, p= .9); when comparing the first window (12-18 months) with the last one (36 months) the change in TP of explicit responses to the child's laughter is significant (W= 3, p=.03). In children, on the other hand, the comparison between the second and third year is not significant; we see a significant change in the TP of explicit response to the mothers' laughter only when comparing the second year to the beginning of the fourth (W= 28, p=.04).

4.3 Pragmatic function

In both mothers and children, over 70% of the laughs produced have the function of showing enjoyment of an incongruity, covering the majority of laughter-use (Fig. 3), as is also reported for adult-adult interaction (Mazzocconi et al., 2020). While for mothers in comparison to adult interaction the percentages are quite similar, in children the percentage of laughs used to show enjoyment of incongruity (84%) is significantly higher (McNemar's χ^2= 80.27, df= 1, p<.001). The range of functions used in children is smaller than the one observed in mothers (Fig. 3). In children we observe the progressive emergence of different laughter functions: at 12 months of age child laughs are used to show enjoyment of a pleasant incongruity; at 18 months we observe the emergence of laughter to mark incongruity; at 24 months laughter used to show affiliation; at 36 months laughter to smooth the interaction (see Fig. 4).

5 Discussion and Conclusions

We observe important changes both in child and mother laughter use over time. We not only observe differences between child and adult laughter behavior, but also a certain peculiarity in the mother's laughter behaviour in interaction with her child in comparison to adult-interaction, and a specific attunement to the child communicative and cognitive development. As the child grows older we observe a decrease in the percentages of dyadic laughter from the mothers. This signals a decrease in the urge to respond to every instance of laughter, since the child has progressively available a broader range of means to establish communication. On the other hand, the increase of explicit responses to the mother's laughter from the child is in line with the finding reported by Thompson (1991) of infants responding significantly more quickly to emotional elicitors with increasing age, showing more interest in others' reactions and more engagement in interaction. The fact that the child does not orient towards the mother's laughter around 12 months of age can also be explained on the basis of attentional capacities, being not yet mature to easily redirect resources to an intervention or to other stimuli. Regarding the pragmatic functions of laughter we observe a narrower range of functions in children compared to mothers and adults. Until 24 months the only function laughter is used for is to show enjoyment of pleasant incongruity, which we observe also in non-human primates (Davila-Ross et al., 2011). It is only later that we gradually observe different functions not observable in primates: laughter to show enjoyment without incongruity (to show affiliation), and laughter used in moments of unpleasant incongruities in order to smooth the situation and/or ingratiate the partenr. Interestingly, we observe this kind of laughter at around 36 months, the age in which a sense of the public self (i.e. reputation) starts to emerge in children (Tomasello, 2009).

In conclusion, our data show that laughter behaviour evolves a lot from 12 to 36 months mirroring several aspects of the child neuro-psychological development. Around 30 and 36 months of age we see a more balanced reaction to each others' laughter, signalling the child's increasing awareness and interest in others' non-verbal expressions and mental states. While from the point of view of the pragmatic use of laughter, we see that at 36 months it is very far from the adults', and laughter to modify or signal non literal meaning is still absent. Nonetheless, its socially oriented functions to manage interactions, are just emerging. We aim to extend our investigation to a larger sample. We know that autistic children show atypical laughter behaviour both in terms of production, perception, and responsiveness (e.g. Reddy et al. (2002)). We hypothesize that laughter may be an early means to identify delays or difficulties in pragmatic development.

6 Acknowledgements

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A Laughter pragmatic functions classification

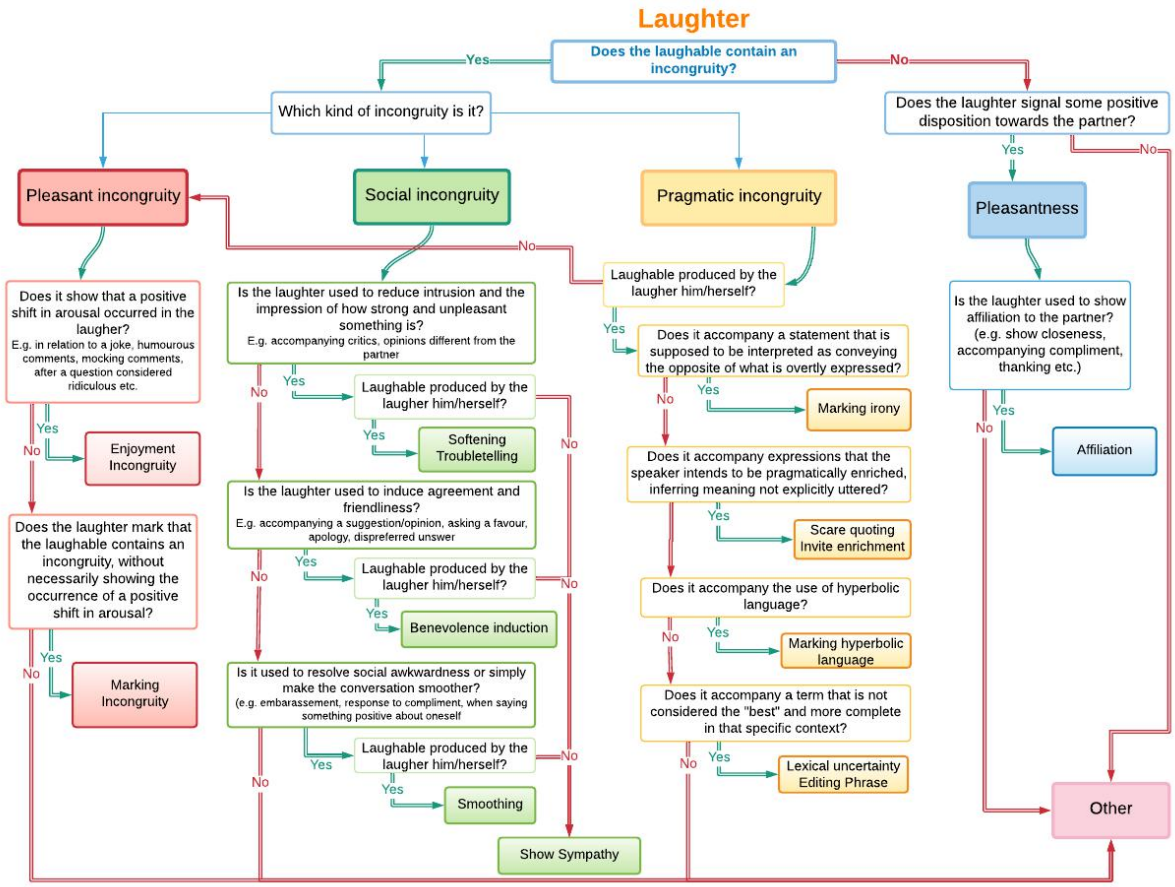

Figure 4: Binary decision tree for laughter pragmatic functions classification (Mazzocconi et al. 2020).

B Frequency of laughter

1. Logistic regression formula using the *glm* function from the *lme4* package (Bates et al. 2015):

   (glm (Laughter ~ Age * Participant, data=data, family=binomial))

   - Laughter: laughter occurrences coded as a dichotomous dependent variable for each second of the videos analysed.

   - Age: factor with 5 levels (12, 18, 24, 30 and 36 months of child's age).

   - Participant: Categorical variable (Child/Mother).

2. Results logistic regression with Helmert contrast.

Contrast	Estimate	Std. Error	z value	Pr(>|z|)
(1) 18vs12	-0.27146	0.11739	-2.312	0.020758 *
(2) 24vs(12+18/2)	0.17832	0.05585	3.193	0.001409 **
(3) 30vs(12+18+24/3)	-0.03391	0.04422	-0.767	0.443141
(4) 36vs(12+18+24+30/4)	0.09693	0.02745	3.531	0.000414 ***
MumvsChild	0.42109	0.13024	3.233	0.001224 **
(1):MumvsChild	0.04599	0.23479	0.196	0.844720
(2):MumvsChild	-0.22453	0.11170	-2.010	0.044422 *
(3):MumvsChild	-0.06976	0.08844	-0.789	0.430269
(4):MumvsChild	-0.15702	0.05490	-2.860	0.004237 **

Table 2: Results of the Logistic Regression with Helmert contrast - In the first part of the table we report the coefficients relative to each factor and contrast singularly, while in the second part we report the interactions between each of the contrasts and participant (Mother vs Child)

C: Transitional Probability calculation

1. Dyadic laughter

$$\text{trans. prob. of dyadic laughter by child} = \frac{\#\text{dyadic child laughs}}{\#\text{laughs by mother}}$$

2. Explicit response to other's laughter

$$\text{trans. prob. of explicit response by child} = \frac{\#\text{explicit child responses}}{\#\text{laughs by mother} - \#\text{child response unclear or not visible}}$$