Cognition 231 (2023) 105314

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/cognit

Just teasing! - Infants' and toddlers' understanding of teasing interactions and its effect on social bonding

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ARTICLE INFO

Keywords:
Infants
Intention understanding
Development
Teasing
Humor

ABSTRACT

The current study investigates infants' and toddlers' understanding of teasing interactions and its effect on subsequent social interactions. Teasing is a special kind of social interaction due to its dual nature: It consists of a slightly provocative contingent action accompanied by positive ostensive emotional cues. Teasing thus presents an especially interesting test case to inform us about young children's abilities to deal with complex social intentions.

In a first experiment, we looked at 9-, 12-, and 18-month-old infants' ability to understand and differentiate a teasing intention from a trying intention and a refuse intention. We found that by 12 months of age, infants react differently (gaze, reach) and by 18 months they smile more in reaction to the Tease condition.

In the second experiment, we tested 13-, 20- and 30-month-old children in closely matched purely playful and teasing situations. We also investigated potential social effects of teasing interactions on a subsequent affiliation sequence. Twenty- and 30-month-old children smile more in the Teasing than in the Play condition. For the 30-month-old toddlers, additionally, number of laughs is much higher in the Tease than in the Play condition. No effect on affiliation could be found.

Thus, from very early in development, infants and toddlers are able to differentiate teasing from superficially similar but serious behavior and from around 18 months of age they enjoy it more. Infants and toddlers are able to process a complex social intention like teasing. Findings are discussed regarding infant and toddler intention understanding abilities.

1. Introduction

Teasing is a very interesting type of social interaction as it lies exactly on the boundary between aggression and play – "an intentional provocation accompanied by playful off-record markers that together comment on something relevant to the target" (Keltner, Capps, Kring, Young, and Heerey, 2001) – we call this the "dual nature" of teasing. If a person doesn't understand the underlying playful intent, then teasing can be perceived as mean behavior.

Given the wealth of social effects and the complexity of the underlying cognitive structure, it is the more surprising that teasing interactions are ubiquitous in adult-infant-interactions in many cultures. Not only do caregivers frequently engage in teasing their infants, also infants have been observed to tease their caregivers (Reddy and Mireault, 2015, App. B). Previous research has credited teasing interactions in the long run with constructive functions for social relations: As Eisenberg (1986) noted, family members often utilize teasing to promote positive interactions, and peers have been found to tease to express affection, promote playful interactions, and as a means of building or maintaining group membership (Shapiro, Baumeister, and Kessler, 1991; Thorne, 1993; Voss, 1997).

Teasing thus presents an especially interesting test case to inform us about young children's social cognitive abilities. If young children are able to correctly interpret teasing, this would provide evidence for

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https://doi.org/10.1016/j.cognition.2022.105314
Received 14 February 2021; Received in revised form 20 October 2022; Accepted 22 October 2022
Available online 7 November 2022

young children's capacity to understand complex social intentions. This is theoretically important as it helps us to understand how children develop from basic social cognitive abilities to more complex ones. The comprehension of a tease as a positive event depends fundamentally on the understanding that behind the annoying behavior lies a playful communicative and prosocial intention which mitigates the ostensibly provocative act (Haugh, 2016; Kruger, Gordon, and Kuban, 2006). There has been a long debate whether infant and toddler social cognition can be explained by a lean account with minimal competences (see for discussion Gómez, 2010; Sirois and Jackson, 2007; and Stack and Lewis, 2008) or whether infants and toddlers show behavior based on higher order mental skills – a "rich" social cognition (Liszkowski, Carpenter, Henning, Striano, and Tomasello, 2004; Tomasello and Carpenter, 2007). Teasing interactions presuppose rich social cognition since ithey require the interactants to disentangle the overt slightly aggressive behavior from the ostensive-emotional cues. To do so, individuals have to interpret the teaser's goal based on background knowledge, communication content, and paralinguistic cues (Alberts, 1992). The accompanying communicative and emotional cues involve laughter, vocal stress, exaggeration, and contrastiveness which commonly also indicate play (Drew, 1987). The playful interpretation of such ambiguous actions is also supported by additional ostensive cues like eye contact and addressing of the other individual by name (Csibra and Gergely, 2006), as well as facial expressions (e.g. eyebrow movements) and gestures.

As for the active use of teasing, it has often been described as a deliberate violation of norms or routines. In order to tease, an individual needs an awareness of shared knowledge of social rules and routines, and of mutual social expectations; plus, the skills to playfully exploit these expectations for a social purpose (Keltner et al., 2001; Reddy and Mireault, 2015). Hence, active teasing presupposes even higher order social cognitive skills than teasing comprehension.

1.1. Development of intention understanding and social intention understanding in infancy: Teasing and humor

Is it feasible to assume that infants and toddlers could be able to understand complex social intentions like teasing? Most research on intention understanding compares whether children can tell the difference between intentional and unintentional actions. But no specific test concerning the understanding of teasing intentions and differentiation from other forms of social and playful intentions has been done so far.

Infants' growing understanding of intentional action has been shown by a number of studies and in many different paradigms from as early as 6 months to 18 months of age - depending on the method, e.g., imitation tasks (Bellagamba and Tomasello, 1999; Carpenter, Akhtar, and Tomasello, 1998; Johnson, Booth, and O'Hearn, 2001; Meltzoff, 1995) or looking time studies (Johnson, Shimizu, and Ok, 2007; Luo and Baillargeon, 2005; Mahajan and Woodward, 2009; Moses, Baldwin, Rosicky, and Tidball, 2001; Woodward, 1998).

Behne and colleagues, more specifically, investigated infants' differentiated understanding of unwilling versus unable intentions and found that infants from 9 months onwards were able to differentiate these intentions (Behne, Carpenter, Call, and Tomasello, 2005). In that study, children experienced an interaction with an adult who was either unable or unwilling in different ways to hand over an object. For instance, in one unwilling condition, the adult held out a toy to the infant (looking to the infant) and then pulled it away accompanied by teasing smiles (i.e. smiles that were highly contingent with the withdraw action). In a matched unable condition, she also held out a toy to the infant (again looking to the infant) but kept dropping it "accidentally" before the infant could grasp it (accompanied by facial expressions of surprise and frustration), so that the toy rolled back to her. In one further condition, the adult again held out the toy (alternating gaze between toy and infant, smiling in a teasing way) and did just not hand it over.

Infants aged 9 months and older responded with the expected reaction: when the experimenter was unwilling to give them a toy, they showed impatience, but when she was trying but failing to give them a toy, they waited patiently. These different reactions were measured by reaching, banging and looking away as a sign of impatience.

As for the more specific development of teasing comprehension, parents start teasing their infants from three to six months of age with such simple games as 'peek-a-boo' or 'give-and-withdraw' (Trevarthen, 1990). Teasing the baby in a peek-a-boo game or by dangling a toy just out of reach of the infant has to be finely timed in order to elicit laughter rather than tears of frustration (Reissland, Shepherd, and Herrera, 2005). Peek-a-boo is a very basic form of teasing (see also Bruner, 1983; Bruner and Sherwood, 1976) where a caregiver plays with the child's expectation by taking away a positive stimulus (hiding a smiling face) and then giving a little startle („boo") followed by strong positive expressions like laughter, smiling and joyful speech or giggle. Peek-a-boo requires the understanding of the playful intention of the other, despite the annoying behavior, and the exploitation of common knowledge („we are in a game together"). A study showed that seven- to nine-month-old infants look longer to an experimenter who engages in holding out and retrieving a toy if the experimenter presents a neutral facial expression and thus no information on the communicative intention of the action is available, and they look only shortly, if the experimenter accompanies the behavior with social smiling (Nakano and Kanaya, 1993; Striano and Vaish, 2006).

The data suggest that around their first birthday, infants develop some understanding of the playful intention latent in caregivers' teasing behavior. Parental teasing includes the slightly threatening action plus the accompanying play signals that transmit parents' playful intention to their infant. These play signals include more infant directed speech, smiling, gazing (Hoicka, 2016; Hoicka and Gattis, 2012; Lillard et al., 2007) and later on disbelief language (Hoicka and Butcher, 2015; Hoicka and Gattis, 2008), question intonation (Hoicka and Gattis, 2012) and exaggerated action and sound (Lillard et al., 2007; Lillard and Witherington, 2004).

Despite the relevance of teasing in human social life, very little is known about its development. Research on related social phenomena – like humor – support the hypothesis that infants and toddlers should be able to comprehend teasing interactions: Humor is a complex social behavior and shares with teasing the necessity to understand playful intention and the exploitation of common knowledge and common ground. Humor and teasing in infants deliberately violate shared expectations, understandings and conventions by creating social misexpectations (Reddy and Mireault, 2015). Teasing – on the other hand – has elements of provocation which are not involved in humor. Hence, playful or humorous interactions are cognitively simpler than teasing, since they only require infants and toddlers to respond congruently to the presented emotional cues rather than understanding that the communicative intention is different from the presented emotional cues. The dual nature of teasing, i.e. the necessity to keep in mind two contradictive representations of what is overtly said or done and what is meant explains the higher cognitive complexity of teasing.

Research on the development of humor comprehension shows that infants from as early as five months of age laugh in response to absurd events and clowning (Mireault et al., 2012, 2018). From around seven months of age, infants laugh at "stimuli" which in adults and older children would be called humorous and use neutral affect of others to appraise an absurd event as not amusing (Mireault et al., 2015). By 11 to 12 months of age, infants laugh more at events involving inappropriate or incongruous acts than at conventional actions (Sroufe and Wunsch, 1972) and they use their parents' affective signals to evaluate the event as funny (Mireault et al., 2014). Infants' laughter at the violation of social expectancies reveals grasp of the social conventions governing the use of objects and the performance of actions. Note, that these are also prerequisites for engaging in teasing. Hoicka and Gattis (2008) compared toddlers' differential reaction towards simpler forms of playful interactions such as jokes and mistakes. They found that only the

25- to 36-months-old infants differentiated between mistakes and humorous intentions, imitating the humorous actions marked by laughing, and correcting mistaken actions. The authors suggest that understanding humorous intentions behind uncorrected actions occurs earlier than understanding other kinds of intentional actions such as the intention to pretend (Rakoczy, Tomasello, and Striano, 2004) or the intention to lie (Siegal and Peterson, 1998).

Regarding the production of teasing, observational records have suggested that at 9–12 months, infants engage in teasing interactions with others, for example by initiating a game of offering and withdrawing of objects with a joking expression (Reddy, 1991, 2001; see App. B for personal observation of one of the authors). Teasing often occurs in response to interpersonal conflict: An observational study of sibling and parent-child interactions identified the occurrence of conflicts and teasing in families with children between the ages of one and two years (Dunn, 1989; Dunn and Munn, 1985). As children engaged in increased conflict with their siblings and parents, they tended to negotiate these conflicts with increased teasing – thus emphasizing its importance for managing social relations.

Infants also engage in active joking from the first year (Addyman and Addyman, 2013; Hoicka and Akhtar, 2012; Reddy and Mireault, 2015) – mostly with their caregivers (MacDonald and Silverman, 1978; Waters, Matas, and Sroufe, 1975). Humor production in early development does not often occur between strangers (Fine and de Soucey, 2005). Thus, parents are the best informants on children's humor production. Fifteen- to 22-month-old infants produced a variety of jokes that involved violating rules and expectations (e.g., putting inappropriate objects in their mouths – crayons, sand, and sponges) – whilst laughing and looking for a reaction (Loizou, 2005). Children by two to three years of age produce humorous acts in controlled observational settings (Hoicka and Akhtar, 2012). In that study, parents reported children copying jokes during the first year of life, and producing novel jokes from two years, smiling, laughing, and looking for a reaction when joking. Similar results were confirmed by experimental data where two-year-old children began to produce novel humorous acts in the interaction with their parents (Hoicka and Akhtar, 2011; Hoicka and Gattis, 2008). Novel jokes seem to suggest that between two and three years of age, children can understand the cognitive structure of humor, instead of merely copying such behavior for the sake of funny social effects.

On the basis of these studies, it can be concluded that infants by the end of their first year of life are able to interpret actions in terms of underlying goals and intentions and to differentiate different kinds of intentions based on situational and expressive cues. Teasing appears as a special kind of social intentional action. However, it is not clear whether infants can also (1) correctly interpret a teasing intention since it is based on contradictory information and contains irritating elements and (2) differentiate teasing from other expressions of playful communicative intentions, since most of previous research focused on less sophisticated forms of communicative playful exchanges, such as humor.

The first aim of the current study was therefore to verify infants' ability to discriminate between different kinds of intentional actions and to understand the infants' ability to deal with the dual nature of teasing interactions as being frustrating and playful at the same time. We evaluated whether infants distinguish teasing from other intentions which share either similar actions or similar vocalizations and facial expressions, and which produce the same outcome (the infant never gets the object by the experimenter).

The first experiment tested the literature-based hypothesis that infants from around their first birthday differentiate and enjoy teasing interactions. Specifically, we hypothesize that they do not interpret teasing actions only based on superficially perceived characteristics, such as not getting the toy. If that was the case, they should not be able to differentiate superficially similar behaviors with the same factual outcome.

In the second experiment, we took an even more fine-grained approach to investigate whether children react differently to teasing than to equally affectively marked but purely playful interactions. The types of interaction involved similar movements and outcomes but different social-communicative intentions. The second experiment tested the hypothesis that infants can distinguish the two kinds of playful interaction and they can behave accordingly. They do not interpret teasing actions only based on the prominent play signals which accompany the behavior.

Additionally, we measured the effect of these two types of interaction on a subsequent affiliation task where infants could choose to interact with the Teaser and the Player: Bonding is one of the social functions of teasing (Haugh and Pillet-Shore, 2018). In adult initial interactions, teasing may invite intimacy and contribute to negotiating relationship boundaries (Miller, 1986; Mills and Babrow, 2003; Tholander and Aronsson, 2002). By claiming common ground, teasing minimizes social distance and generates the feelings of familiarity (Eisenberg, 1986), friendship and empathy. However, in young children, humor does not tend to occur between strangers (Fine and de Soucey, 2005), and children engage more in humor with their parents (MacDonald and Silverman, 1978; Waters et al., 1975). It is the back and forth of mutual expectations, assumptions and trust in prosocial motives which gives the teasing episode the power to foster affiliation and create intimacy in a social relationship. On the basis of these studies, we hypothesized that toddlers will prefer the teasing partner over the playing partner. Exploratively, we also provided each child with the opportunity to tease his or her caregiver as a measure of teasing production in these age groups.

2. Experiment 1

In the first experiment, we evaluated whether infants can distinguish teasing from other types of interactions such as refusing or trying to give an object (the infant never gets the object by the experimenter).

For this purpose, we re-analyzed the data collected by Behne and colleagues for a study on infant intention understanding, i.e. differentiating unwilling versus unable intentions (see Behne et al., 2005). In the unwilling conditions, that study included also teasing actions: the experimenter was offering the child an object and withdrawing it repeatedly upon the infant's grasp with a smiling face. Of the nine different conditions in that study, we chose the Tease condition and two control conditions that had not formerly been compared.

In the current study, the experimenter was: 1) either unwilling to give up the object, and teasing the infant ('Tease'), or (2) unwilling, and simply refusing to hand over the object to the infant ('Refusal'), and (3) attempting to hand over the object, but clumsily being unable to do so by dropping it ('Clumsy'). The adult's patterns of movements were closely matched. In the 'Tease' condition, the adult held out a toy to the infant (looking at the infant), and then smiled and pulled it away teasingly (that is, contingent on the infant's attempt to grasp it). In the 'Clumsy' condition, in contrast, the adult also held out a toy to the infant (again looking at the infant), with a friendly smile, but when the infant tried to grasp the toy, the adult "accidentally" dropped it onto a ramp so that the toy rolled back to the experimenter and showed expressions of frustration. In the 'Refusal' condition, the experimenter placed the toy in front of herself, and repeatedly alternated her gaze between infant and toy, smiling in a teasing way. We decided to consider these two control conditions, since each of them controlled for some relevant feature of the target 'Tease' condition: In particular, the 'Clumsy' condition showed the same playful and dynamic offering and losing of a new object to the infant, while the loss of the object was marked by facial expression of surprise and frustration. However, it did not share the provocative aspect of teasing. The 'Refusal' condition shared similar vocalizations and facial expressions (smiling in a teasing way), but did not share the back and forth of the action (the object remained stationary). Thus, there was no equivalent action and interaction (the experimenter remained motionless during these trials).

We measured various new infant behavioral reactions to these three

conditions. We were interested in the amusement of the child during these kinds of interaction. We measured the duration of social smiles, gaze to the experimenter, and of reaching attempts directed towards the experimenter. Two infant behaviors–social smiling and looking to the experimenter–were newly coded from video for this re-analysis of the data. Social smiling was considered a measure of enjoyment, and consequently an indirect measure of the infant's understanding of teasing intentions; gaze directed at the experimenter was considered a measure of the degree of involvement of the infant in the social interaction; and finally, the reaching gestures were considered as an indicator of infants' persistence in trying to obtain the object and in being engaged in the social interaction.

Our aim was to find out whether infants enjoy the teasing interaction more than the interactions in the 'Clumsy' condition (with corresponding actions) and the 'Refusal' condition (with similar emotional cues). Diverse infants' reactions in these three conditions would indicate a rather sophisticated, intention-based interpretation of the situation – independent of the material outcome (infant does not get the object in either case) and unrelated to a similar facial expression feedback (the experimenter smiles in both 'Tease' and 'Refusal' conditions). Our prediction based on the literature on intention understanding was that infants from 9 months onwards would react differentially to the three different conditions. We expected that playful teasing would be perceived by infants as an enjoyable activity thereby promoting more smiling, gazing and longer reaching times as signs of social-emotional engagement.

2.1. Method

2.1.1. Participants

Twenty-four 9-month-olds (11 girls, mean age = 9;8 months, range = 8;28–9;17), twenty-four 12-month-olds (16 girls; mean age = 12;6, range = 11;19–12;14) and twenty-four 18-month-olds (9 girls; mean age = 18;3, range = 17;13–18;14) were included in the data analysis. In addition, 2 nine-month-old infants, 12 twelve-month-old infants and 9 eighteen-month-old infants participated in the study, but were excluded from data analysis due to missing trials (14 infants), experimenter error (2), child refusal (5), and intervention of caregiver (2).

Participants came from a middle-sized German city and were recruited from a database of parents who had volunteered to participate in studies of child development. For reasons of sensitivity about collecting demographic data in Germany, we did not collect data on ethnicity, race or socioeconomic status from our participants. The official statistics indicate that the population from which participants were drawn consists of 93.5% native Germans and is predominantly middle class. Infants received a small gift for participating.

2.1.2. Design and materials

In the original study, each infant participated in three activity groups (tease, refuse, play; see Behne et al., 2005 for details), each comprising of an unwilling, a trying, and a distracted condition, for a total of nine experimental trials per infant. Experimental trials were interspersed in a game of passing toys. Activity group order as well as the order of conditions were counterbalanced across infants.

During the experiment, the infant sat on the parent's lap at a table (80 cm × 80 cm) across from a female experimenter. On the table, a ramp (38 cm long, 30 cm wide, 5 cm high at the experimenter's side) attached to the table sloped down towards the experimenter, so that when she dropped the ball in the clumsy trial, it rolled back to her. Different small toys were passed to the infant in random order, and various containers were used. The infant was encouraged to discard toys in-between trials with the help of the parent and an assistant sitting next to them. The session was filmed with two video cameras, one facing the infant and one facing the experimenter. For details of the set-up and timing, please refer to Behne et al., 2005.

2.1.3. Procedure

Previous to the test session, the experimenter and the assistant played with the infant until the infant felt comfortable interacting with both adults. To set up the game of passing toys, the experimenter handed the infant a number of toys, one at a time. Offering a new toy was often accompanied by "Oh, look!" When given the toy, the infant either took it and dropped it down a chute, as established in the warm-up, or played with it. The assistant then prompted the infant to drop the toy down the chute or hand it to her. The next toy was not presented until the assistant had placed the toy out of sight of the infant. In contrast, in the test trials, the infant was shown new toys without receiving them (see detailed description of the test trials below). Each test trial lasted 30 s (timed by the assistant), at the end of which the experimenter placed the toy out of sight of the infant and returned to the passing toys game, as a filler. The infant was given four toys in turn between each test trial.

The test trial started only if the infant had accepted at least three of the toys offered previously. If an infant lost interest in the game and stopped taking offered toys, the session was ended and the infant was not included in the final sample. Breaks in-between games were interspersed if the infant became restless. The experimenter could continue after a brief break, passing several toys before the next test trial started. Out of the nine original conditions, we considered only the three following conditions:

Tease (originally called unwilling-tease): During the 30s, the experimenter repeatedly held out a ball, looking at the infant. When the infant reached for the ball, the experimenter rapidly pulled it back again in a provocative manner, with a teasing smile.

Clumsy (originally called trying-clumsy): During the 30s, the experimenter repeatedly held out a ball, looking at the infant. When the infant reached for the ball, the experimenter "accidentally" dropped it and the ball rolled down the ramp towards the experimenter. The experimenter's facial expression conveyed surprise and frustration.

Refusal (originally called unwilling-refuse): The experimenter placed the toy in front of the infant. During the next 30s, she repeatedly alternated her gaze, looking down at the toy and then back at the infant, saying "hum" every now and then. She remained motionless while smiling at the infant in a teasing way, conveying reluctance to pass the toy.

2.2. Results

2.2.1. Coding and reliability

Infants' behavior during each of the 30s trial period was coded from videotape using the program Interact (Interact 9, Mangold). As response measure, we analyzed the duration of three different behaviors: Except for "reaching", these measures were not included in the original paper by Behne et al. (2005).

Social smile was coded when the infant's smile or laugh was clearly directed towards the experimenter during the interaction, and expressive of enjoyment. The eyes and mouth of the infant had to be clearly visible (e.g. infant was not using a pacifier), with an upwards movement of the corners of the mouth, and the gaze was clearly directed towards the experimenter. Vocalizations, when present, were also used as further confirmation of the infant's enjoyment.

Gaze to adult was coded when it was clearly directed towards the experimenter's face. The eyes of the infant had to be clearly visible. Time was coded from the millisecond in which the gaze was on the trajectory of the experimenter's eyes to the first movements which suggest a change of gaze direction.

Reaching was coded when the infant's arm was fully outstretched in the direction of the experimenter or the toy, while the infant was also looking in that direction. The time was coded from the beginning of the arm movements towards the experimenter and ended as soon as the infant started to pull the arm back (those few occasions during which an infant was clearly reaching and just glanced away briefly were also included in reaching time account). Pointing gestures which were

directed to the experimenter in an imperative fashion were also coded as reaching because of the difficulty of distinguishing them reliably. Other behavioral responses that occurred were leaning forward, climbing onto the table, vocalizing, pointing elsewhere, banging with the feet, turning to the parent, and playing with the chute or ramp. These were not coded separately either because they occurred infrequently, or because they were difficult to code reliably.

For each parameter, five infants (20.83%) in each age group were coded independently by a second observer, who was blind to the hypotheses of the study. Inter-observer reliability was determined by calculating Pearson product–moment correlation coefficients for Reaching, and Intraclass Correlation Coefficients for Gaze and Smile duration. Inter-observer agreement was high for all parameters (reaching: $r = 0.92$, gaze: ICC = 0.99, smile: ICC = 0.98; all ps < 0.001).

2.2.2. Data analyses

Data and analysis are available for open access under (Colle, Grosse, Behne, and Tomasello, 2022).

To test for effects of order, we performed a Friedman test with nine trials for each parameter and age group. All statistical tests were two-tailed. The order of conditions did not have any significant effects on the infants' responses in either age group for any of the response parameters. Thus, this factor was not included in further analyses.

Power analysis. To determine the power of the study, we used GPower (Version 3.1.9.7.). Given the effect sizes and participant numbers, we achieved a power of 0.62, with a critical F-value of 2.44.

Smile duration. For the smile duration data, the assumptions for an ANOVA were not fulfilled. We therefore used non-parametric statistics for the main results. For testing the interactions of factors there is no non-parametric procedure available. Thus we used the corresponding parametric test (GLM) for testing the interaction, but handle the result with caution.

First, we ran a repeated measures ANOVA (GLM) to test for possible interactions between the factors Age, Condition and Sex. There was a significant interaction of Age and Condition ($F(4) = 3.19$, $p = .02$, $\eta^2 = 0.09$) and a main effect of Condition ($F(2) = 10.41$, $p < .001$, $\eta^2 = 0.14$). See the mean smile duration of the three groups in Fig. 1. No other factors had a significant main effect. To back up the main effect of condition, we also calculated a non-parametric Friedman test on Condition. Also the non-parametric test revealed a significant effect of Condition ($\chi^2(2; N = 72) = 18.38$, $p < .001$).

To explore the differences between the conditions further and take the interaction with age into account, we performed pairwise comparisons between the conditions using Wilcoxon signed-ranks tests for each age group. Because of the relatively high number of post-hoc comparisons ($N = 9$), the p-values for hypotheses testing were adjusted using the Benjamini-Hochberg procedure (BH; Benjamini and Hochberg, 1995) to avoid alpha-error accumulation (Hemmerich, 2016).

While post-hoc comparisons for the 9-month-old infants do not show any significant differences between the conditions, for the 12-month-old infants, there is a tendency to smile more in the Tease than in the Clumsy condition. All other comparisons were not significant, although inspection of the data suggests that this might be due to small sample size in group-wise analyses. Thus, an effect might be under development which finally bears out more strongly at 18 months. For the 18-month-old infants, the picture is clearer: Smile duration was highest in the Tease condition, moderate in the Clumsy condition and almost zero in the Refusal condition. Differences between Tease and Clumsy condition show a trend (corrected $p_{BH} = 0.09$) and differences between Clumsy and Refusal as well as Tease and Refusal conditions were significant (see Table 1 for test statistics).

Reaching duration. For this measure the assumptions for parametric analysis were fulfilled, thus we used a repeated measures ANOVA to test for significant effects of Age, Condition and Gender. The analysis showed no significant interactions, but significant main effects of Condition ($F(2,66) = 51.93$, $p < .001$, $\eta^2 = 0.44$) and Age ($F(2,66) = 5.48$, $p = .01$, $\eta^2 = 0.14$). Post-hoc pairwise age group comparisons showed that reaching duration was higher in the 18-month-olds ($M = 14.39$, *95% CI* [12.29,16.5]) than in both the 9-month-old infants ($M = 9.93$, *95% CI*

Table 1
Results of the Wilcoxon signed-rank test for smile duration.

Condition pair	Z	N_{total}	$N_{w/o\ ties}$	P	P_{BH}	r
9 months						
Tease vs.Clumsy	−1.87	24	11	0.07	0.14	0.27
Tease vs. Refusal	−0.97	24	14	0.36	0.46	0.14
Clumsy vs. Refusal	−0.84	24	13	0.42	0.47	0.12
12 months						
Tease vs. Clumsy	−1.76	24	15	0.08	0.08	0.25
Tease vs. Refusal	−1.41	24	12	0.17	0.25	0.20
Clumsy vs. Refusal	−0.09	24	11	0.97	0.97	0.01
18 months						
Tease vs. Clumsy	−2.10	24	21	0.03	0.09	0.30
Tease vs. Refusal	−3.62	24	17	<0.001	<0.01	0.52
Clumsy vs. Refusal	−2.83	24	13	0.00	<0.01	0.41

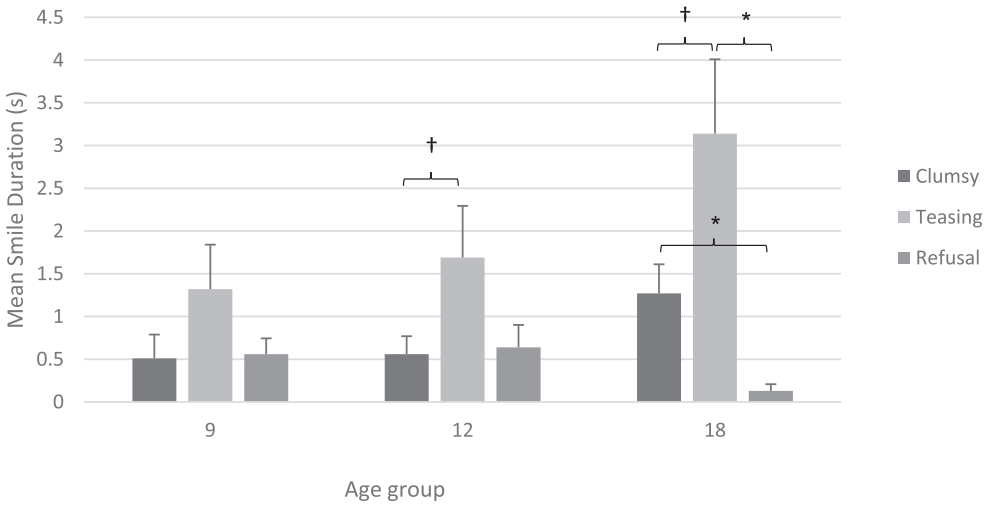


Fig. 1. Smile duration (in seconds) per condition and age group. Error bars indicate standard errors. Asterix (*) denotates differences at a corrected 95% alpha-error level; crosses (†) indicate significance at a corrected 90% alpha-error level.

[7.87, 12.0], $p = .004$) and the 12-month-old infants ($M = 10.34$, *95% CI* [8.18,12.5], $p = .009$), while the two younger age groups did not differ from each other ($p > .05$). See the mean reaching time of the three age groups in Fig. 2.

To further detail out the condition effect, we used an additional GLM to test for the differences between specific condition pairs for each age group separately (for test statistics see Table 2). In all age groups, reaching duration was higher in the Tease condition than in the other two conditions. In the Clumsy condition, reaching duration was still significantly higher than in the Refusal condition.

Gaze duration. The duration of gaze was measured to control for the possibility that infants smile more in the Tease condition simply because they look longer at the experimenter's face. Data were corrected by using Square Root-Transformation to fit the assumptions for parametric tests.

Again, we used a repeated measures ANOVA (GLM) including the factors Age, Condition and Gender. This time there was a significant interaction between Age and Gender ($F(2,66) = 5.77$, $p < .01$, $\eta^2 = 0.15$) as well as a main effect of Condition ($F(2,132) = 21.20$, $p < .001$, $\eta^2 = 0.24$). Testing each age group separately, Gender only had an effect in the 9-month-old infants, where boys (M = 1.91, 95% CI [1.61,2.21]) looked significantly longer than girls (M = 1.27, 95% CI [0.92,1.62]), $F(1,22) = 8.4$, $p < .01$, $\eta^2 = 0.28$). This was not the case in the other two age groups. See the mean gaze duration of the three groups in Fig. 3.

Again, condition differences were explored in more detail using additional GLMs for pairwise condition comparisons, with α-levels corrected by the Benjamini-Hochberg procedure (p_{BH}). In contrast to the smile and reaching measures, gaze duration was significantly higher in the Refusal condition than in the Tease condition and also differed significantly from the Clumsy condition, while gaze duration was not different between the Tease and the Clumsy conditions (see Table 3). Thus, higher smiling measures in the Tease condition are not caused by longer looking times.

2.3. Discussion

The first experiment tested infants' comprehension of different intentions, performed with very similar behaviors (same movement, different accompanying cues; different movement, same accompanying cues), and the enjoyment produced by teasing interactions.

Overall, the three groups of infants, age range 9–18 months, showed clearly differential reactions to the three different conditions tested. From 9 months on, infants reach longest in the Tease condition, a bit less in the Clumsy condition and least in the Refusal condition. At the same age, they also look longer to the experimenter in the Refusal condition than in the two other conditions. This finding is congruent with our predictions based on the literature on intention understanding.

The more specific reaction of joy as expressed in the smile measure, in contrast, shows a developmental trend. For the younger infants (9 and 12 months) there is only a tendency for a significant difference of smiling in the Tease condition compared to their smiling in the Clumsy condition and no difference compared to the Refusal condition. This effect develops in strength with age resulting in significant differences for the 18-month-old infants. Infants of this age group smiled more when the experimenter deliberately engaged them in an offer and withdraw teasing game, compared to the condition where the experimenter gave a similar emotional cue, a teasing smile, without an active reciprocal interaction (as in the refusal condition); or when the experimenter performed the same action with identical outcome (offering a toy to an infant who does not obtain it), but with different social intentions and emotional cues (as in the Clumsy condition). This result seems to suggest that when infants recognize the experimenter's intention of teasing, they are more likely to remain engaged in the interaction and to perseverate in the amusing and competitive social game of obtaining the object.

Based on the literature of the functions and effects of teasing, we expected that playful teasing would be perceived by infants as an enjoyable activity thereby promoting more smiling, gazing and longer reaching times as signs of social-emotional engagement. However, the

Table 2
Results of repeated measures ANOVA for reaching duration.

Condition pair	F	Df	p	p_{BH}	η^2
9 months					
Tease vs. Clumsy	4.83	1,23	0.04	0.04	0.17
Tease vs. Refusal	21.89	1,23	<0.01	0.011	0.49
Clumsy vs. Refusal	12.31	1,23	<0.01	0.011	0.35
12 months					
Tease vs. Clumsy	16.99	1,23	<0.01	0.011	0.43
Tease vs. Refusal	73.00	1,23	<0.01	0.011	0.76
Clumsy vs. Refusal	7.75	1,23	0.01	0.011	0.25
18 months					
Tease vs. Clumsy	10.09	1,23	<0.01	0.011	0.31
Tease vs. Refusal	35.36	1,23	<0.01	0.011	0.61
Clumsy vs. Refusal	11.61	1,23	<0.01	0.011	0.34

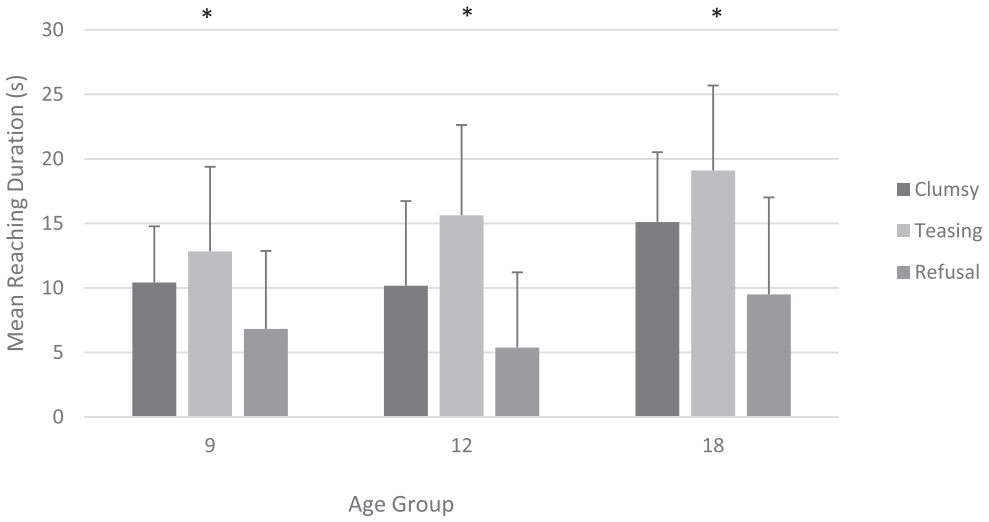


Fig. 2. Reaching duration (in seconds) for conditions and age groups. Error bars indicate standard deviation. Asterix (*) denotates differences at a corrected 95% alpha-error level.

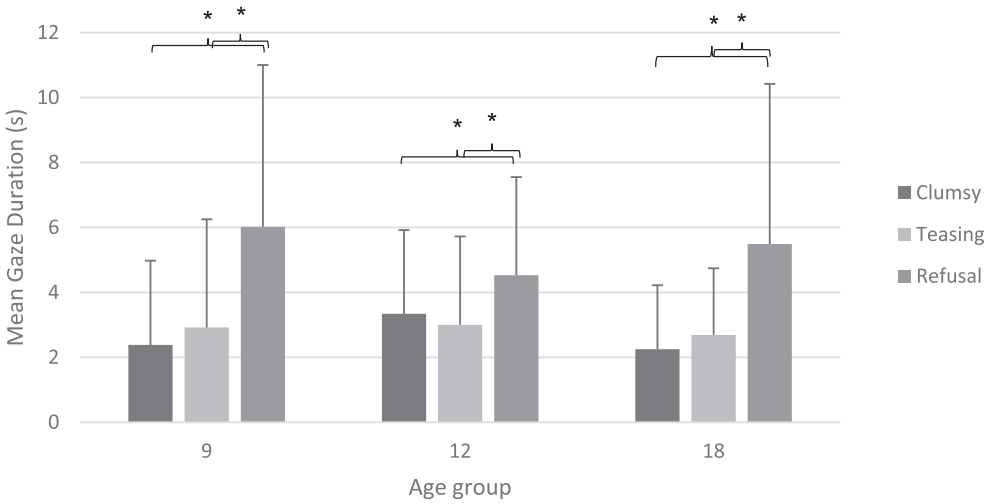


Fig. 3. Duration of gaze towards the experimenter (in seconds) for conditions and age groups. Error bars indicate standard deviation. Asterix (*) denotates differences at a corrected 95% alpha-error level.

Table 3
Results of repeated measures ANOVA for gaze duration.

Condition pair	F	Df	p	p_{BH}	η^2
9 months					
Tease vs. Clumsy	0.50	1,22	0.49	0.55	0.02
Tease vs. Refusal	6.33	1,22	0.02	0.03	0.22
Clumsy vs. Refusal	12.79	1,22	<0.001	0.002	0.37
12 months					
Tease vs. Clumsy	0.19	1,22	0.67	0.67	0.01
Tease vs. Refusal	14.15	1,22	<0.001	0.002	0.39
Clumsy vs. Refusal	10.39	1,22	<0.001	0.002	0.32
18 months					
Tease vs. Clumsy	0.67	1,22	0.42	0.54	0.03
Tease vs. Refusal	13.78	1,22	<0.001	0.002	0.39
Clumsy vs. Refusal	9.71	1,22	0.01	0.018	0.31

results for the different age groups were mixed. For the two younger age groups – 9 and 12-months of age – we only observed longer reaching behavior in the Tease condition than in the other two conditions. For the 18-months-old infants, however, we found clear signs of positive emotional engagement demonstrated by more social smiles.

Finally, the results show that gaze duration was significantly higher in the Refusal condition compared to both the Tease and the Clumsy condition. A plausible explanation of this finding is that in the Refusal condition the experimenter does not actively engage the infant in social interaction, but she only looks at the infant in a provocative or teasing way. Therefore, in the Refusal condition, the infant might find the experimenter's interaction quite puzzling. Consequentially, the longer gaze duration may represent an infant social adaptive strategy, with the infant investigating the experimenter's attitude and attempting to figure out the reasons for her odd behavior.

Overall, our results suggest a developmental pattern with infants from 9 to 18 months becoming increasingly able to discriminate teasing from other kinds of social interactions, and thus better able to enjoy teasing (as measured by smile duration) and to get involved in it (as measured by reaching duration). These results suggest that children from as early as 9 months not only are able to differentiate unwilling from unable intentional actions and thus interpret actions as goal directed (Behne et al., 2005), but also differentially react to teasing versus mistaken versus outright refusal intentional actions – a differentiation that goes over and beyond goal-directedness pointing at understanding complex social intentions. This result strengthens the conclusion that young children are skilled in understanding actions based on both – the intentions and accompanying cues.

However, the contrasts in this first experiment were stark and an alternative interpretation is thus, that children only smile more because of the mere presence of those contingent play signals. Thus, in the second study, we offer a more fine-grained comparison with play signals in both conditions.

3. Experiment 2

In Experiment 1, we found that infants from 9 to 18 months responded differently and more positively to teasing interactions than to superficially similar actions like refusal or clumsiness. However, it is possible that infants responded more positively in the Tease condition (smiling and reaching more), because they were responding primarily to the more positive emotional valence displayed in this condition, without fully understanding the intention of teasing. Indeed, the teasing trials involved both interpersonal reciprocity (the experimenter offers and withdraws the object only when the infant tries to get it), and positive emotional cues (the experimenter smiles during the interaction). In contrast, in the two control conditions, either the reciprocal interaction was not involved (Refusal condition), or the interaction was cued by negative emotional expressions (Clumsy condition). Thus, the higher incidence and duration of smiling, laughing and reaching in the Tease condition might simply be an indication of generally positive and playful infant disposition, rather than a direct measure of teasing comprehension.

Therefore, we designed two experimental conditions, one playful condition and one teasing condition, which involved similar positive emotional cues, similar actions, and the same objects and we tested them with three different age groups (13-, 20-, and 30-months-old toddlers). We hypothesized that even at 13 months, infants can distinguish between and understand the two different positive social interactions, and that they would enjoy the Tease condition more than the Play condition. As in the first experiment, we evaluate the infants' social smile, expecting infants to enjoy the Tease condition more (smiling and laughing more) compared to a very similar positive and playful control condition. Additionally, we analyzed infants' fussiness as a possible sign of distress in the teasing interaction and laughter as an even stronger positive affective reaction.

A further goal of the second study was to examine whether teasing interactions can facilitate social bonding even in a novel relationship, inducing a preference for the teasing experimenter rather than the

playful experimenter. Humor and teasing have been considered critical to building and maintaining relationships with others, since they generate positive emotional states and predispose favorably to further social activity (Keltner et al., 2001; Weisfeld, 1993). We therefore assessed effects of interaction-type on social relations by introducing a second measure in order to evaluate which of the two experimenters the infant was spontaneously driven to approach first, the teaser or the player, when in invited to share interesting information. This test was presented immediately after the experimental session.

The initial choice and the percentage of time that each infant spent in the proximity of each experimenter were taken as measures of affiliative preference. We expected that infants would spontaneously prefer the teasing experimenter.

Additionally, as an explorative attempt, we gave infants the opportunity to actively produce themselves with their caregiver the teasing action they had just perceived as recipient. No specific hypothesis was connected to this phase of the study.

3.1. Method

3.1.1. Participants

In total, 68 infants participated in the study. Fifteen 13-month-olds (8 girls; mean age = 13;20 months; range = 13;03–14;06), seventeen 20-month-olds (9 girls; mean age = 20;06; range = 19;23–20;17) and eighteen 30-month-olds (8 girls; mean age = 32;24; range = 27;07–33;20) were included in the data analysis. Eight 13-month-old, seven 20-month-old and three 30-month-old infants participated in the study but were excluded from analysis due to fussiness (8 infants), equipment failure (2), experimenter error (1), missing data (6) and one child had to be excluded due to a previously unknown clinical condition.

3.1.2. Design

Each testing session consisted of three phases: (1) Manipulation & Understanding phase, (2) Affiliation Test phase and (3) Production Test phase with caregiver.

In Phase 1 – Manipulation and Understanding - we implemented two conditions in a within-subject design (Tease condition and Play condition). Each infant participated in three teasing games and three comparable playful games; with 6 trials per game. Similarities and differences of the two conditions are summarized in Table 4. To convey the teasing versus playful intention, we used specific gaze behavior, smile features, contingency between experimenter's and infant's actions as well as vocalization cues. The specification of these features were based on previous studies which analyzed parents' communicative cues when engaging in humorous behavior (Hoicka, 2016), like infant directed speech, smiling, gazing (Hoicka, 2016; Hoicka and Gattis, 2012; Lillard et al., 2007), question intonation (Hoicka and Gattis, 2012) and exaggerated action and sound (Lillard et al., 2007; Lillard and Witherington, 2004). We measured smile duration, fussiness duration and number of laughs.

In Phase 2 – Affiliation Test – infants had one single trial to choose with which experimenter they would prefer to play: The Teaser or the Player. We measured first choice, time spent with each experimenter, and communicative attempts with each of the experimenters.

In Phase 3 – Production Test with caregiver – we provided the infant with five possibilities to tease his or her caregiver with games similar to the ones in Phase 1. We measured the number of teasing attempts by infants.

The order of presentation of the games in phase 1 was counterbalanced within each age group. Starting condition (Tease or Play) was counterbalanced. The role of Teaser and Player were counterbalanced between the two experimenters between infants, as well as the side on which the teaser sat in relation to the infant and which of the experimenters would support the child in the production phase.

Table 4
Condition features for the play and the tease conditions.

Feature	Play condition	Tease condition
Facial expression	Smile, happy, throughout	Teasing smile, eyebrow-movements, contingent on action
Gaze	Alternate between object and infant	Mostly on infant, look at infant always after teasing action
Vocalization	Funny sound effect, continuous	Rising intonation to create tension, taking the object away is stressed by vocalization
Timing/ Contingency	Continuous movement	Contingent on infant's action

3.1.3. Material and set up

Phase 1 – Manipulation and understanding. The room was equipped with three carpets: two red carpets for the manipulation phase, one light grey carpet for the production phase.

For phase 1, infants sat on a marked position, the caregiver was seated behind the infant to constrain the child's movement. E1 and E2 were sitting on marked positions opposite the infant position at 1,5 m distance to each other (see Fig. 4). Next to the parent, a small box was provided to put away the toy after each trial.

The two experimenters were well differentiated by the color of their T-shirts and their appearance. Five video-cameras filmed infants' and Es' faces and the infants' looking behavior.

In the Manipulation and Understanding phase, we used three different games:

Game 1: "Offer-Withdraw": The infant was offered 12 small and simple objects suitable for infants, like blocks, dolls, and cars (see Appendix A for picture).

Game 2: "Rattle Can": We used a decorated can and wooden cubes. The can was hold out for the infant to put in a wooden cube. The can produced a funny noise when cubes rolled into it (see Appendix A for picture).

Game 3: "Sticky Stick". We used a wooden stick with a magnet at the end. 12 colorful magnets were offered with this stick by the experimenter to the infant to take the magnet (see Appendix A for picture).

Phase 2 – Affiliation test. Caregiver and infant were positioned on a marked spot in the middle of the room equidistant to both experimenters (see Fig. 5). Both experimenters hold a "treasure box" to attract the infant's attention (see Appendix 1 for picture).

Phase 3 - Production test with caregiver. Caregiver, infant and one experimenter were located at the rear part of the room. One experimenter accompanied the infant (role of experimenter was counterbalanced) and helped with the objects. The caregiver sat opposite the infant (see Fig. 6).

3.1.4. Procedure

Warm up. Each testing session started with a free play phase in the warm-up room with both experimenters. This phase ended when the infant seemed to be comfortable with both experimenters as displayed by smiling at them and handing over objects. While one experimenter – the Teaser - played with the infant, the other experimenter – the Player – informed and instructed the caregiver about the first two phases of the study. This was done to show children that the Teaser can also play normally, so that the teasing later in the study is not perceived as peculiar characteristic of this specific person but as intended behavior.

For phase 1, the caregiver was instructed to move the infant from one position to the other, to make sure it would be properly seated and stay on the marked position. The caregiver was instructed to get rid of the object obtained by the infant at the end of each trial to start the following one. The caregiver should remove the objects after some time for exploration and put it into a small box next to him or her. Furthermore, the caregiver should react minimally to engagement attempts of the infant and refrain from any emotional displays or remarks about the interaction between infant and experimenter (especially, not talk or laugh).

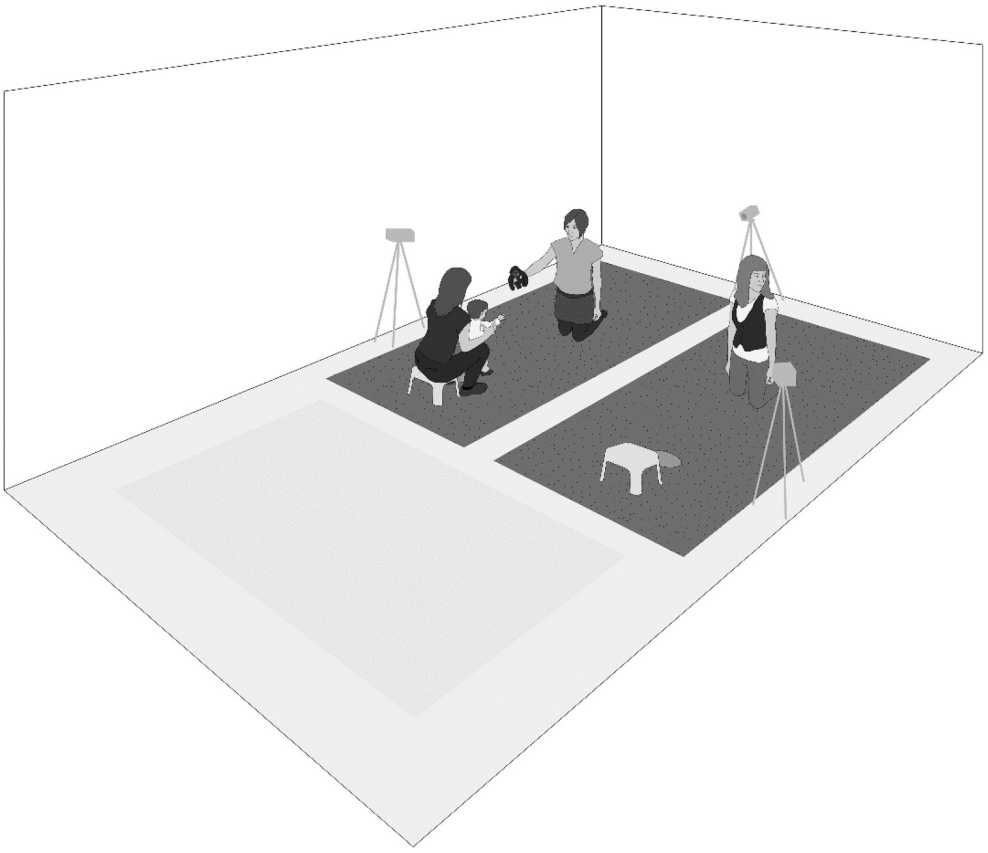


Fig. 4. Set up for the manipulation and understanding phase.

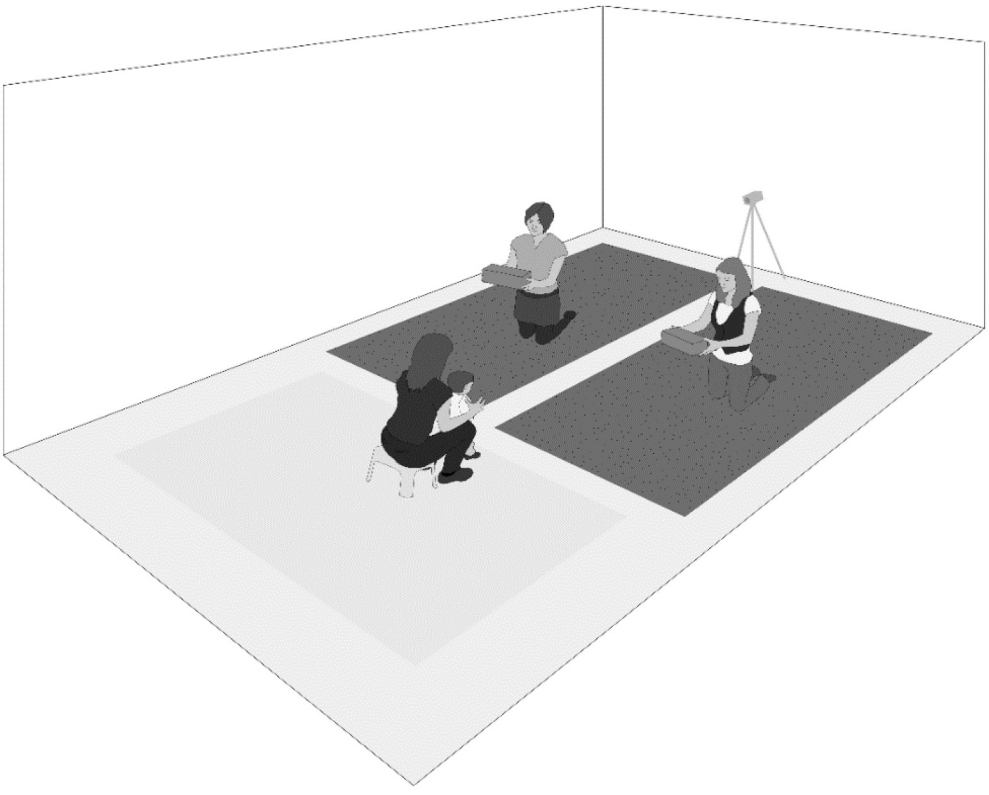


Fig. 5. Set up in the affiliation test phase.

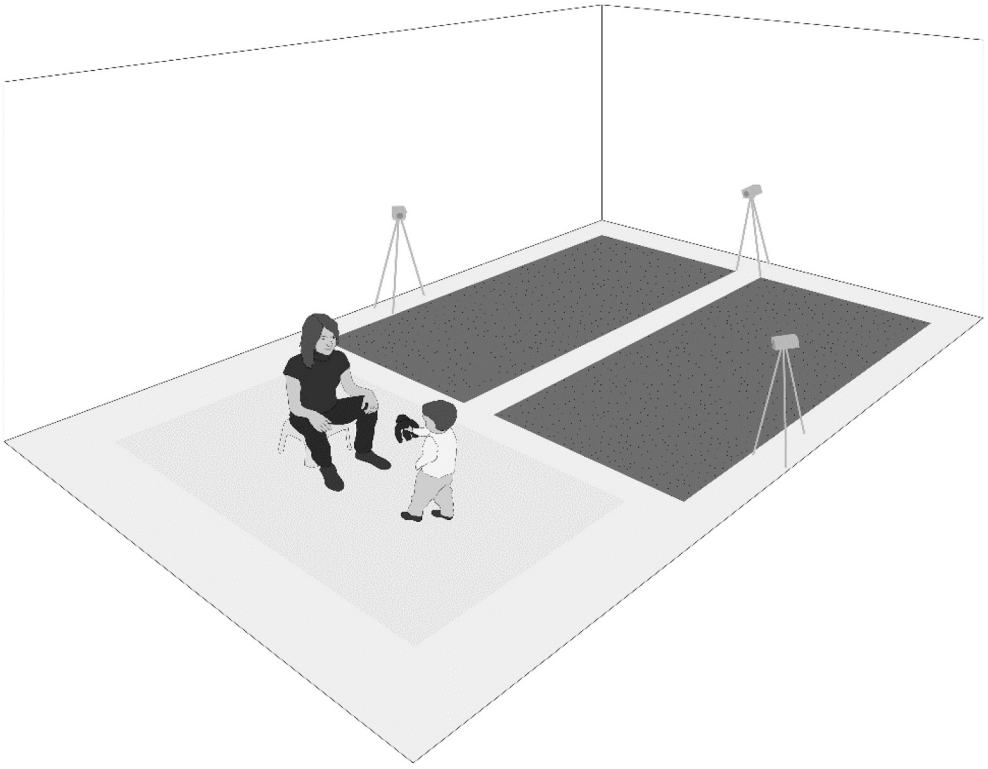


Fig. 6. Set up in the production test phase.

For phase 2, the caregiver was instructed to wait for a cue of the experimenter who was the Player in this testing session and upon this cue the caregiver should go with the infant to a marked spot on the third carpet, position the infant there and hold it until getting a cue (both experimenters simultaneously lift the boxes) to let the infant go freely by saying "Well, go, have a look!" Then, the experimenters switched and the Player played with the infant and the Teaser informed and instructed the caregiver about the third phase of the study.

For phase 3, the caregiver was asked to play each of the games of phase 1 with the infant. The caregiver was asked to start and immediately tease the infant for three rounds to put the infant in a teasing disposition. We modelled the teasing behavior (offer and contingent withdrawal) and trained the teasing cues (vocalization, smile and raised eyebrows, rising intonation) with the caregiver. The caregiver should then give the objects to the infant, encouraging her with "Now it is your turn!" He should then stretch out one hand to request the object/ball without a verbal request. When the infant offered an object, the caregiver should reach for the object very slowly to give the infant more time to withdraw the object. This slow reaching movement was also trained with the caregiver. If the infant teased, the caregiver was instructed to react strongly and excited about the very funny action. After the instruction was finished and the infant acquainted with both experimenters, the caregiver, the infant and the experimenters moved to the testing room.

Phase one: Manipulation and understanding. The infant started playing at one of the two red carpets according to a counterbalancing schedule. The corresponding experimenter Teaser or Player made sure the infant was seated properly and engaged the infant by calling her name "[Name of infant], look here!" and proposed the first game.

Game 1: "Offer and Withdraw". The first game was a typical offer-withdraw game with 12 simple and interesting objects (blocks, dolls, cars) which the experimenter offered to the infant by hand (see Fig. 4). In the Play condition, the Player offers the toy and hands it over with a long curved movement. In the Tease condition, the Teaser offered and withdrew the object two times before handing it over. After some time for exploration, the caregiver put the toy away and the experimenter started the next trial. The same structure was used for game 2 and 3. The structure was equal for both conditions, i.e. both experimenter roles. Each condition encompassed six test trials and six filler trials. Filler trials were alternated with test trials to keep motivation up and to lower predictability.

A filler trial was initiated by the corresponding experimenter calling the infant's name: "[Name of infant], look here! – a [object label]!" [smiling]. The experimenter offered a toy moving it towards the infant in a direct line and accompanied the movement with a vocalization in rising intonation (to create tension). When the infant reached for it, the experimenter simply handed it over.

A teasing trial was initiated by the Teaser calling the infant's name: "[Name of infant], look here! – a [object label]!" [smiling]. The teaser offered a toy moving it towards the infant and accompanied the movement with a vocalization in rising intonation (to create tension). When the infant reached for the toy, the Teaser pulled it back in a teasing fashion with a cheeky smile, eyebrow raise and a special sound with rising intonation ('ah!').

A playing trial was initiated by the Player calling the infant's name: "[Name of infant], look here! – a [object label]!" [smiling]. The Player offered a toy moving it towards the infant in a curved line (to equate the time it takes until the infant finally gets the object) and accompanied the movement with a playful vocalization in non-rising intonation (continuous sound effect). The Player made five curves along the way and looked up twice with a happy smile. When the infant reached for the toy, the Player handed it over.

After this first round, the caregiver brought the infant to the other red carpet and made it sit properly. Then the infant was engaged by the other experimenter in the same game in the remaining condition.

Game 2: "Rattle Can". The caregiver gave the infant small wooden cubes which the infant could put into a tin can. The experimenter manipulated the movement of the tin can towards the infant.

Game 3: "Sticky stick". The experimenter offered little magnetic objects with a magnetic stick.

Phase two: Affiliation test. After the infant had played the three games with both experimenters, caregiver and infant went to the marked position on the third carpet (white line, see Fig. 5). Each of the experimenters put out a small treasure box sitting on the carpet (market position, same distance from infant).

According to a fixed script, experimenters opened the boxes simultaneously, gazed inside and expressed their excitement about the content. They alternated gaze between content of box and infant, saying "Oh! Wow! Look there!" Then, they simultaneously lifted the boxes (which was the cue for the caregiver to send the infant by saying "Well, go, have a look!") The experimenters continued to wonder at the box until the infant started walking or crawling in their direction. As soon as the infant started moving, they stopped vocalizing and gazing at the infant and only continued silently to wonder at the content of the box. When the infant communicated with one experimenter, this experimenter reacted minimally but naturally (i.e. repeated what the infant said and smiled acknowledgingly). The phase stopped when the infant returned to her caregiver.

Phase three: Production test. For the next phase, the infant and the caregiver moved to the light colored carpet on marked positions (see Fig. 6). The caregiver received a prepared toy box. For phase 3, the caregiver was asked to play each of the games from phase 1 with the infant. The caregiver was asked to start and immediately tease the infant for three rounds to put the infant in a teasing disposition. We modelled the teasing behavior (offer and contingent withdrawal) and trained the teasing cues (vocalization, smile and raised eyebrows, rising intonation) with the caregiver in the warm up room. The caregiver should then give the objects to the infant, encouraging her with "Now it is your turn!"

For each game, the infant had five opportunities to tease. The caregiver scaffolded the interaction by stretching out his hand as if requesting and smiling. When the infant offered the object, the caregiver reached for the object very slowly to give the infant more time to do any teasing, i.e. withdraw the object. If the infant was hesitant to engage in the interaction the experimenter who was sitting next to the infant would encourage the infant to give by saying "OK, go ahead!" In case of a teasing attempt, caregivers were instructed to react strongly and show their excitement about this very funny action.

3.2. Results

3.2.1. Coding and reliability

Proportion of Smile Duration was coded as the amount of time infants smiled per each trial and the total length of each trial to calculate the proportion of time infants spent smiling. A smile was defined as in Experiment 1: Social smile was coded when the infant's smile or laugh was clearly directed towards the experimenter during the interaction, and expressive of enjoyment. The eyes and mouth of the infant had to be clearly visible (e.g. infant was not using a pacifier), with an upwards movement of the corners of the mouth, and the gaze was clearly directed towards the experimenter. Vocalizations, when present, were also used as further confirmation of the infant's enjoyment.

Proportion of Games in which infants smiled more in the Tease condition than in the Play condition. We coded for each trial whether the proportion of smile/total trial duration was higher in the Tease than in the Play condition. If the smile proportion was higher, we coded 1, if it was equal or lower, we coded 0. Then we calculated a proportion of these values of the three games for each infant. This yielded a scale between 0 and 1 with the scores of 0, 0.33, 0.66 or 1.

Proportion of Fussing Duration was coded as the amount of time infants were fussing per each trial and the total length of each trial to calculate the proportion of time infants spent fussing. Fussing was defined as all signs of distress, trying to get away and being away from the designated place (red cushion). Vocalizations, when present, were also used as further confirmation of the infants being disquiet.

Number of laughs was coded in addition to smile. Laughter was defined as smile plus typical vocalization. Occurrences of laughs were counted.

Affiliation was measured in two ways: (1) which experimenter the infant approached first (First Choice) and (2) we measured how much time each infant spent with each of the experimenters (Duration of Contact). Coding started when infants passed the marking on the carpet and ended, when they turned away for more than seven seconds.

Production. There were hardly any production events to be observed.

Reliability. All data of this study were coded by two independent coders blind to the hypotheses of the study. It was decided a priori that the data of Coder 1 would be used in cases of disagreement. Inter-observer reliability was determined by calculating intra-class correlation coefficients (ICC; Ranganathan, Pramesh, and Aggarwal, 2017) between the two data sets for smile duration (ICC = 0.998), number of laughs (ICC = 0.937), fussiness duration (ICC = 0.967) as well as duration of contact (ICC = 0.957). Inter-observer agreement was excellent for these parameters. First Choice was controlled by calculating Cohen's kappa ($\kappa = 0.871$, $p < .001$) and was also almost perfect.

3.2.2. Data analysis

Data and analysis are available for open access under (Colle et al., 2022).

Power analysis. To determine the power of the study, we used GPower (Version 3.1.9.7.). With an assumed large effect size of 0.4 (based on the large effect $\eta^2 = 0.14$ of the main measure in Study 1), and an alpha-level set at 0.05, our sample size of 50 dyads in three groups and two conditions (tease vs. play) yields the following parameters for a repeated measures ANOVA: Critical F: 3.19; Power: 0.99.

Controlled factors. First, we ran a GLM on our main measure – smile duration - with the control variables game (trial 1–3) and teaser_person (i.e., which of the two experimenters acted in the role of the teaser) and our factors of interest, age and condition, to check for potential influence of the controlled variables. The test shows a significant main effect of game ($F(2) = 6.91$, p 0.001, $\eta^2 = 0.46$), but no interaction of game with either condition or age (Game x Age: $F(4) = 0.41$, $p = .80$, $\eta^2 = 0.006$, Game x Condition: $F(2) = 0.41$, $p = .66$, $\eta^2 = 0.003$). That means that infants generally enjoyed the games to different degrees but effects for age and condition were in the same direction in all games.

The factor teaser_person was not significant ($F(1) = 1.9$, $p = .17$, $\eta^2 = 0.007$) and did also not interact with one of the independent variables (Teaser_Person x Age: $F(2) = 1.16$, $p = .32$, $\eta^2 = 0.01$, Teaser_Person x Condtion: $F(1) = 0.92$, $p = .34$, $\eta^2 = 0.003$).

Overall proportion of smile duration. We collapsed all trials of one condition for each child. We used a Repeated Measures ANOVA with condition as within-subject factor and age as between-subject factor. There was a significant Condition x Age interaction ($F(2) = 3.33$, $p = .044$, $\eta^2 = 0.124$) as well as main effects of condition ($F(1) = 38.54$, $p < .001$, $\eta^2 = 0.45$) and age ($F(2) = 9.13$, $p < .001$, $\eta^2 = 0.28$). As becomes clear from inspection of the data, the interaction is due to the bigger difference between the conditions in the older infants. But in all age groups the proportion of smile per trial is higher in the Tease than in the Play condition (see Fig. 7).

We followed up the interaction with post-hoc pairwise comparisons of each age group, α-level corrected with the Benjamini-Hochberg procedure (p_{BH}), see Table 5.

Proportion of number of games in which infants smiled more in the Tease condition than in the play condition. An infant could have a high overall proportion score by just smiling a lot in only one of the games or it might have a high score by smiling a little bit in each of the games. To be sure that infants reacted to the teasing consistently and understood it as a positive interaction, we additionally looked at this measure. We calculated the proportion of those games per infant in which the proportion of smile/total trial length was higher in the Tease than in the Play condition, that is, each infant could get a score of either 0, 0.33, 0.66 or 1, see Fig. 8.

We then calculated a One-way ANOVA with Age as between-subject

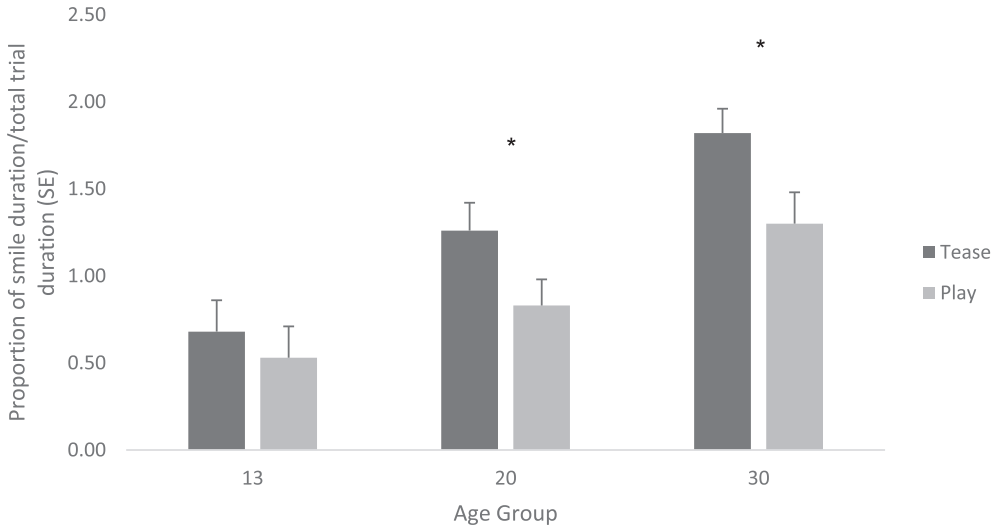


Fig. 7. Proportion of smile duration (s) per condition. Duration collapsed for three trials per child. Maximum value is 3. Main effects of age and condition were found. Standard errors are represented in the figure by the error bars attached to each column. Asterix (*) denotates differences at a corrected 95% alpha-error level.

Table 5
Posthoc pairwise comparisons (Tease vs. Play) of smile duration for each age group with repeated measures ANOVA.

Age group	F	p	p_{BH}	η^2	Power
13 months	3.21	0.09	0.09	0.19	0.39
20 months	25.42	<0.001	0.002	0.61	>0.99
30 months	17.46	0.001	0.002	0.51	0.98

Note: p_{BH} denotates the p-value corrected for multiple testing with the Benjamini-Hochberg-Procedure.

factor (F(2) =1.13, $p = .33$). Infants in all age groups to the same amount were likely to smile more in the teasing than in the playing trials. However, when compared to chance (50%), only for the 20- and 30-month-old infants was the difference higher than expected by chance (One-Sample *T*-Test; Age 13 months: $t = 1.62$, df = 14, $p = .13$; Age 20 months: $t = 5.58$, df = 16, $p < .001$; Age 30 months: $t = 4.61$, df = 17, p < .001).

Overall proportion of fussing duration. As counterpart of smiling and as a sign of possible distress due to the mean part of teasing interactions, we measured children's amount of fussiness in proportion of time per trial. We collapsed all trials of one condition for each child. We used a Repeated Measures ANOVA with condition as within-subject factor and age as between-subject factor. There was neither a significant Condition x Age interaction (F(2) = 0.97, $p = .39$, $\eta^2 = 0.04$) nor any main effects of Condition (F(1) =0.003, $p = .96$, $\eta^2 < 0.001$) or Age (F(2) =0.56, $p = .58$, $\eta^2 = 0.02$; see Fig. 9). Thus, there is no evidence that infants perceive the teasing interaction as more or less stressful than the playful interaction.

Number of laughs. Laughter is an even stronger affective reaction than smile and we wanted to explore whether infants laugh more in the Tease condition than in the Play condition across all age groups.

We related number of laughs to trial duration. These relations were collapsed per child over all three trials. Data were not normally distributed, since laughing was much less prominent, especially in younger infants. We log-transformed (ln(x + 2)) data to account for skewness and outliers. We used a Repeated Measures ANOVA with condition as within-subject factor and age as between-subject factor. There was a significant Condition x Age interaction (F(2) =4.67, $p = .014$, $\eta^2 = 0.17$) as well as main effects of Condition (F(1) =14.62, p <

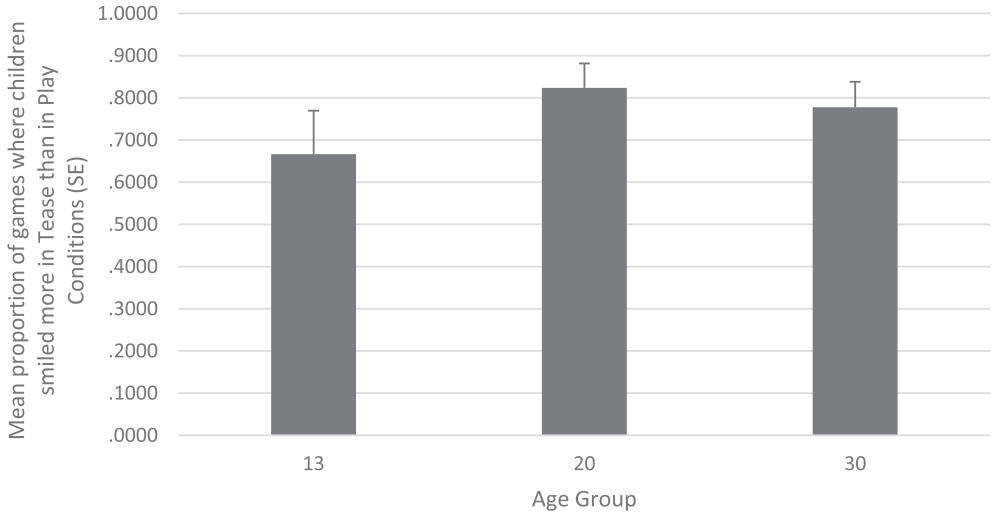


Fig. 8. Proportion of games in which infants smile more in the Tease than in the Play condition. No effect of age was found. Standard errors are represented in the figure by the error bars attached to each column.

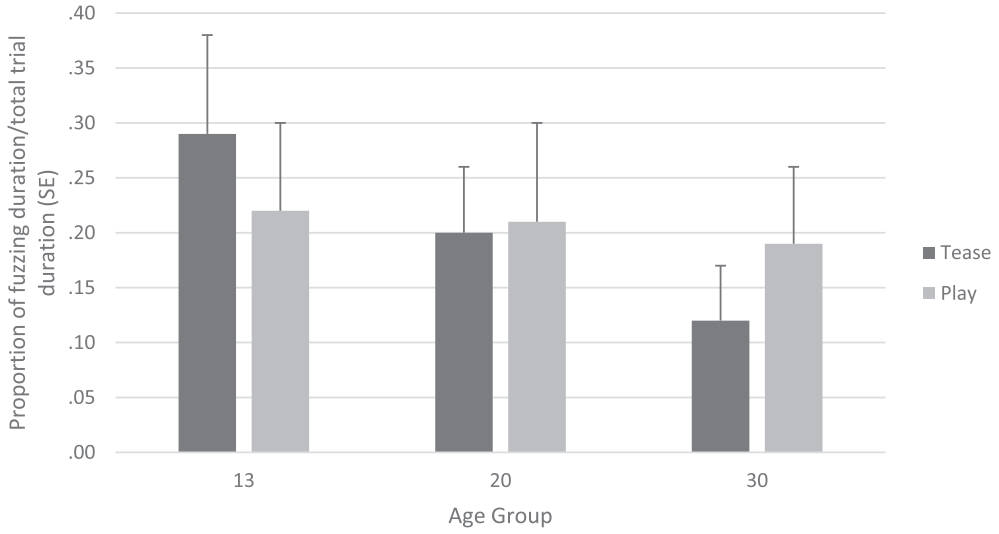


Fig. 9. Proportion of fussing duration (s) per condition. Duration collapsed for three trials per child. Maximum value is 3. No effects of age and condition were found. Standard errors are represented in the figure by the error bars attached to each column.

.001, $\eta^2 = 0.24$) and Age ($F(2) = 3.22$, $p = .049$, $\eta^2 = 0.12$). As becomes clear from inspection of the data, the interaction is due to the bigger difference between the conditions in the oldest age group. But in all age groups the number of laughs across all trials is higher in the Tease than in the Play condition (see Fig. 10). We followed up the significant interaction with post-hoc pairwise comparisons of each age group, α-level corrected with the Benjamini-Hochberg procedure (p_{BH}), see Table 6. There are tendencies for the younger age groups, but only for the 30- month-olds the group-wise comparison reaches significance at the 0.05-level.

First choice. In the second phase of the study, infants had the opportunity to share interesting information with one or both experimenters. We measured which person the infant approached first and then how long she stayed with each of the experimenters. Three infants had to be excluded because they made no choice at all. For the remaining infants we ran a Chi-Square-test (χ^2) for independent samples. It showed no effect of experimenter ($\chi^2(1) = 1.064$, $p = .30$, Cramer's $V = 0.21$).

Table 6
Posthoc pairwise comparisons of number of laughs for each age group with repeated measures ANOVA.

Condition pair	F	p	p_{BH}	η^2	Power
13 months					
Tease vs. Play	3.12	0.10	0.10	0.18	0.38
20 months					
Tease vs. Play	3.27	0.09	0.10	0.17	0.40
30 months					
Tease vs. Play	10.69	0.005	0.015	0.39	0.87

Note: p_{BH} denotates the *p*-value corrected for multiple testing with the Benjamini-Hochberg-Procedure.

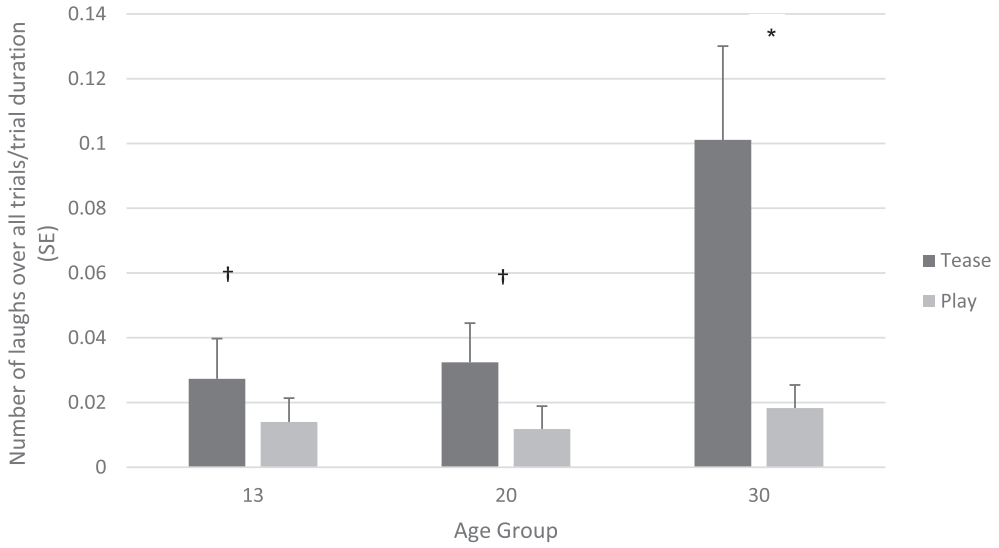


Fig. 10. Number of laughs related to trial duration over all trials per child. Main effects of age and condition and a significant Age x Condition interaction were found. Standard errors are represented in the figure by the error bars attached to each column. Asterix (*) denotates differences at a corrected 95% alpha-error level; crosses (†) indicate significance at a corrected 90% alpha-error level.

Total affiliation time. For the time spent with each of the experimenters (Teaser and Player) we used a Repeated Measures ANOVA with age as between-subject factor. There was neither an interaction of Experimenter x Age ($F(2) = 0.53$, $p = .59$, $\eta^2 = 0.024$), nor a main effect of experimenter ($F(1) = 0.735$, $p = .396$, $\eta^2 = 0.016$). Also age as between-subjects factor was not significant ($F(2) = 1.76$, $p = .138$, $\eta^2 = 0.074$; see Fig. 11).

3.3. Discussion

Experiment 2 more rigorously evaluates infants' ability to understand and enjoy teasing interactions as based on a complex social intention which is different from purely playful interactions. In Experiment 1, comparing teasing to two conditions which were not playful (Refusal, Clumsy) even the 12-month-old infants showed a tendency to smile more in the Tease condition than in the Clumsy condition.

In Experiment 2, results for the 13-month-old infants, however, are inconclusive. There is a tendency that they smile more in the Tease than in the Play condition. However, the proportion of games in which infants smile more in the Tease than in the Play condition was hardly different from chance for this youngest age group. The number of laughs (weighed by trial duration) also shows a tendency for more laughing in the Tease condition, but only at the 90%-level. These results need to be treated with care and need corroboration by future studies.

For the 20-month-old infants, the picture is quite clear: We find a significant effect of smile duration with infants smiling more in the Tease than in the Play condition, as expected. Also, the proportion of trials in which infants smile more in the Tease than in the Play condition is significantly different from chance. The number of laughs shows a tendency to be higher in the Tease than in the Play condition.

For the 30-month-old toddlers, our findings are strongest with highly significant differences in all measures (smile duration, number of trials where infants smile more in the Tease than in the Play condition, and number of laughs) which indicate enjoyment of the teasing interaction.

These results suggest that teasing enjoyment increases with age. Moreover, infants' greater enjoyment in the teasing interaction was also confirmed by the number of laughs, which can be considered a stronger and less ambiguous measure of social enjoyment. These findings corroborate the hypothesis that infants from as early as 13 months of age to some extent distinguish between and react differently to different types of positive social interactions. From 20 months of age, it can be securely assumed, that infants enjoy teasing not only because of the accompanying emotional cues but also because of its specific dual nature (provocative contingent action + positive ostensive emotional cues).

A second goal of this experiment was to assess the affiliative effect of teasing in establishing new relationships. Unexpectedly, we could not find any effect of the type of previously experienced interaction (teasing or playing) on infants' subsequent affiliation in a forced choice task. Based on the theoretical considerations, we expected infants to spontaneously prefer the teasing experimenter as a partner for sharing interesting information. This was not the case in our experimental design. In the literature, humor and teasing have been proposed to serve as bonding mechanisms, creating in-group feelings and enhancing intimacy by its playful but risky nature and its reference to common ground (Benson and Haith, 2010; Eisenberg, 1986; Reddy and Mireault, 2015). We see three different possibilities for why we could not see an effect of teasing on preferring one experimenter over the other in our study: First, it might be that the Play condition with its equally joyous nature in terms of fun, gaze and smile by the experimenter was too strong a competitor for fostering a novel relationship. Second, it might be that the length of interaction with the experimenters was not sufficient for the infant to develop differential preferences. And third, it is also possible that the type of affiliation test that we used was not apt to show the type of relationship advantage that teasing produces. For example, if intimacy is the major aspect which is enhanced by teasing, rather children's propensity for bodily contact could be enhanced.

Concerning infants' production of teasing with their caregiver, we could hardly observe any instances. Concerning the lack of teasing production in our experiment, it remains an open question what are the exact preconditions for infants to engage in active teasing. From observation we know that they do use newly acquired behaviors (Reddy and Mireault, 2015). But they also need a safe environment to engage in such an intimate behavior as teasing and our laboratory might not have provided the right kind of safe and familiar environment. This might be the reason why playful teasing occurs mainly with parents and close friends (Buhrmester and Furman, 1987; Reddy and Mireault, 2015). Dense observational data is needed to determine the contexts and preconditions as well as the effect of teasing production in infancy.

4. General discussion

In the present study, we set out to investigate the understanding (and the production) of teasing in early infancy, as well as the influence of teasing interactions on a novel social relationship. We designed two

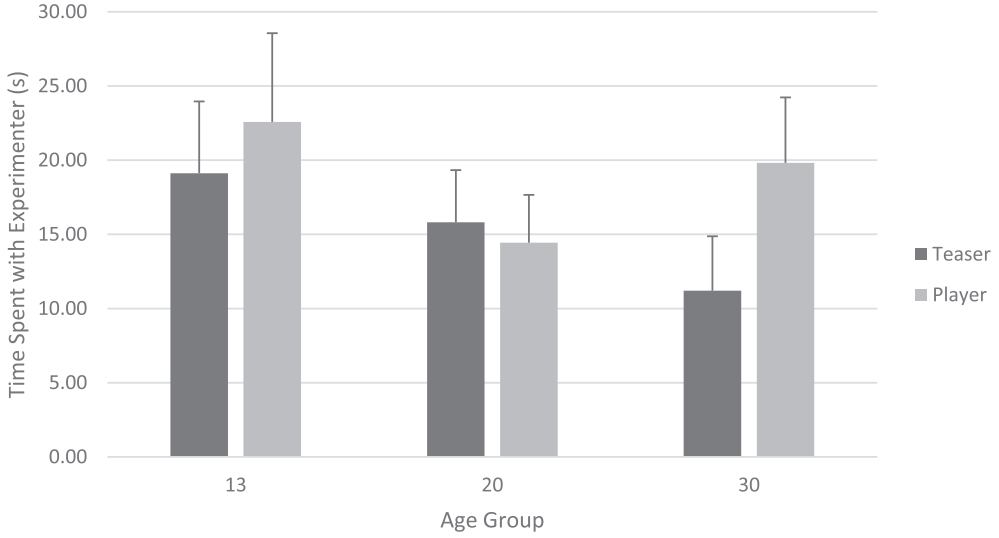


Fig. 11. Time spent with each of the experimenters (in seconds). Standard errors are represented in the figure by the error bars attached to each column. No statistically significant difference could be found.

sequential experiments: In Experiment 1, we re-coded and re-analyzed the data by Behne et al. (2005) to explore infants' differential understanding of different types of intentions including teasing. In Experiment 2, we created a more fine-grained comparison to test infants' appreciation of teasing over and above other purely playful interactions. In this second experiment, we also tested the effect of a teasing interaction on a novel social relationship and provided infants with the opportunity to tease their caregiver.

In experiment 1, we found that the three groups of infants, age range 9–18 months, showed clearly differential reactions to the three different conditions tested. From 9 months on, infants reached longest in the Tease condition, a bit less in the Clumsy condition and least in the Refusal condition. At the same age, they also looked longer to the experimenter in the Refusal condition than in the other two conditions.

The more specific reaction of joy as expressed in the smile duration measure, in contrast, showed a developmental trend as shown in a significant interaction between condition and age. For the younger infants (9 and 12 months), smile duration is not significantly different between either condition pair (although there is a tendency for a significant difference between the Clumsy and the Tease condition). While we cannot rule out a lack of power as the cause for the null-result in the 9- and 12-month-old infants, for 18-month-old infants we can present evidence for enjoying the teasing interaction: Differences between Tease and Clumsy condition show a trend (corrected $p_{BH} = 0.09$) and differences between Clumsy and Refusal as well as Tease and Refusal conditions were significant. In essence, our results suggest a developmental pattern with infants from 9- to 18 months becoming increasingly able to discriminate teasing from other kinds of social interactions, and thus better able to enjoy teasing (as measured by smile duration) and to get involved in it (as measured by reaching duration).

In Experiment 2 – comparing the enjoyment of a teasing interaction and a purely playful interaction – we also found a developmental pattern: For the 13-month-old infants, results show some tendency, but were inconclusive and have to be treated with care. In the older age groups—at 20 and 30 months—there are clear signs that toddlers enjoy teasing more than a simpler playful interaction as shown by greater proportion of smiling in the Tease trials, with 30-month-old toddlers showing a greater difference in smile duration and number of laughs than the two younger groups.

The affiliation test showed no effect of the type of interaction (teasing or playing): Infants approached both experimenters with equal likelihood. Additionally, as an explorative attempt, we gave infants the opportunity to produce with their caregiver the teasing action they had just perceived as recipient. Unexpectedly, we could hardly observe any teasing instances in this phase. Possible reasons for these unexpected results are discussed in the discussion section of Experiment 2.

4.1. Theoretical implications

Teasing has been construed as being based on a complex cognitive architecture because the recipient has to weigh action or content against accompanying markers, taking into account the context, shared knowledge and the specifics of the relationship (Haugh, 2017). According to this view, an individual who engages in teasing needs an awareness of shared knowledge of social rules and routines, and of mutual social expectations; plus, the skills to playfully exploit these expectations for a communicative purpose. In its most basic form, at least, infants have to be able to process the contradicting behavioral and social-communicative cues. It is the back and forth of mutual expectations, assumptions and trust in prosocial motives which gives the teasing episode the power to foster affiliation and create intimacy in a social relationship.

Despite this complexity, teasing is ubiquitous in adult-infant-interactions in many cultures, and very little is known about its development and early social functions. Empirical data is scarce and comes mainly from observational studies which makes it difficult to draw conclusions about the involved cognitive complexity (Trevarthen, 1990; Hubley and Trevarthen, 1979; Reddy, 1991, 2001; App. B).

The two experiments in the present study show evidence that from around their first birthday, infants do differentiate teasing interactions from other intentional actions (Experiment 1) and from at least 20 months they enjoy it more than simpler forms of playful interactions (Experiment 2). The latter is a more sophisticated distinction and shows the growing competence of children to process multiple – even contrasting cues – in social interactions. They appreciate the dual nature of teasing – comprising of a provocative contingent action and positive ostensive emotional cues – over and above a purely playful action with likewise positive cues but no provocative contingent action. These findings are in line with prior observational (Reddy, 1991; Reddy and Mireault, 2015) and experimental (Nakano and Kanaya, 1993) studies. Our study, however, is the first to demonstrate this positive effect of teasing with a stranger (experimenter teasing the infant).

From a theoretical perspective, the findings of our study are especially interesting concerning intention understanding. Differentiating the Tease from the Refuse condition in Experiment 1 goes over and beyond goal-directed action understanding: On that interpretation level, a child might merely perceive both actions as "the person doesn't want to give me the object". However, children do differentiate between these two conditions already by 9 months of age. That means they interpret the goal of the interaction partner on a more complex level and process behavioral cues as well as ostensive cues like gaze, facial expression and intonation. A nascent understanding of the teasing intention as being one to create a joyful interaction is evident by 18 months at the latest.

These findings are generally in line with the findings on early intention understanding showing infants' emerging competence in ascribing and distinguishing different types of intentions from as early as five – seven months (Luo and Baillargeon, 2005; Mahajan and Woodward, 2009) and more robust skills at 14–18 months (Behne et al., 2005; Carpenter et al., 1998; Johnson et al., 2001; Moses et al., 2001; Woodward, 1998). But it complements these findings in demonstrating young infants' skills to process more and more complex social interactions by integrating multiple behavioral and ostensive cues – in the case of teasing even if they seem to be contradictive like a slightly threatening action and ostensive play signals (Nakano and Kanaya, 1993). Teasing is a complex social intention and evidence of its understanding in infants and toddlers strengthens rich accounts of infant and toddler social cognition (Liszkowski et al., 2004; Tomasello and Carpenter, 2007).

With the effects getting more robust and stronger by 20 to 30 months of age (as evident in the results of children's laughter), the emergent understanding of teasing goes hand in hand with the understanding of other contrastive information like false belief, pretense or lying – other complex social intentions-, which have been shown to emerge at 18 months at the earliest (Buttelmann, Carpenter, and Tomasello, 2009).

In adults, teasing can serve a variety of diverse social functions, such as fostering interpersonal relationships and in-group solidarity (Blythe, 2012; Boxer and Cortés-Conde, 1997; Haugh, 2010; Straehle, 1993), creating intimacy and bonding (Eder, 1991; Eisenberg, 1986). It is this contrastive nature of the tease that makes it difficult to understand but also effective for social interaction. However, our data do not confirm these social functions for young infants. In our affiliation test, the previous teasing seemed to have no positive effect on the infant's choice of which experimenter to approach. Thus, it could be, that the relationship enhancing effect in teasing is much less pronounced than expected – at least with newly met persons. However, since this is the first study that tried systematically to carve out one of the social functions of teasing and also the first study to do so in interactions with a stranger – there remain a multitude of possible factors bearing on this result (see discussion of Experiment 2). More observational and experimental research is necessary to pin down the social functions of teasing in adult-infant-interaction.

Research on teasing production in infancy is scarce and little is known about the specifics of when, how and where infants tease. From

parental reports and occasional observations by researchers we know that infants do tease from as early as 9–12 months by offering and withdrawing objects, showing off with noncompliance or ostensible disrupting the ongoing interaction. In these acts, infants are showing the beginnings of deliberate violations of norms and socially agreed meanings (Reddy, 1991; Reddy and Mireault, 2015, App. 2). Unfortunately, with the present study we could not contribute much to the exploration of teasing behavior produced by infants. Except for the insight that it is not easy to observe teasing at this young age under laboratory conditions. Even in naturalistic settings, with in-home observation, not many teasing episodes have been caught on camera. Most of the infant produced teasing described so far, has been reported by parents. This is not surprising since teasing is a risky endeavor and thus is most likely to happen off camera and at times of heightened interaction and emotionality and in a familiar and safe environment in the absence of strangers.

4.2. Limitations and future directions

A disadvantage of the presented experimental paradigm is the decreased ecological validity of controlled situations. Children were confronted with unnatural situations in unfamiliar places and with strangers as conversational partners. Such adverse circumstances might lead to a suboptimal demonstration of their true abilities or even let them exhibit untypical behaviors. We have designed the experiments in a way which as closely as possible models a real-world situation without losing the possibility of controlling the factors under consideration. Nevertheless, in the case of teasing, the mere fact that families have to leave their home and infants (who in this developmental period might be especially shy with strangers) have to interact with strangers might distort the results as discussed above.

Since the sample consisted solely of German children, more specifically from an urban setting, it is not a foregone assumption that these results are valid for children form different cultures or from rural settings. Cross-cultural validation would be necessary to justify a broader generalization.

Ethics statement

The experiment was performed in accordance with the ethical standards laid down in the Declaration of Helsinki. The study was approved by the ethics committee of the Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany. It was carried out with the written informed consent of the infants' parents, and in accordance with all applicable laws and rules governing psychological research in Germany.

Access to data

Data and analysis are available on OSF via the following link: https://osf.io/7r4h2/?view_only=168d5f0e226d4f5e9114cf5161c7ca50

Author note

We have no conflicts of interest to disclose.

CRediT authorship contribution statement

Livia Colle: Conceptualization, Data curation, Writing- Original draft preparation. **Gerlind Grosse:** Conceptualization, Methodology, Investigation, Writing – review & editing, Data curation, Formal analysis. **Tanya Behne:** Conceptualization, Data curation. **Michael Tomasello:** Supervision, Resources.

Funding

The first author Gerlind Grosse received funding in form of a postdoc stipend from the Max Planck Society, Germany.

Data availability

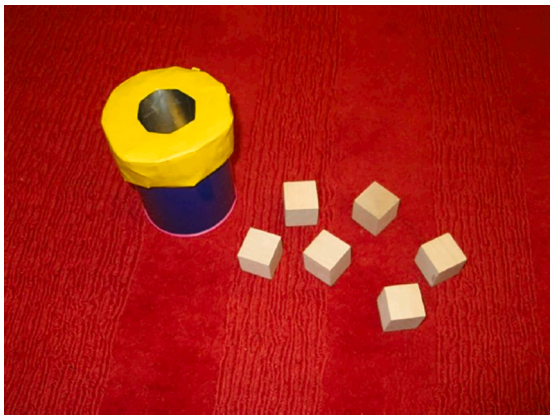
Data and analysis are available for open access under (Colle, Grosse, Behne, and Tomasello, 2022).

Acknowledgements

We would like to thank Angela Lohse, Antonia Misch, and Isabelle Lehn for help with data collection and coding, and Roger Mundry for statistical advice. Finally, we thank all the children and their parents for participating.

Appendix A. Material

Appendix Fig. 1. Materials for the "Offer & Withdraw" game.



Appendix Fig. 2. Materials for the "Rattle Can" game.

Appendix Fig. 3. Materials for the "Sticky Stick" game.

Appendix Fig. 4. Treasure boxes for affiliation test phase.

Appendix B. Natural observation of teasing production by G. Grosse

A., 13 months, 22 days.

We are sitting on a picnic blanket: A., mother, father, sister and a friend. We are eating blueberries. Mother gives A. blueberries (puts them with her fingers in A's mouth) and accompanies the movements with speech. At one point, A. takes a blueberry out of the bowl and holds it out to her mother. As soon as the mother tries to take it with her lips, she pulls it back and laughs. Everybody else is laughing too. She does that twice in a row. Next, she holds out a blueberry to her sister W. and does the same, also repeatedly. Again, there is a lot of laughter and giggling by the observants.

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