Humor production may enhance observational learning of a new tool use action in 18-month-old infants

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Abstract

Many studies have shown that making children laugh enhances certain cognitive capacities such as attention, motivation, perception and/or memory, which in turn enhance learning. However, no study thus far has investigated whether laughing has already an effect on learning earlier in infancy. The goal of this study was to see whether using humor with young infants in a demonstration of a complex tool use task can enhance their learning. Fifty-three 18-month-old infants participated in this study and were included either in a humorous- or a control demonstration group. In both groups infants observed an adult using a tool to retrieve an out of reach toy. What differed between groups was that in the humorous demonstration group, instead of playing with the toy, the adult threw it on the floor immediately after retrieval. The results show that infants who laughed at the demonstration in the humorous demonstration group reproduced significantly more the target action than infants who did not laugh and those in the classic demonstration group. This effect is discussed with regard to individual differences in terms of temperament and social capacities as well as positive emotion and dopamine release.

Keywords: humor, laughing, tool use, infants, observational learning

Introduction

In the 1970s, there was a surge in humor studies (McGhee, 1979; Sroufe & Wunch, 1972), which was followed by a 30-year period of neglect of this topic. Interest in humor studies began approximately a decade ago, when researchers began to investigate the development of the understanding and production of humor in early infancy (Reddy, 2001). However, humor development remains understudied. Moreover, most of these studies describe the age at which infants begin to understand and produce humor during the first years of life (Hoicka & Akhtar, 2011; Reddy, 2001). Fewer studies have systematically investigated the effect of humor on infants' perception and action (Hoicka & Akhtar, 2012; Hoicka & Gattis, 2008; 2011; Hoicka, Jutsum, & Gattis, 2008). The goal of our study was to investigate the effect of humor on infants' reproduction of a novel action.

The consensus in the literature on the definition of humor holds that it is related to understanding or producing an incongruity (e.g., McGhee, 1979). Incongruity is the simultaneous occurrence of normally incompatible elements, producing surprise. Incongruity can provoke emotional reactions such as perplexity, fear, astonishment or laughter. Thus incongruity alone is not sufficient to explain the experience of humor. Humor must be placed in a social framework where the incongruity is intended for an audience (Hoicka & Gattis, 2008). In order to make the incongruity a shared experience and show that it is intended to be humorous, individuals use cues such as laughing or smiling as they produce them (Hoicka & Akhtar, 2011). Another way for receivers to distinguish humor production from other types of verbal productions is to pay attention to the specific acoustic properties of humor (Hoicka & Gattis, 2011). In this study, 22 mothers read a book containing humorous and neutral sentences to their 18- to 24-month-olds. Mothers used a higher mean of the fundamental frequency (F0), greater mean intensity, and a slower speech rate to communicate verbal humor as compared to verbal non-humor.

Descriptive studies suggest that as early as 8 months of age, infants can deliberately repeat actions to re-elicit previously obtained laughter from others (Reddy, 2001). Infants can also produce different types of humor such as object-based humor (putting a shoe on their head), label-based humor (using non-words such as "goojooboo" instead of words) or funny actions (woobling head; Hoicka & Akhtar, 2012; Loizou, 2005; Reddy, 2001). Other studies showed that not only can infants repeat actions that re-elicit laughter in adults, but two-year-olds can produce novel humor that they also cue with smiles or laughter (Hoicka & Akhtar, 2011; Mireault et al., 2012). These results suggest that as early as two years of age, toddlers understand the incongruity of the joke as well as the social frame and can use this incongruity to produce humor themselves.

Experimental studies show that from the age of 19 months, infants discriminate humor from other forms of mental states such as making mistakes. They copy incongruous actions paired with laughter (e.g., putting shoes on their hands) whereas they correct mistakes (Hoicka & Gattis, 2008) and misspeaking foreigners (Hoicka & Akhtar, 2012).

While human humor has a number of unique properties, laughter is a feature that we share with great apes in play contexts (e. g., Waller & Dunbar, 2005). Thus, from an evolutionary point of view, it is reasonable to assume that humor and laughter serve important functions at both individual and group levels. However, because of our lack of knowledge on the early development of humor, its function and significance remain uncertain.

One suggestion is that laughter induces a positive attitude in the observer, thereby facilitating interaction by reducing threat, which also contributes to social bonding in groups, enhancing prosociality and cooperation (Wilkins & Eisenbraun, 2009). Reddy (2008) argued that even the earliest consistent way of producing laughter in babies—tickling—requires an interpersonal context in which parents cue their actions with laughing. Other studies have

shown that parents consistently use smiling and laughing as cues when engaging in absurd actions (i.e, odd faces and voices) with their 3- to 6-month-old infants in order to make these actions humorous (Mireault, Sparrow, Poutre, Perdue, & Macke, 2012; Mireault et al., 2014). Thus, humor seems to be systematically used in the daily interpersonal interaction between babies and parents, thus facilitating interaction and communication between them.

Another possible function of laughter could be to facilitate the learning of new things from others by inducing a state of positive affect (Fredrickson, 2001). In humans, the effect of humor on learning is well known in classrooms with young and adult students. Various studies with students have investigated the effect of using humor in teaching. Even though there is no consensus in the literature regarding the effect of humor on learning in classrooms, some studies report a positive correlation. For instance, it has been suggested that teachers' use of humor can enhance some mechanisms that are important for learning, such as attention and motivation (Bryant & Zillman, 1989). Others have proposed that the use of humor can attenuate factors that hinder learning, such as stress and anxiety (Korobkin, 1988). However, to date, there have been no studies systematically investigating how or if humor can help infants and toddlers learn novel actions. The results of one study investigating an indirect effect of humor on word learning in toddlers suggest that word learning can be facilitated by enriching the linguistic context through the use of humor (Hoicka, Jutsum, & Gattis, 2008). The authors of this study analyzed the language used by parents when reading either humorous or non-humorous pages in a book to their 19- to 26-month-old infants. They showed that parents used a significantly higher percentage of high-abstraction extra-textual utterances when reading the humorous pages. They concluded that sharing humorous books increases infants' exposure to high-abstraction vocabulary and language, which in turn may enhance their language abilities.

The goal of our study was to investigate whether humor and laughing per se can help infants learn a novel means-end action through observation. To do so we assessed infants' observational learning of a novel action through a demonstration involving humor and we compared these infants' performance with that of a control group who were given a classical humorless demonstration. The novel action was a tool use action in which the infants' task was to retrieve an out-of-reach toy using a rake-like object. Rat-Fischer, O'Regan, and Fagard (2012) tested 14- to 22-month-old infants on this tool use task and showed that infants only begin to successfully retrieve the toy using the rake (around 30% success) at 18 months of age. In our study, we tested this task at 18 months in order to determine whether using humor and making babies laugh while demonstrating the target action would increase learning.

Method

Participants

Seventy infants (mean age = 18 months, 7 days; range = 18 months to 18 months, 14 days; 23 females) participated. Six infants were excluded due to fussiness (four infants in the classical demonstration group and two in the humorous demonstration group). Infants were assigned, as they became available, to one of two experimental conditions until a final sample of at least 16 infants per group was reached. Infants were recruited from a list of local families provided by the city of Paris and approved by the prefect. We sent a postal letter to each of these families explaining the overall goal of our developmental studies running in the BabyLab (investigating early social learning), without giving specific details on the actual experiment. Parents were blind to the material used and the hypotheses of this experiment. Families who contacted us and expressed interest in participating in this study were recruited. All parents provided written informed consent on behalf of the children enrolled in the study

before participating. Specific demographic information on average parental income, education or age was not available for this study.

Materials

Materials consisted of a toy and a tool. The toy was a small duck, 3 cm long, 2 cm high and 2 cm wide. The tool was identical to the one used in Rat-Fischer, O'Regan, & Fagard's (2012) study and consisted of a rake-like T-shaped object made of white cardboard. The handle was 20 cm long and the head 20 cm wide. The rake was quite plain, to avoid distracting the infants from the toy. To avoid infants' loss of interest toward the out-of-reach toy, we used ducks of different colors and brightness all over the testing session.

Procedure

Testing took place in the university laboratory. The infants were seated on the parent's lap in front of a table. The parent was blind to the hypothesis and was asked to remain quiet. All sessions were videotaped. Eleven infants spontaneously succeeded the novel means-end action without needing a demonstration and thus were excluded from the experimental part of the study. The remaining fifty-three infants were assigned to one of the two experimental groups as they became available to us until we reached 16 infants per group. Because we wanted to test the effect of humor on infants' learning and because not all of the infants tested in the humorous demonstration group laughed, more infants were tested in the humorous demonstration group in order to reach at least 16 laughing infants. This leads to a total of 16 infants in the control demonstration group and 37 infants in the humorous demonstration group (N = 16 laughing infants and N = 21 non-laughing infants). In the humorous group, infants who laughed at least once at the demonstrations were considered as "laughing infants" (N = 16), but most of the laughing infants laughed at half of the demonstrations (N = 12).

Note that, for all laughing infants, laughing began while the experimenter demonstrated the target action and even though some infants continued to laugh after they successfully retrieved the toy, laughing was not the consequence of their retrieval success. In addition, laughing began after the experimenter threw the toy on the floor and not before. None of the infants was already laughing before the incongruity occurred. Thus, the humorous demonstration group was subdivided into two subgroups: laughing group (N = 16) and non-laughing group (N = 21). The experiment involved two experimenters: Experimenter 1 (E1) sat on the opposite side of the table to the infant. Experimenter 2 (E2) sat at the table, to the right of the infant. Neither of the experimenters was blind to the hypotheses. The procedure consisted of the following phases.

Phase 1 (familiarization) was the same for all infants. E1 gave the duck to the infant for 30 s, during which period the infant was free to manipulate it. E1 then took the duck back and gave the infant the rake for 30 s of manipulation. This prior familiarization with the experimental materials was included so that the novelty of the objects would not lead the infants to exclusively focus only on one or the other.

Phase 2 (spontaneous success) was designed to check whether the infants would spontaneously succeed at the task before seeing a demonstration. In both groups, E1 placed the toy in front of and out of reach of the infant, at a distance of approximately 70 cm. E1 then placed the rake near the infant's hand. Thus, from the infant's point of view, the toy was behind the rake. E1 said "Look at the duck; do you want to play with it? How can you get it?" If the infant failed to retrieve the toy 60 s after first touching the rake or stretching his or her hand out toward the toy, the test ended. If, within this test period, the infant became discouraged after having tried to retrieve the toy and failed, E1 encouraged the infant once by touching the duck and saying "Go ahead; how can you get that duck?" If the infant ignored or threw the rake away, E1 placed the rake near the infant once more and another 60-s test

period began. Parents were asked to restrain their infants if they tried to crawl onto the table to get the toy. At the end of phase 2, only the 53 infants who failed spontaneously (82 %) were kept for the rest of the study, and statistical analyses included only these infants.

Phase 3 (demonstration). In each of the groups, Phase 3 began with E1 putting the toy in front of E2 and out of her reach and placing the rake near E2's hand, with the handle oriented toward E2.

J'inverserais et mettrais le groupe experimental, 'humorous demo' d'abord, ensuite le controle.

In the *control group*, E2 took the rake with her right hand and used it to bring the toy closer. She then reached for the toy with her left hand, grasped it, and played with it for few seconds while looking and smiling at the infant. The demonstration was repeated eight times. E2 then gave the toy to E1.

In the *humorous demonstration group*, E2 took the rake with her right hand and used it to bring the toy closer. But, in contrast to the control condition, instead of grasping the toy to play with it, she threw it to the floor to her side immediately after retrieving it and alternated looks between the object and the infant while smiling. This socially indicated to the infant that her actions were intended to be humorous. The demonstration was also repeated eight times. The effect of repetition on humor perception is well studied in the literature and we wanted to make sure that infants do perceive the humor production in our humorous demonstration. Other studies in our Lab used that used similar tasks showed that four demonstrations were enough to trigger learning. In order to ensure the effect of repetition, we doubled this exposure and used eight demonstrations. Each demonstration lasted approximately five seconds which leads to a total of 45 seconds of demonstration. The total durations of the classical and humorous demonstrations were equal.

Phase 4 (test) was the same as Phase 2 in both conditions of demonstration and occurred immediately after demonstration. The procedure lasted approximately five minutes.

Coding

Videos of 15 infants (about 30%) were coded independently by a second observer to assess inter-observer reliability. Both coders were blind to the hypothesis. The interrater reliability was perfect- c'est aussi un peu rare, s'il y a 4 scores, qu'ils étaient d'accord pour chaque score- il fadrait plutot dire 90 ou 95%..., with a Cohen's Kappa of 1. Each infant's behavior was scored on a scale from 0 to 4 during the 60s test period. The scale was based on whether the infant manipulated one or both objects; did or did not make a connection between the toy and the rake without necessarily retrieving the toy; and whether they ultimately retrieved the toy using the rake.

Score 1: interested in toy or tool alone: points to toy, refusing or ignoring tool; grasps tool and plays with it; swipes table with it, sweeping toy away by accident; grasps tool, plays with it and then rejects it, possibly interested in toy again; points to toy.

Score 2: Interested in tool in connection with toy: grasps tool and touches or pushes toy with it.

Score 3: Interested in tool for retrieval, understands connection between rake and tool, but uses trial and error, therefore success is difficult or partial: grasps tool, makes clear attempts to bring toy closer, but fails or makes awkward movements to bring toy to hand and succeeds or retrieves toy after several attempts.

Score 4: Interested in tool for retrieval, solid understanding of connection between rake and toy, intentional full success: grasps tool directly, places it behind toy to retrieve it and succeeds.

An infant could perform one or several actions within the 60 s manipulation period. The mean number of actions per infant was 2.16 (SD = 1.7). Infants were categorized according to their best action produced within this period.

We first calculated the percentage of infants who successfully reproduced the target action after observation in each group (classical demonstration, humorous laughing and humorous non-laughing). Infants were classified as successful when they succeeded in retrieving the object using the rake either immediately after observation or within one minute of manipulation (scores 3 and 4).

Then, we analyzed the mean score of the best action performed and the distribution of infants' scores. We report the distribution in the results section but because there were few infants for each score, we split these scores into two categories and statistical analyses were conducted on these two categories. The first category (N = 30) included infants who did not perform successful retrieval (the infant manipulated the rake or reached for the toy with her hand, made a connection between the toy and the rake without necessarily retrieving the toy, scores 1 and 2) and the second category (N = 23) included infants who successfully retrieved the toy using the rake either after several trials or immediately after observation (scores 3 and 4).

Results

Percentage of success

The results show that the percentage of infants who successfully retrieved the toy using the tool in the control group (elle voulait pas q tu changes ca partout?) classical demonstration group (25%) and the non-laughing group (19%) was similar. In contrast, in the laughing group, most infants, except one, succeeded at retrieving the object using the rake (93.7%), either through trial and error (score 3) or directly (score 4). A Kruskal-Wallis test shows that the difference between the three groups is significant ($H (d = 2) = 23.8$; $p < .0001$).

Mean score

Figure 1 presents the mean score of the best action according to group. An analysis of variance (ANOVA) on the mean score of the best action produced within the 60-second test period showed a significant effect of group ($F (2, 50) = 21.6$, $p < .0001$). A post hoc LSD test showed that there was no significant difference between the classical demonstration group and the non-laughing group. The effect was due to the difference between the laughing group and the other two groups. Cohen's *d* indicated that the effect was large (0.9). The infants in the laughing group used the rake successfully to retrieve the toy significantly more often than those in the two other groups.

Insert figure 1 about here

Distribution of infants

Table 1 shows the distribution of infants between the different scores in each group. It can be seen here that more infants obtained scores 1 and 2 than scores 3 and 4 in the control- and non-laughing groups, and that the pattern is reversed in the laughing group. It can also be

seen that the majority of the laughing infants succeed the task directly after demonstration (9 infants obtained a score of 4 and 6 obtained a score of 3). In the other two groups, only one infant obtained a score of 4.

Insert table 1 about here

Because there were few infants for each score, we established two categories and conducted statistical analyses on these. The first category (N = 30) included infants who showed no successful retrieval (the infant manipulated the rake or reached for the toy with bare hand, made a connection between the toy and the rake without necessarily retrieving the toy, scores 1 and 2) and the second category (N = 23) included infants who successfully retrieved the toy using the rake either after several trials or immediately after observation (scores 3 and 4). A contrast in category distribution by condition was significant in showing a difference only for the laughing group, χ^2 (2, N = 53) = 23.8; $p < .001$). Thus, most infants in the laughing group used the rake successfully in order to retrieve the toy.

Discussion

We investigated whether showing 18-month-old infants a humorous demonstration would increase the learning of a novel tool use task by observation. Infants are known to spontaneously succeed at this task around the end of their second year, but a previous study found that only 30% of 18-month-olds succeeded at it after observation (Rat-Fischer, O'Regan, & Fagard, 2012). Infants were either shown a classic demonstration in which the experimenter used a rake to retrieve an out-of-reach toy, or a humorous demonstration in which the experimenter threw the toy on the floor immediately after retrieval instead of

playing with it, thus creating an incongruity. Incongruity is known to be a key component of humor perception. About half of the infants laughed at the demonstration in the humorous demonstration group, whereas the other half watched the demonstration without laughing.

Our result show that most of the infants who laughed at the demonstration successfully retrieved the toy using the rake after observation, unlike the infants in the other two groups (classical demonstration control? and humorous non-laughing). Only less than one third of the infants in these other groups learned the target action by observation and there were no differences related to gender or age – mettre ceci ds les résultats aussi, non? which is in line with the results of previous studies using the same tool use task (Esseily, Rat-Fischer, O'Regan, & Fagard, 2013; Somogyi & Esseily, 2014; Rat-Fischer, O'Regan, & Fagard, 2012).

Les hypotheses seraient plutot au début de l'étude- ici ce sont des explanations…

We propose two explanations for the obtained results: the first concerns individual differences in terms of temperament, whereas the second is discussed in relation with endorphin dopamine? release and its effect on learning.

The first explanation postulates that laughing and non-laughing infants may present individual differences, such as different thresholds for smiling and laughing. Even though laughing did not begin before the production of humor, it is possible that laughing infants already had hada lower threshold for laughing and smiling. In this case, it is not humor per se that may have facilitated learning but temperamentally "smiley" babies were more likely to engage with the environment and therefore to attempt and succeed at the task. This could also have entailed that these "smiley babies" perceived the experimenter's smiles and laughs as encouragements to reproduce the target action. This, however, is less likely to explain the results for two reasons. First, the experimenter smiled at the object and looked at the infant in

both humorous and control (d'abord humorous, car c'est le group expé et ensuite controles-peut-etre partout dans le texte il vaudrait mieux avoir le meme ordre, non? groups and second, the experimenter who performed the demonstration and smiled to the infants was different from the one who tested them. It could be however that laughing babies may have higher social skills, which enable them to easily interact with others in different social situations. In our case, laughing infants may have been more comfortable in the presence of strange adults and more disposed to reproduce others' actions. It could be that all infants learned in all groups but only those in the laughing group demonstrated that they learned by reproducing the action whereas infants in the others groups failed to do so. Some studies show positive correlations between sense of humor and socio-emotional capacities such as social interactions in adults (ex: Nezlek & Derks, 2001). However, to date, there are no such studies in infants to help us better understand the relations between humor perception and social interaction.

What else might underlie the individual difference? One possibility is that laughing babies might have higher cognitive capacities than non-laughing babies perceiving better the incongruity of the action. This needs further investigation. Some studies in adults suggest that individuals who have higher sense of humor and understand the humor production have also higher intelligence quotient (ex: Feingold & Mazzella, 1991).

A second explanation to consider is that positive emotions can have an effect on dopamine and endorphin release which in turn can have an effect on learning. Indeed, positive emotions have been shown to improve creative problem solving and facilitate cognitive flexibility (Ashby & Isen, 1999). Ashby & Isen (1999) argued that this improvement in problem-solving performance is due to the increase in brain dopamine levels resulting from positive emotions. Laughing clearly induces a positive emotional state which may have led to improved performance. A number of studies have shown benefits of enhancing positive

emotions before testing. For instance, when the experimenter establishes a social connection with the infant before testing begins by mimicking the infant's play or engaging in social interaction, the infant is more likely to initiate play (Fawcett & Lizkowski, 2012) or to exactly imitate the experimenter's actions (Nielsen, Simcock, & Jenkins, 2008) or to learn by observation a new tool use action (Somogyi & Esseily, 2014). Thus, the effect observed here might be a general effect due to positive emotion and not to humor or laughter per se. This needs further investigation.

In conclusion, whereas previous studies have shown the effect of humor in educating students, and others have shown that humor production and comprehension emerge during infancy, to our knowledge no study so far has demonstrated that laughing at a humorous situation can facilitate learning in infants. Our results suggest that laughing might be a stimulant of learning even during the second year of life. Further work is clearly now required to elucidate the question of the mechanisms underlying this effect of laughter on infants' learning, and more specifically why laughing babies were so much better at imitating the exact gesture of an adult demonstrator. In addition to a better understanding of why we make our babies laugh, our finding may have implications to promote the cognitive development of infants including those with developmental learning impairments.

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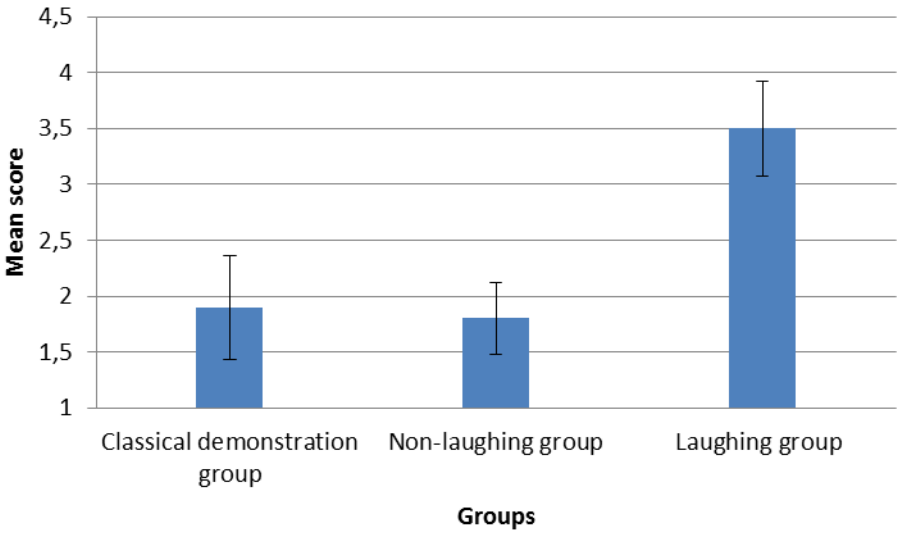

Figure 1: Mean score of the best action performed within the 60s manipulation test period as a function of group.

Table 1. Distribution of all infants for each of the scores as a function of group.

	Score 1	**Score 2**	**Score 3**	**Score 4**
Classical demonstration group	6	6	3	1
Non-laughing group	8	9	3	1
Laughing group	0	1	6	9