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"Should I or shouldn't I?" Imitation of undesired versus allowed actions from peer and adult models by 18- and 24-month-old toddlers

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ABSTRACT

Imitation is a common way of acquiring novel behaviors in toddlers. However, little is known about toddlers' imitation of undesired actions. Here we investigated 18- and 24-month-olds' (N = 110) imitation of undesired and allowed actions from televised peer and adult models. Permissiveness of the demonstrated actions was indicated by the experimenter's response to their execution (angry or neutral). Analyses revealed that toddlers' imitation scores were higher after demonstrations of allowed versus undesired actions, regardless of the age of the model. In agreement with prior research, these results suggest that third-party reactions to a model's actions can be a powerful cue for toddlers to engage in or refrain from imitation. In the context of the present study, third-party reactions were more influential on imitation than the model's age. Considering the relative influence of different social cues for imitation can help to gain a fuller understanding of early observational learning.

1. Introduction

Every day toddlers observe and imitate other people's actions, many of which are novel to them (Barr & Hayne, 2003). Not all actions toddlers witness receive approval. On the contrary, a third party like the toddler's parent might react angrily when, for example, an older sibling uses the new crayons for wall painting or plays with food. From a parent's point of view, toddlers would be well advised to give a miss to imitating these types of actions. But who knows a young child who has never done any mischief? At least some misbehaviors might be inspired by other people's examples. In the present study we investigated 18- and 24-month-olds' imitation of a peer and an adult model's actions. Depending on condition, another person reacted either in a neutral or in an annoyed way to the model's actions (henceforth the model's actions will be labelled as "allowed" and "undesired" actions, respectively). Our main research question was whether toddlers would be equally likely to imitate allowed versus undesired actions from an adult compared to a peer model.

In contrast to research with preschoolers and school-aged children (e.g., Bandura, Ross, & Ross, 1963), studies on early imitation have almost exclusively focused on actions of neutral or positive valence so far. In a typical imitation procedure, a person (i.e., the model) demonstrates one or more target actions using objects. Either immediately or after a delay a test occurs. At the test, children

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are provided with the objects and given the opportunity to perform the same actions as the model (e.g., Barr, Dowden, & Hayne, 1996; Meltzoff, 1985; Seehagen, Konrad, Herbert, & Schneider, 2015; Zmyj, Daum, Prinz, Nielsen, & Aschersleben, 2012). Imitation scores of children in the experimental condition(s) are usually compared to those of children in an additional age-matched baseline control condition. Children in the baseline control condition receive the objects for interaction at test without prior demonstration of the target actions. Imitation is inferred if children in the experimental condition(s) perform more target actions than infants in the baseline control condition at test (for a review, see Hayne, 2004). Typically, the model demonstrates the actions with objects that are unfamiliar to the children and there are no cues in the situation indicating that the execution of the actions might be frowned upon. For example, there are no aversive consequences of performing the target actions for the model.

Such imitation studies have revealed that a model's identity can influence early imitation (for reviews, see Wood, Kendal, & Flynn, 2013; Zmyj & Seehagen, 2013, for negative findings on familiar vs. unfamiliar models, see Devouche, 2004; Seehagen and Herbert, 2010). In terms of a model's age, infants aged 6 months and older copy one- and multi-step actions from adult models, both immediately (e.g., Barr et al., 1996; Herbert, Gross, & Hayne, 2006; Seehagen & Herbert, 2012) and after delays (e.g., Barr et al., 1996 Collie & Hayne, 1999). A handful of studies have shown that from at least 12 months onwards, toddlers utilize peers as models and copy their actions, even after a delay (Hanna & Meltzoff, 1993; Ryalls, Gul, & Ryalls, 2000; Seehagen & Herbert, 2011; Zmyj, Aschersleben, Prinz, & Daum, 2012; Zmyj, Daum et al., 2012). The relative influence of a peer versus an adult model on toddlers' behavior, however, seems to depend on the participants' age (Seehagen & Herbert, 2011) and to interact with several other aspects of the experimental procedure such as mode of presentation (live vs. televised), length of retention interval (immediately vs. 10-min or 1-week delay) and familiarity of the modelled actions (familiar vs. novel, Ryalls et al., 2000; Seehagen and Herbert, 2011; Zmyj, Daum et al., 2012).

In addition to cues within the experimental situation, toddlers' social experiences outside the laboratory might influence their imitation from peer and adult models. For example, in Seehagen and Herbert's (2011) study, length of regular peer exposure was related to toddlers' imitation from a televised peer model. The longer the 15- and 24-month-old participants had been attending play groups and/or day care, the more actions they imitated from the peer model in the laboratory. One possible explanation for this finding is that toddlers gain an understanding of the usefulness (or trustworthiness) of peer models through extended contact to similarly-aged children (cf. Seehagen & Herbert, 2011; Zmyj & Seehagen, 2013). Taken together, the existence of a universal peer-model or adult-model advantage seems unlikely. Instead, toddlers' age, their developmental history and factors within a learning situation might determine whether they will imitate a peer or an adult model more readily. As yet, it is unexplored whether the permissiveness of an act is one of the factors that shapes selective imitation from a peer versus an adult model (Meltzoff, 2007 Seehagen & Herbert, 2011).

Investigating toddlers' imitation of undesired actions is not trivial from a practical point of view. Based on their previous experiences, a given action (e.g., jumping on a sofa) might be perceived as undesired by some toddlers and as allowed by others. Thus, it would be difficult to identify one or several actions that are definitely understood to be undesirable by all toddlers in a given sample. Using any of the few actions that are likely to meet this criterion because they are universally prohibited (e.g., hitting another child with a shovel) would be problematic for ethical and safety reasons. A feasible solution for this issue is to use actions that are neutral per se but that get tagged as allowed or undesired by someone else's reaction to their execution. That is, after toddlers observe a model perform some arbitrary actions, another person could react in a neutral or in an annoyed way.

Such an approach was used in an inventive procedure developed by Repacholi and Meltzoff (2007) and Repacholi, Meltzoff, and Olsen (2008). In these studies, 18-month-old toddlers observed how a model performed actions with objects. A second person, the "emoter", reacted either neutrally or angrily to the execution of the actions. In an immediate test, toddlers were given the opportunity to imitate the model's actions. Analyses revealed that toddlers regulated their behavior during test according to the emoter's prior reactions and the emoter's current behavior. Toddlers imitated fewer actions when the emoter had reacted angrily *and* monitored the toddlers' behavior during test than when the emoter had either reacted neutrally, or reacted angrily and did *not* monitor the toddlers' behavior during test (i.e., indicated by reading a magazine or closing her eyes). Thus, by 18 months of age, toddlers regulate their imitative behavior such that they are less likely to imitate actions that might be undesired by others, at least if they are monitored when having the opportunity to perform these actions. However, it is unknown whether toddlers' proneness to imitate such undesired actions varies depending on the identity of the model. On the one hand, it is possible that an adult emoter's angry reaction to a peer model is very effective for preventing subsequent imitation because a toddler reasons that, due to the similarity to the model, he or she will probably face the same reactions (Bandura, 1977; Meltzoff, 2007). On the other hand, from a young age, children distinguish between people of high and low status in their imitative behavior, preferentially copying models of a high status (Wood et al., 2013). Considering this, an emoter's angry reaction to an adult model might be particularly impressive because an adult is likely perceived as a person of high status. Thus, a toddler might reason that it would be wise to avoid performing actions that not even an adult is allowed to do. The primary question of interest in the present study was whether 18- and 24-month-old toddlers would be more likely to imitate undesired actions from a peer or from an adult model. We included two age groups as imitation from screens, which was required in the present study, is more difficult than imitation from live models for toddlers (Barr, 2013). In addition, it has been suggested that with increasing age, toddlers might become more aware of the relevance of peers' behavior for their own actions (Seehagen & Herbert, 2011). From this perspective, it would be expected that older toddlers might more heavily guided by a peer model than younger toddlers. Thus, in addition to 18-month-olds, the age group studied by Repacholi and Meltzoff (2007) and Repacholi et al. (2008), we assessed 24-month-old toddlers.

Table 1
Number of 18- and 24-month-olds in each condition.

Condition						
		Adult allowed	Adult undesired	Peer allowed	Peer undesired	Baseline
Age group	18 months	$n = 12$	$n = 12$	$n = 12$	$n = 12$	$n = 10$
	24 months	$n = 10$	$n = 12$	$n = 12$	$n = 11$	$n = 7$

2. Method

2.1. Participants

Toddlers were recruited from public birth registers in a medium sized German city. The final sample consisted of $N = 110$ full-term healthy toddlers who were tested within 17 days of turning 18 ($n = 58$) and 24 ($n = 52$) months, respectively (see Table 1 for n per condition in each age group). Fifty-two toddlers were male. Toddlers primarily came from middle to upper-middle class backgrounds. Fifty-five per cent of the mothers and 62% of the fathers of the 18-month-olds had a university degree. Sixty-three percent of the mothers and 65% of the fathers of the 24-month-olds had a university degree. Five additional toddlers ($n = 3$ twenty-four-month-olds and $n = 2$ eighteen-month-olds) were tested but not included in the final sample due to technical failure of the cameras. The present study was approved by the local Ethics Committee of the Faculty of Psychology at Ruhr-Universität Bochum.

2.2. Design

In a between-subjects design, toddlers of both ages were randomly assigned to one of five conditions as they became available. There were four experimental conditions and one baseline control condition at each age. Toddlers in the experimental conditions participated in an imitation task. First, they observed a televised model demonstrate three target actions with a set of stimuli. As done in previous studies on peer imitation (e.g., Seehagen & Herbert, 2011; Zmyj, Aschersleben et al., 2012, Daum et al., 2012), we decided to use televised presentations to keep the peer model's demonstrations consistent across participants, and to protect the peer model from being repeatedly exposed to the emoter's angry reactions.

Then, toddlers were given the opportunity to copy the target actions during an immediate test. Depending on condition, toddlers either observed a peer model or an adult model, and the experimenter either reacted in a neutral way to the model's actions to indicate that the actions were allowed (i.e., *peer allowed* and *adult allowed*), or she reacted angrily to the model's actions to indicate that the actions were undesired (i.e., *peer undesired* and *adult undesired*). That is, the experimenter also acted as the emoter. Toddlers in the baseline control condition did not receive any demonstrations of the target actions. Instead, their spontaneous production of any target actions was assessed at the test.

2.3. Material

2.3.1. Stimuli

The rattle stimuli (see Herbert and Hayne, 2000a; Herbert and Hayne, 2000b) consisted of a green stick (12.5 cm long) which was attached to a grey plastic lid (9.5 cm in diameter), with Velcro attached to the underside of the lid; a green wooden ball (ca. 3 cm in diameter); and a clear plastic square jar with Velcro around the top (8 cm high, 5.5 cm wide, 5.5 cm deep). Unlike in previous studies, the opening of the plastic jar was uncovered. The cover we used had to be removed during filming the peer videos because the peer model had difficulties pushing the ball through the perforated cover inside the container. The opening of the jar remained uncovered at test. The three target actions were 1) put the ball in the container, 2) attach the stick with the lid to the container while the ball is in the container, and 3) shake the assembled rattle by holding the stick.

2.3.2. Videos

Two videos were created. In each video, a model demonstrated the three target actions using the rattle stimuli. One video showed a peer model (an 18-month-old girl) and one video showed an adult model (a 24-year-old woman). To ensure that the peer and adult videos were matched as closely as possible in terms of speed and general execution of the target actions, the peer video was filmed first. The adult model watched the peer video multiple times before performing the target actions. Both models were unfamiliar to the toddlers in the present study. Neither model used any language cues to describe the stimuli or the target actions, or any other ostensive cues. However, both models smiled and looked towards the camera when performing the last target action (shaking). The camera angle for the videos was adapted for each model separately in order to ensure that the models' upper body centered in the video. This was done because of the focus on model identity in the present study. Since the peer model was physically smaller than the adult model, this resulted in zooming in closer for the peer videos. As a consequence, the imitation stimuli were depicted slightly larger in the peer video than in the adult video. Previous research has shown that the size of stimuli does not alter infants' imitation from televised presentations, even if the stimuli are presented as close-up shots (Barr & Hayne, 1999, Exp. 1c). Each video was shown three times in succession to toddlers in the respective conditions. Before the third presentation, the screen went white for 14 s,

allowing the experimenter to enter the room. To attract the toddlers' attention, a cartoon-style sun appeared on the screen for three seconds immediately before each video presentation, accompanied by a ringing noise. In total, the adult video lasted 63 s and the peer video lasted 65 s.

2.3.3. Comprehension questionnaire

We sought to get an estimate of toddlers' understanding of the sentences that the emoter used to indicate approval or disapproval of the model's actions (i.e., "No, she must not do that. I don't like that." Or "Yes, she can do that. I like that."). Caregivers estimated how many of the two sentences in question their child understood.

2.4. Procedure

All toddlers were tested in a laboratory at Ruhr-Universität Bochum at a time of day when they were likely to be alert and playful. On arrival, the purpose of the study was explained to the accompanying caregiver and informed consent was obtained. Caregivers were asked not to label any stimuli or target actions during the demonstration and test sessions, and to refrain from helping their child to perform any target actions at test. Toddlers in the baseline control condition did not participate in the demonstration session. The test procedure in this condition was identical to that used in the experimental conditions.

2.4.1. Demonstration session

The toddler sat on his or her caregiver's lap on a chair in front of a computer screen (diameter: 56 cm) at a viewing distance of approximately 140 cm. Once toddler and caregiver were seated, the experimenter left the room and started the video from the adjacent room (peer or adult video, depending on the condition). Toddler and caregiver watched the first two demonstrations of the target actions. During the 14-s break following the second demonstration, the experimenter returned to the room and kneeled to the side of the screen so that she was able to look at the screen while the toddler could see her profile. The experimenter entered after the first two demonstrations to allow the toddlers to watch the initial demonstrations without distraction, and to keep the procedure similar to that of Repacholi et al.'s studies (Repacholi & Meltzoff, 2007; Repacholi et al., 2008). During her absence, the experimenter monitored the procedure via live broadcast on a screen in the adjacent room. Toddler, caregiver and experimenter watched the last demonstration together. Depending on the toddler's condition, the experimenter reacted either neutrally or angrily to the model's actions.

In the conditions "peer undesired" and "adult undesired", the experimenter expressed anger by showing an annoyed facial expression while watching the demonstration of the target actions, characterized by lowered eyebrows, narrowed eyes and pursed lips. When the video finished, the experimenter pointed to the screen which showed a still image of the video's last frame and said in an angry voice: "No, she must not do that. I don't like that." while looking at the screen.

In the conditions "peer allowed" and "adult allowed", the experimenter expressed a neutral attitude by showing a neutral facial expression while watching the presentation of the target actions. When the video finished, the experimenter pointed to the screen which showed a still image of the video's last frame and said in a neutral voice: "Yes, she can do that. I like that."

In all conditions, the experimenter then addressed the toddler in a pleasant voice, stating that she would now switch off the screen and wondering what they could do next before she suggested to the toddler to look behind two movable room dividers that occluded a corner of the room.

2.4.2. Test

The experimenter removed the room dividers. Behind the wall, a 73 cm high square table was revealed. Before the toddler's arrival, all parts of the rattle stimuli had been placed on the table so that the toddlers did not see the experimenter have any physical contact with the stimuli. The experimenter asked the caregiver to sit on a chair in front of the table with the toddler on the lap. Once the stimuli were within reach, each toddler was allowed 2 min to reproduce any target actions. During this time, the experimenter sat on another chair at the table, maintained a neutral facial expression, looked at the toddler's chest and remained passive. This behavior was guided by Repacholi and Meltzoff (2007), Repacholi et al. (2008) who found that the emoter's angry reaction was only effective for shaping infants' subsequent behavior if she was present during test and faced the infant with her eyes open, but without making direct eye contact as this upset some infants. All demonstration and test sessions were video recorded.

2.5. Coding

Toddlers' visual attention to the screen during demonstrations of the target actions, latency to touch the stimuli, and presence or absence of each target action during test was coded offline using specialized software (Interact 9, Mangold International). If a toddler did not touch the stimuli during the 2-min test period, he or she received a score of 120 s for latency. While it is common practice to exclude participants for failure to touch the stimuli, in the context of the present study this approach might have undermined answering our research question. That is because the emoter's angry response could well make toddlers hesitant to touch the stimuli altogether. To keep procedures identical across conditions, we decided to keep all toddlers who did not touch the stimuli within the imitation period in the final sample. These toddlers received an imitation score of 0. Due to the random assignment, it is reasonable to assume that toddlers with different temperament (e.g., in terms of behavioral inhibition) were equally distributed across conditions. The length of time (in percent) toddlers spent looking at the screen during demonstrations was calculated after scoring by the experimenter. Number of performed target actions were summed up and could range between 0 and 3. For imitation scores, videos of

n = 91 (83%) participants were coded by a second independent rater who was blind to the toddler's respective condition. Inter-rater reliability was perfect, ICC = 1. For visual attention during demonstrations, videos of n = 87 (79%) participants were coded by a second independent rater who was blind to the toddlers' respective condition. Inter-rater reliability was excellent, ICC = 0.97.

3. Results

3.1. Preliminary analyses

First, we tested whether there were any differences between the experimental conditions in terms of visual appeal and linguistic difficulty. A 2 (age: 18 months, 24 months) × 4 (conditions: peer allowed, peer undesired, adult allowed, adult undesired) ANOVA on toddlers' visual attention to the screen during presentation of the target actions revealed no significant main or interaction effects, biggest $F(1, 84) = 2.862$, $p = 0.09$. Data from one 24-month-old was missing due to the toddler moving out of camera range. A second 2 (age: 18 months, 24 months) by 4 (conditions: peer allowed, peer undesired, adult allowed, adult undesired) ANOVA on toddlers' understanding of the two sentences that the emoter stated after watching the respective video revealed an effect of age, such that 24-month-olds understood more of the two sentences than 18-month-olds ($M = 1.84$, $SD = 0.37$ vs. $M = 1.46$, $SD = 0.68$), $F(1, 84) = 9.813$, $p = 0.002$, $\eta_p^2 = 0.105$. Data was not provided for one 24-month-old toddler. There was no effect of condition and no age × condition interaction, all $Fs < 1$. Thus, there was no indication that visual appeal and linguistic difficulty varied as a function of experimental condition.

Second, we assessed whether the speed toddlers started interacting with the stimuli at test varied as a function of age and condition by conducting a 2 (age: 18 months, 24 months) x 5 (condition: peer allowed, peer undesired, adult allowed, adult undesired, baseline control) ANOVA on toddlers' latency to touch the stimuli at test. There was no effect of age or condition and no interaction effect, largest $F(1, 100) = 2.69$, $p = 0.104$. Five 24-month-olds (three in the peer undesired condition, one in the adult allowed, and one in the adult undesired condition) and one 18-month-old toddler (adult undesired condition) did not touch the stimuli within the test period and hence received a score of 120 s (latencies for the five conditions were as follows: Baseline: $M = 1.32$ s, $SD = 2.54$; Peer allowed: $M = 1.72$ s, $SD = 4.04$; Peer undesired: $M = 16.62$ s, $SD = 41.01$; Adult allowed: $M = 6.22$ s, $SD = 25.43$, Adult undesired: $M = 11.87$ s, $SD = 33.77$).

3.2. Main analyses: imitation

Our main interest was to examine imitative behavior of allowed versus undesired actions from an adult versus peer model. Imitation was inferred if toddlers in the experimental conditions performed a statistically significant higher number of target actions than toddlers in the baseline control condition.

We thus conducted a 2 (age: 18 months, 24 months) × 5 (condition: peer allowed, peer undesired, adult allowed, adult undesired, baseline control) ANOVA on toddlers' mean imitation scores (see Table 2 for mean imitation scores for each condition at each age). There was no significant effect of age, and no significant age × condition interaction, biggest $F(1, 100) = 1.581$, $p = 0.211$. However, there was a significant effect of condition, $F(4, 100) = 3.055$, $p = 0.02$, $\eta_p^2 = 0.109$, see Fig. 1.

A post-hoc Dunnett's t-test revealed that toddlers in the peer allowed condition performed a significantly higher number of target actions than toddlers in the baseline control condition ($p = 0.007$). Furthermore, the difference in imitation scores between toddlers in the adult allowed condition and toddlers in the baseline control condition was marginally significant ($p = 0.059$). Toddlers in the peer undesired ($p = 0.363$) and in the adult undesired ($p = 0.488$) conditions, in contrast, did not perform more target actions than toddlers in the baseline control condition. An additional post-hoc t-test showed that toddlers in both "allowed" conditions (peer, adult) combined performed a higher number of target actions then toddlers in both "undesired" conditions (peer, adult) combined ($M = 1.91$, $SD = 1.071$ vs. $M = 1.34$, $SD = 1.166$), $t(91) = 2.464$, $p = 0.016$, $d = 0.509$.

Overall, this pattern of results indicates that toddlers were more likely to imitate actions that were tagged as allowed by the emoter's reactions to them than actions that were tagged as undesired by the emoter's reactions to them.

4. Discussion

The main question of interest in the present study was whether 18- and 24-month-old toddlers' imitative behavior varies as a function of a model's age and permissiveness of the demonstrated actions. In accordance with Repacholi and Meltzoff (2007) and Repacholi et al. (2008) work the toddlers in the present sample were more likely to copy actions that had been tagged as allowed by

Table 2
Mean imitation scores (*SD*) for each condition per age group.

Condition						
		Adult allowed	Adult undesired	Peer allowed	Peer undesired	Baseline
Age group	18 months	1.75 (*1.06*)	1 (*0.85*)	1.92 (*1.17*)	0.92 (*1*)	1.3 (*0.68*)
	24 months	1.8 (*1.14*)	1.58 (*1.31*)	2.17 (*1.03*)	1.91 (*1.3*)	.71 (*0.76*)

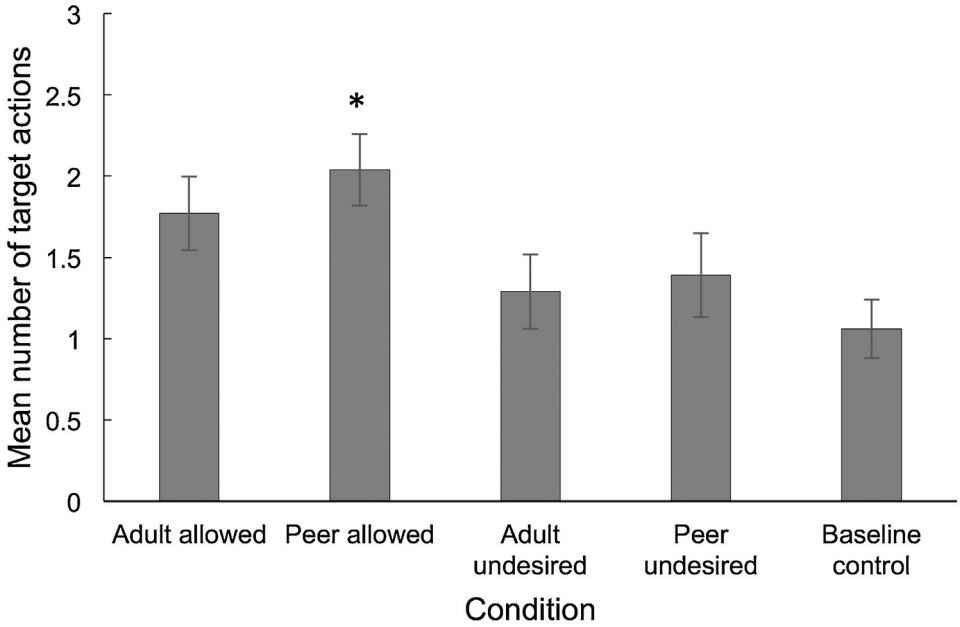

Fig. 1. Mean imitation scores (± 1*SE*) as a function of experimental condition, collapsed across age groups. An asterisk indicates that the mean imitation score of a condition is significantly higher than that of the baseline control condition.

the emoter's reactions than actions that had been tagged as undesired by the emoter's reactions. Extending Repacholi et al.'s results, the present study revealed that the emoter's reactions influenced imitation from a peer as well as from an adult model. If the emoter displayed a dislike for either model's actions, toddlers' production of target actions did not exceed baseline levels. The absence of a difference in latency to touch the objects shows that the toddlers in both "undesired" conditions did not refrain from interacting with the objects in general. Rather, the effect of the emoter's dislike was selectively connected to the model's actions. Thus, toddlers appear to use third-party appraisals of a model's actions to guide their imitative behavior in social learning situations with different models.

It is possible that the emoter was particularly influential due to the set-up and procedure in the present study. The experiment was conducted in a laboratory setting that was unfamiliar to the toddlers but that the emoter apparently knew well and navigated confidently. In addition, the emoter also served as the experimenter, guiding toddler and caregiver through the entire procedure. Previous imitation (Seehagen & Herbert, 2012; Zmyj, Buttelmann, Carpenter, & Daum, 2010) and social referencing research (Stenberg, 2009) suggests that infants and toddlers preferentially use information provided by persons they perceive to be competent and able to provide meaningful information (cf. also Wood et al., 2013). Perhaps an emoter who is perceived to be lower in status (e.g., a child) and/or not in charge of a particular setting (e.g., toddler's home) would be less effective in preventing the imitation of undesired actions. To test this idea, future studies could vary the identity of the emoter (e.g., child, mother, experimenter) and the setting (e.g., lab, home). In the presence of a less powerful emoter, toddlers might imitate undesired actions to some extent − and perhaps preferentially from specific models. In addition, it would be desirable to increase the sample size in similar studies to be able to reliably detect effects of different types of social cues that are moderate or small in magnitude.

Imitation of neither the allowed nor the undesired actions varied as a function of the model's age. Thus, we did not find any evidence for a general "peer model advantage" or an "adult model advantage". It seems that the emoter's reactions were the more powerful social cue in our experimental procedure, perhaps overriding the potential influence of a model's age on imitation. In addition, the nature of the task we used might – at least partly – explain the results. It has been suggested that toddlers imitate peers primarily for affiliative reasons and adults for learning purposes (Zmyj & Seehagen, 2013). In accordance with this idea, 14-month-old infants preferentially imitated familiar behaviors (e.g., clapping) from a peer and novel behaviors (e.g., using their head to turn on a light) from an adult model in previous studies (Zmyj, Aschersleben et al., 2012; Zmyj, Daum et al., 2012). However, it is conceivable that in many situations, infants and toddlers might be both socially and cognitively motivated to imitate. Thus, it is difficult to pinpoint the exact reasons or motivation for imitative behavior in complex social learning situations (Over & Carpenter, 2013; Zmyj & Seehagen, 2013). Some previous research did not find consistent differences in immediate imitation from peer and adult models in 18- to 24-month-olds (Seehagen & Herbert, 2011; Shimpi, Akhtar, & Moore, 2013). As in these studies, the peer and adult model in the present study demonstrated playful object-directed actions that resulted in a pleasant outcome. The objects in the present study were novel (perhaps triggering a cognitive motivation to learn about them) while the actions as such that is, inserting a ball in a container, attaching an object to another, and shaking were likely not novel to the toddlers. An avenue for future research could be to use the present design but have the models demonstrate actions that are either highly unusual, and thus truly novel (e.g., turning on a lamp with the head, Meltzoff, 1988), or definitely familiar and typically used in a communicative context (e.g., hand clapping, Zmyj, Aschersleben et al., 2012).

In addition to the model's age, the toddlers' age did also not lead to any differences in imitation scores. This result is in accordance

with previous imitation research using similar tasks with 18- and 24-month-olds where age-related changes in imitation scores emerged only after substantial delays, and not at the immediate test (Herbert & Hayne, 2000b). Thus, from at least 18 months of age, toddlers reliably take into account a third party's reactions about actions performed by differently aged models, even if the demonstrations are televised and thus more difficult to process than live demonstrations (Barr, 2013). Interestingly, however, although in the present study there was an age-related difference in infants' understanding of the emoter's comments on the model's actions, this difference in understanding did not translate into age-related differences in imitation scores. It is possible that other social cues of the emoter were more influential on toddlers' behavior than her words. For example, her facial expressions and/or intonation might have conveyed her message more vividly. Alternatively, it is possible that our simple comprehension measure did not adequately capture toddlers' understanding of the relevant sentences. In future studies, obtaining standardized scores using established measures such as the MacArthur-Bates Communicative Development Inventories (CDI, Fenson et al., 1993) could be used instead or in addition.

Over the last years, researchers have studied the role of a number of social cues for early imitation, including a model's competence (Zmyj et al., 2010), age (Ryalls et al., 2000 Seehagen & Herbert, 2011; Zmyj, Aschersleben et al., 2012, Daum et al., 2012), group membership (Buttelmann, Zmyj, Daum, & Carpenter, 2013), familiarity (Seehagen and Herbert, 2010; Seehagen and Herbert, 2012), use of language (Hayne & Herbert, 2004; Seehagen & Herbert, 2010), and ostensive cues (Csibra & Gergely, 2009). In everyday life, more than a single social cue is typically available to toddlers in rich social learning situations. For example, a mother might use infant-directed speech to describe how she prepares a sandwich, or an older sibling might initiate eye contact before starting to teach a toddler how a novel toy works. In the present study, we investigated the role of two social cues simultaneously, an emoter's appraisal of an action sequence, and age of the model. In this context at least, the emoter's reactions were more influential in shaping toddlers' imitation than the age of the model. Determining how infants and toddlers take into account different social cues, and under which circumstances they give more weight to one or the other in complex social learning situations will be a relevant avenue for further research.

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References

Bandura, A. (1977). *Social learning theory*. Oxford, England: Prentice-Hall.

Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *The Journal of Abnormal and Social Psychology*, *66*, 3–11. http://dx.doi.org/10.1037/h0048687.

Barr, R. (2013). Memory constraints on infant learning from picture books, television, and touchscreens. *Child Development Perspectives*, *7*, 205–210. http://dx.doi.org/10.1111/cdep.12041.

Barr, R., & Hayne, H. (1999). Developmental changes in imitation from television during infancy. *Child Development*, *70*, 1067–1081.

Barr, R., & Hayne, H. (2003). It's not what you know, it's who you know: Older siblings facilitate imitation during infancy. *International Journal of Early Years Education*, *11*, 7–21. http://dx.doi.org/10.1080/0966976032000066055.

Barr, R., Dowden, A., & Hayne, H. (1996). Developmental changes in deferred imitation by 6- to 24-month-old infants. *Infant Behavior and Development*, *19*, 159–170. http://dx.doi.org/10.1016/S0163-6383(96)90015-6.

Buttelmann, D., Zmyj, N., Daum, M., & Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Development*, *84*, 422–428. http://dx.doi.org/10.1111/j.1467-8624.2012.01860.x.

Collie, R., & Hayne, H. (1999). Deferred imitation by 6- and 9-month-old infants: More evidence for declarative memory. *Developmental Psychobiology*, *35*, 83–90. http://dx.doi.org/10.1002/(SICI)1098-2302(199909)35:2<83:AID-DEV1>3.0.CO;2-S.

Csibra, G., & Gergely, G. (2009). Natural pedagogy. *Trends in Cognitive Sciences*, *13*, 148–153. http://dx.doi.org/10.1016/j.tics.2009.01.005.

Devouche, E. (2004). Mother versus stranger: a triadic situation of imitation at the end of the first year of life. *Infant and Child Development*, *13*, 35–48. http://dx.doi.org/10.1002/icd.334.

Fenson, L., Dale, P., Reznick, I. S., Thal, D., Bates, E., Hartung, J. P., et al. (1993). *MacArthur Communicative Development Inventory: User's guide and technical manual*. San Diego, CA: Singular Publishing.

Hanna, E., & Meltzoff, A. N. (1993). Peer imitation by toddlers in laboratory, home, and day-care contexts: Implications for social learning and memory. *Developmental Psychology*, *29*, 701–710. http://dx.doi.org/10.1037/0012-1649.29.4.701.

Hayne, H., & Herbert, J. (2004). Verbal cues facilitate memory retrieval during infancy. *Journal of Experimental Child Psychology*, *89*, 127–139. http://dx.doi.org/10.1016/j.jecp.2004.06.002.

Hayne, H. (2004). Infant memory development: Implications for childhood amnesia. *Developmental Review*, *24*, 33–73. http://dx.doi.org/10.1016/j.dr.2003.09.007.

Herbert, J., Gross, J., & Hayne, H. (2006). Age-related changes in deferred imitation between 6 and 9 months of age. *Infant Behavior and Development*, *29*, 136–139. http://dx.doi.org/10.1016/j.infbeh.2005.08.002.

Herbert, J., & Hayne, H. (2000a). Memory retrieval by 18–30-month-olds: Age-related changes in representational flexibility. *Developmental Psychology*, *36*, 473–484. http://dx.doi.org/10.1037/0012-1649.36.4.473.

Herbert, J., & Hayne, H. (2000b). The ontogeny of long-term retention during the second year of life. *Developmental Science*, *3*, 50–56. http://dx.doi.org/10.1111/1467-7687.00099.

Meltzoff, A. N. (1985). Immediate and deferred imitation in fourteen- and twenty-four-month-old infants. *Child Development*, *56*, 62–72. http://dx.doi.org/10.2307/1130174.

Meltzoff, A. N. (1988). Infant imitation after a 1-week delay: Long-term memory for novel acts and multiple stimuli. *Developmental Psychology*, *24*, 470–476. http://dx.doi.org/10.1037/0012-1649.24.4.470.

Meltzoff, A. N. (2007). 'Like me': A foundation for social cognition. *Developmental Science*, *10*, 126–134. http://dx.doi.org/10.1111/j.1467-7687.2007.00574.x.

Over, H., & Carpenter, M. (2013). The social side of imitation. *Child Development Perspectives*, *7*, 6–11. http://dx.doi.org/10.1111/cdep.12006.

Repacholi, B. M., & Meltzoff, A. N. (2007). Emotional eavesdropping: Infants selectively respond to indirect emotional signals. *Child Development*, *78*, 503–521. http://dx.doi.org/10.1111/j.1467-8624.2007.01012.x.

Repacholi, B. M., Meltzoff, A. N., & Olsen, B. (2008). Infants' understanding of the link between visual perception and emotion: 'If she can't see me doing it, she won't get angry. *Developmental Psychology*, *44*, 561–574. http://dx.doi.org/10.1037/0012-1649.44.2.561.

Ryalls, B. O., Gul, R. E., & Ryalls, K. R. (2000). Infant imitation of peer and adult models: Evidence for a peer model advantage. *Merrill-Palmer Quarterly*, *46*(1),

188–202.
Seehagen, S., & Herbert, J. S. (2010). The role of demonstrator familiarity and language cues on infant imitation from television. *Infant Behavior and Development*, *33*, 168–175. http://dx.doi.org/10.1016/j.infbeh.2009.12.008.
Seehagen, S., & Herbert, J. S. (2011). Infant imitation from televised peer and adult models. *Infancy*, *16*, 113–136. http://dx.doi.org/10.1111/j.1532-7078.2010.00045.x.
Seehagen, S., & Herbert, J. S. (2012). Selective imitation in 6-month-olds: The role of the social and physical context. *Infant Behavior and Development*, *35*, 509–512. http://dx.doi.org/10.1016/j.infbeh.2012.05.002.
Seehagen, S., Konrad, C., Herbert, J. S., & Schneider, S. (2015). Timely sleep facilitates declarative memory consolidation in infants. *Proceedings of the National Academy of Sciences of the United States of America*, *112*, 1625–1629. http://dx.doi.org/10.1073/pnas.1414000112.
Shimpi, P. M., Akhtar, N., & Moore, C. (2013). Toddlers' imitative learning in interactive and observational contexts: The role of age and familiarity of the model. *Journal of Experimental Child Psychology*, *116*, 309–323. http://dx.doi.org/10.1016/j.jecp.2013.06.008.
Stenberg, G. (2009). Selectivity in infant social referencing. *Infancy*, *14*, 457–473. http://dx.doi.org/10.1080/15250000902994115.
Wood, L. A., Kendal, R. L., & Flynn, E. G. (2013). Whom do children copy? Model-based biases in social learning. *Developmental Review*, *33*, 341–356. http://dx.doi.org/10.1016/j.dr.2013.08.002.
Zmyj, N., Aschersleben, G., Prinz, W., & Daum, M. (2012). The peer model advantage in infants' imitation of familiar gestures performed by differently aged models. *Frontiers in Psychology*, *3*. http://dx.doi.org/10.3389/fpsyg.2012.00252.
Zmyj, N., Buttelmann, D., Carpenter, M., & Daum, M. M. (2010). The reliability of a model influences 14-month-olds' imitation. *Journal of Experimental Child Psychology*, *106*, 208–220. http://dx.doi.org/10.1016/j.jecp.2010.03.002.
Zmyj, N., Daum, M. M., Prinz, W., Nielsen, M., & Aschersleben, G. (2012). Fourteen-month-olds' imitation of differently aged models. *Infant and Child Development*, *21*, 250–266. http://dx.doi.org/10.1002/icd.750.
Zmyj, N., & Seehagen, S. (2013). The role of a model's age for young children's imitation: A research review. *Infant and Child Development*, *22*, 622–641. http://dx.doi.org/10.1002/icd.1811.