Evidence for nonconscious behavior-copying in young children

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Abstract

Behavioral mimicry is the nonconscious copying of an interaction partner's behavior and is affected by social dynamics. Whereas it has been studied extensively in adults, little is known about the development of mimicry. The aims of this study were twofold, first to identify whether young children demonstrate mimicry and, second, to investigate whether young children's mimicry displays sensitivity to social dynamics. Using a video-based paradigm, 40-month-old children observed six types of behaviors (i.e. yawning, laughing, frowning, cheek-scratching, mouth-rubbing and head-wiggling) performed by a model which they had previously seen either helping or hindering another model. Results indicate that children carried out five of the six behaviors more often while watching the behavior videos than during baseline. However, no differences were found between the two social manipulations. We conclude that young children demonstrate mimicry like that reported in adults and discuss the possible causes of the absence of a social effect.

Keywords: behavioral mimicry; development; action; social dynamics; social interaction.

Introduction

An often unnoticed component of social interactions is behavioral mimicry. Mimicry can be defined as nonconsciously adopting the behaviors of an interaction partner (van Baaren et al., 2009). In one of the first comprehensive studies of mimicry, participants were exposed to foot-shaking or face-rubbing confederates with smiles or neutral expressions on their faces. Chartrand and Bargh (1999) showed that participants were more likely to carry out the modeled behaviors and expressions than the non-modeled behaviors and expressions. Importantly, replicating these behaviors occurred outside of the participants' awareness (Chartrand & Bargh, 1999).

In contrast to the extensive adult literature on mimicry (for a review see Chartrand & van Baaren, 2009), exceptionally few studies have investigated the development of mimicry. Some authors have documented neonatal imitation (e.g. Meltzoff & Moore, 1977; Meltzoff & Moore, 1983). Others, however, note the lack of breadth of these behaviors and have been unable to replicate original findings with older infants and young children (e.g. Anisfeld, 1996; Jones, 2007). Additionally, in such studies, infants and young children are encouraged to replicate modeled behaviors (e.g. Jones 2007), which stands in contrast to the uninstructed mimicry reported in adults. In one study that did not give replication instructions, children saw video stimuli in which someone often yawned, but children under the age of five did not demonstrate instances of yawning (Anderson & Meno, 2003). In a live paradigm, only three out of 40 children under the age of four demonstrated contagious yawning (Helt et al., 2010). Similarly, Over and Carpenter (2009) report that, in a pilot study, 5-year-old children who interacted with an adult who repetitively touched her face failed to mimic this behavior. Notably, the authors posited that there was little evidence to suggest that children under the age of five exhibit mimicry of the sort found in adults (Over & Carpenter, 2009).

Not only do adult studies indicate the uninstructed nature of mimicry, but they also bring to light its sensitivity to social dynamics. For example, liking one's interaction partner has been shown to increase mimicry rates, both when liking was preexistent and manipulated (Likowski et al., 2008; McIntosh, 2006). Although there is no evidence of uninstructed mimicry in young children, a form of imitation has been shown to be affected by social dynamics. Overimitation (also called affiliative imitation) is the replication of actions shown during a task demonstration that are unrelated to achieving the desired end-state of the task (Over & Carpenter, 2012). In a conceptual replication of an adult study by Lakin, Chartrand and Arkin (2008) which showed that being socially excluded lead to higher mimicry rates, Over and Carpenter (2009) found that priming 5-year-olds with social exclusion increased overimitation rates (Over & Carpenter, 2009), indicating that non-mimicry forms of behavior replication are sensitive to social factors in young children.

Children's sensitivity to social dynamics is also manifest in other behavioral measures. One study showed that 3-year-olds helped helpful adults more than destructive adults (Vaish, Carpenter, & Tomasello, 2010). Kenward and Dahl (2011) demonstrated that, when given an uneven number of biscuits, 4.5-year-olds distributed more biscuits to puppets they saw helping another puppet than to puppets they saw violently hindering the other puppet. Three-year-olds did not distinguish in their biscuit-distribution but the authors suggest this was because they were shocked by the violent nature of the events and were not sure which puppet was which (Kenward & Dahl, 2011).

Thus far, no studies have reliably found uninstructed mimicry during early childhood, and it is hence also unknown if children's mimicry is affected by social dynamics. In the present study, we first aimed to identify whether young children demonstrate mimicry like that found in adults. Importantly, we incorporated a range of behaviors, such as facial expressions and manual behaviors, to investigate the generality of young children's mimicry. Also, as past adult studies have successfully used videos to elicit mimicry (e.g. Lakin & Chartrand, 2003; Platek et al., 2003), we chose to present the stimuli as videos to ensure that all children saw identical behaviors. Moreover, this provided the children with a 'task', namely to watch TV, which is in line with the contention of van Baaren and colleagues (2009) that during mimicry experiments the focus should not be on the behaviors specifically. We incorporated a baseline measure so as to compare natural behavior rates with those elicited by observation within participants, because past studies indicate that individual differences influence mimicry rates (e.g. Chartrand & Bargh, 1999; Platek et al., 2003; Sonnby-Borgström, 2002). We hypothesized that children would demonstrate the behaviors at greater frequencies while watching the behavior videos than during baseline.

The second aim was to address whether mimicry is sensitive to social dynamics at three years of age. As past studies demonstrated that children around three and four years of age show differential treatment of helpers versus hinderers (Kenward & Dahl, 2011; Vaish et al., 2010), we used a similar paradigm to manipulate the social dynamics. We designed the models' interactions such that the helper would come across as a nice individual whereas the hinderer would be seen as a mean but not violent individual. In this manner, we aimed to implement a similar effect as in the manipulated-liking designs of adult mimicry studies (Likowski et al., 2008; McIntosh, 2006). Due to possible carry-over effects from previous interactions (e.g. Lakin & Chartrand, 2003), we used this social manipulation as a between-participants factor, such that half of the children were randomly assigned to the helper condition and half to the hinderer condition. We hypothesized that children would mimic helpers more than hinderers, replicating the pattern of higher mimicry rates for liked individuals in adult studies.

Methods

Participants

Participants were recruited through the database of volunteer families of the Baby Research Center Nijmegen. Signed consent was obtained from parents beforehand. Thirty-three children participated in this study (mean age: 39.7 months, range: 39.2-40.2; 23 girls). Seven children were excluded due to not wanting to watch the videos (N=1), technical error (N=1), and not meeting the inclusion criteria of having attended to at least 40% of the behavior videos (N=3) or having watched each behavior video at least once (N=2). Thus, the final sample consisted of 26 children (19 girls).

Stimuli

The stimulus videos for the experiment were made using a digital video camera (Sony Handycam, DCR-SR190E) and were digitally muted. Two types of videos were recorded, social manipulation videos and behavior videos.

Figure 1.2 shows the final scene of the helper video, and gives an indication of the scene composition used in the social manipulation videos. In both the helper and hinderer videos, a stuffed animal was initially positioned in the left, front corner of the table, and the helper or hinderer (H) walked in from the left and the neutral model (N) from the right, each sitting down at their respective sides of the table. After N failed to reach the stuffed animal from her position, H reached over to get the stuffed animal and held it out to N who reached for it. At this point the videos differed; in the helper videos, H passed the stuffed animal to N who held it as in Figure 1.2, whereas in the hinderer videos, H pulled the stuffed animal back and held it to her chest.

Three adult female models were used. Two models were used for H (i.e. H1 and H2), who each played both the helper and the hinderer in order to control for possible idiosyncrasies of each model. The model for H was kept consistent within participants, such that children who saw H1 during the social manipulation video also saw the behavior videos of H1, and the same for H2. The H models wore a colored shirt to aid subsequent identification while N wore black. Since N never reappeared in the behavior videos, only one model played her role.

Six different behavior videos were made. The first, yawning, was selected for its contagious qualities (Figure 1.3; Platek et al., 2003). Two emotional facial expressions, laughing and frowning (i.e. a sad facial expression), were used as they have successfully elicited mimicry in adult studies (Lakin & Chartrand, 2003; Moody & McIntosh, 2011; Sonnby-Borgström, 2002) and recently also in school-aged children (Deschamps et al., 2012). Two manual behaviors were loosely based on those used in interactive adult studies (e.g. Chartrand & Bargh, 1999; Lakin & Chartrand, 2003), namely using the fingertips to scratch the cheek (i.e. cheek-scratching) and rubbing the fingertips back and forth across sealed lips (i.e. mouth-rubbing; Figure 1.5). Finally, in the head-wiggling clip the model moved her head from side to side while looking forwards. Each behavior video showed the model in a neutral position for the first and last 500 milliseconds. Pilot data indicated that children of this age were capable of replicating all behaviors.

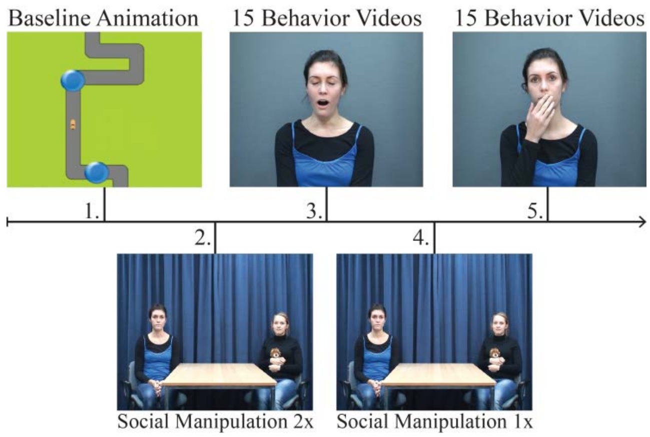

Figure 1: Experimental design.

Design

This experiment consisted of three types of stimuli: the baseline, the social manipulation and the behavior videos. For the baseline, a non-social video (73.7sec.) from an unrelated experiment was shown displaying a single racecar driving through a racetrack (Figure 1.1; Immens, 2011). Next, the social manipulation video (average duration 23sec.), depending on the condition the participant was assigned to, was shown twice (Figure 1.2). The behavior videos (average duration 7sec.) were presented after the social manipulation videos (Figure 1.3 and 1.5). Each of the six behaviors was presented five times, resulting in 30 behavior videos in total, and after every 5 behavior videos an attention grabber video (2 sec.) was shown. After half of the behavior videos were played, the same social manipulation video was shown a third time (Figure 1.4) and was announced via a recording of a voice saying in Dutch, "Look! Again this video." Children's behavior during the third repetition of the social manipulation video was not included in the behavior rate calculations. Together, the baseline, the three repetitions of the social manipulation video and the 30 behavior videos lasted approximately six minutes. At the end of the experiment, the experimenter asked the children if they remembered the social manipulation video, if they could describe what had happened and whether the model was nice or mean, as well as whether the child remembered copying the model's behaviors.

Randomization and counterbalancing. The (pseudo)-randomizations were done using Mix (van Casteren & Davis, 2006). Participants were randomly assigned to one of the two conditions (i.e. helper or hinderer) and one of the two models (i.e. H1 or H2); hence there were four groups, one for every combination of condition and model. For each group there were two presentation orders of behavior videos (i.e. eight in total), which were constrained such that at least three different behavior types had to be presented before the same behavior could be shown again, and these presentation orders were counterbalanced across participants.

Procedure

Following a short play session, the child and parent were led to the experiment room. Children were seated in front of an eye-tracker (T120, Tobii Technology, Stockholm, Sweden, Tobii Studio software) either alone or on their parent's lap. A video camera (Sony Handycam, DCR-SR190E) was positioned to the side of the child such that it was not in her direct visual field but still obtained the most frontal recording angle possible. The only instructions given were to watch the videos. Upon conclusion, the participants were allowed to select a storybook or were given 10 Euros for participating in the experiment.

Coding and Reliability

The children's behavior was coded using ELAN Linguistic Annotator (4.3.3, http://tla.mpi.nl/tools/tla-tools/elan, Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands; Lausberg & Sloetjes, 2009). The coder was blind to condition and the order of stimulus presentation.

Although the experiment was presented on an eye-tracker so that attention could be measured precisely, the percentage of looking time according to the output was often considerably lower than the amount of time that the child actually attended the screen (for comparable eye-tracking discrepancies, see Morgante, Zolfaghari, & Johnson, 2012). For this reason, attention was coded by hand. If the child looked away for more than five seconds, turned to interact with the parent or experimenter, or was not clearly visible on the video, that duration was coded as not-attending.

Pilot data was used to create the coding scheme for the behaviors so as to accommodate how children carry out each behavior. If the child verbally labeled a behavior right before, during or after carrying it out, it was not coded as mimicry. Also, behaviors that started while the child was not attending were not coded as these might have been externally triggered. The exact coding scheme is available from the first author, with the required characteristics as follows. Yawns were coded when the lips were parted forming an O-shape. For laughing, the corners of the mouth needed to be turned upwards (i.e. smiles were also counted) while for frowns they needed to be turned downwards. A cheek scratch was coded if the child brought her hand to her cheek or forehead and made scratching movements with her fingers. If the child rubbed her fingers over her mouth or chin it was coded as a mouth rub. Lastly, the head-wiggle was coded when the child tilted her head to the left or right and then to the other side at least once.

To ensure coding-reliability, a random sample of 20 percent of the participant videos was re-coded. The mean intraclass correlation coefficient between behavior rates of the first and second coding was r = .98.

Behavioral Measures

The timing of all events (e.g. onset and offset times of stimuli and the participant's behaviors) were synchronized and rounded to the nearest 100 milliseconds. The baseline and behavior videos period were separated; the baseline consisted of the duration of the racecar animation and the behavior videos period was defined as starting when the first behavior video started and ending after the last behavior video, but with the social manipulation video in between excluded. Participant's behaviors that occurred during the behavior videos period but before the first attended behavior video of that type were excluded.

Behavior rates. Per participant, it was counted how often each behavior was carried out, and rates were calculated separately for the baseline and behavior videos period. Total behavior rates were calculated by dividing the total behavior count by the duration in minutes that the screen was attended. Similarly, behavior rates were calculated per behavior type using the count of just one behavior. For these separate behavior rates, the duration attended in minutes for the behavior videos period was adjusted to start from the beginning of the first behavior video of that behavior type, resulting in the separate behavior rates being lower than the overall behavior rate. Hence, per participant, per baseline or behavior videos period, seven behavior rates (i.e. behaviors per minute attended) were calculated: the overall rate and one rate for each of the six behavior types.

Analysis

Several comparisons were run to check that the models and the presentation orders did not have an effect on behavior rates during the behavior videos period and were run separately for the two conditions. The helper condition consisted of 12 participants, five of whom saw the videos of model H1, while the hinderer condition had 14 participants, 7 of whom saw model H1. Independent-samples *t*-tests and Mann-Whitney U-tests compared the effect of model (e.g. H1 or H2) on total behavior rates and separate behavior rates, respectively, and Kruskal-Wallis H-tests compared the effect of the presentation orders on both total behavior rates and separate behavior rates. There were no effects of model or presentation orders for total or separate behavior rates in either condition (all *p*s >.1). Therefore, the models and presentation orders were collapsed in the subsequent analyses. Additionally, Mann-Whitney U-tests revealed no differences in behavior rates between children sitting on their parents' laps and those sitting alone on the chair during either the baseline or the behavior videos period (all *p*s >.2).

Results

Out of the 26 participants, 25 participants demonstrated at least one of the six behaviors during either the baseline or the behavior videos period, and 23 participants carried out the behaviors more often while watching the behavior videos than during baseline.

Since it first needed to be investigated whether the two conditions (i.e. groups of participants) differed, the hypothesized difference between the helper and hinderer condition during the behavior videos period was tested. However, a Mann-Whitney U-test revealed no significant difference in total behavior rates between conditions (p>.4). Hence, for the subsequent comparisons the participant groups were collapsed across conditions.

To investigate whether behavior rates differed between baseline and the behavior videos period, a paired-samples *t*-test was used to compare total behavior rates. Children carried out the behaviors significantly more often during the behavior videos period (M=2.38 behaviors per minute, SE=0.24) than during the baseline (M=0.92 behaviors per minute, SE=0.33; $t(25)$=-4.3, p<.001, r=.65).

Subsequently, each separate behavior was investigated using Wilcoxon signed-rank tests, and alpha was corrected for multiple comparisons using a Bonferroni correction[1] (Figure 2). During the behavior videos, the rates of yawning, frowning, mouth-rubbing and head-wiggling, were significantly higher than the baseline rates of yawning (z=3.18, r=.44), frowning (z=2.74, r=.38), mouth-rubbing (z=2.61, r=.36) and head-wiggling (z=2.93, r=.41; all ps<.008), respectively. Cheek-scratching occurred more often during the behavior videos period than during the baseline at a level of marginal significance (p=.011). Laughing did not differ significantly between the two periods.

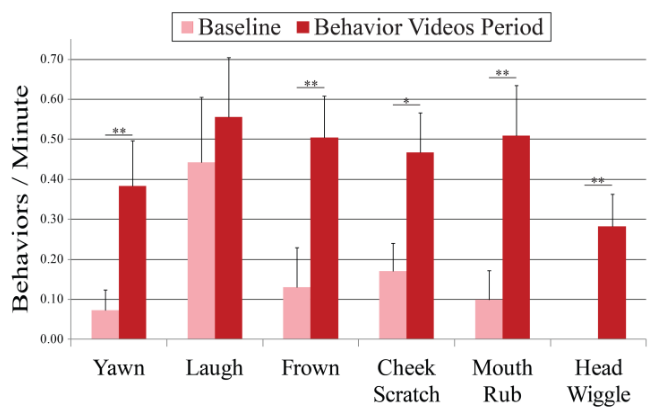

Figure 2: Mean behavior rates of each behavior type for the baseline and behavior videos period. Error bars indicate one standard error above the mean; **p<.008, *p=.011.

For the five behaviors with significant and marginally significant effects, it was investigated post hoc whether any one behavior was more likely to be replicated than the other behaviors. A Friedman's ANOVA was used to compare the difference in behavior rates between baseline and behavior videos period (i.e. behavior videos period behavior rate

[1]The Bonferroni correction was calculated by dividing the alpha level (one-tailed) by the number of comparisons (i.e. six). Hence, adjusted alpha levels were 0.008 for significance values of p<.05 and 0.017 for marginal significance values of p<.1.

minus baseline behavior rate) between the behaviors. No differences between the behaviors were found (all *p*s>.7).

A Mann-Whitney U-test showed that the children's answers to the question of whether they consciously replicated the model's behaviors were not predictive of their behavior rates during the behavior videos period (p>.6).

Discussion and Conclusion

This study aimed to identify and investigate mimicry in 40-month-old children. We found that children carried out the behaviors significantly more often while watching the behavior videos than while watching the baseline video. This was evident across individuals, as 23 out of 26 participants showed higher behavior rates during the behavior videos period than during baseline, and across behavior types, as five of the six behaviors were mimicked. Yawning, frowning, mouth-rubbing, and head-wiggling all occurred at significantly greater rates during the behavior videos than during baseline and cheek-scratching showed this effect at a level of marginal significance. Of the mimicked behaviors, no one behavior was more likely to be mimicked than others, while controlling for baseline rates.

Mimicry of these behavior types have, to the best of our knowledge, not been tested during early childhood before, with the exception of yawning. Helt and colleagues (2010) report very low rates of yawning in live paradigms under the age of four and Anderson and Meno (2003) did not find any instances of yawning during video watching in three-year-olds. In their video-based study, children were instructed to clap whenever they saw a yawn; as also suggested by Helt and colleagues (2010), the disparity between their findings and ours may be a result of the assigned tasks, since our simple instructions to watch the videos better resemble the uninstructed nature of adult mimicry studies. Indeed, the behavior rates during the behavior videos period of our study are similar to the behavior rates measured during live interactions in adults. For example, Chartrand and Bargh (1999) found an average rate of .57 face-rubs per minute, which closely corresponds to the children's average behavior rate of .51 for mouth-rubs.

The only behavior that did not demonstrate a mimicry effect in the current study was laughing. This was likely caused by the children's enjoyment of the baseline video, as average laughing rates during the baseline far exceeded those of the other behaviors' baseline rates. Although the baseline video was selected for its neutrality and non-social nature, the animation still needed to be, and in fact was, attractive enough for children to attend to it.

An important characteristic of mimicry is that it occurs outside of the awareness of both the individual mimicking and the individual being mimicked (Chartrand & van Baaren, 2009). Children were asked at the end of the experiment whether they copied the model while watching the behavior videos, and their answers were not related to their actual mimicry rates. Additionally, during a pilot study children were instructed to copy the behaviors, but it became apparent that they found it unusual to consciously replicate the behaviors of a non-responsive model, even when encouraged by their parents. Furthermore, our coding scheme ensured that the few cases in which children verbally labeled a carried-out behavior, indicating that they were focusing on doing that behavior, were not counted as mimicked behaviors. Anecdotally, several parents remarked that they were surprised to see their child replicate the behaviors seemingly automatically. Altogether, there is sufficient evidence to indicate that the children nonconsciously replicated the behaviors, in line with the definition of behavioral mimicry.

This study further investigated whether children's mimicry is sensitive to social dynamics. To influence the social dynamics, a helper-hinderer manipulation was used in a between-participants design. However, no significant differences between the conditions were found. Given that past studies have linked mimicry with social perspective taking skills (e.g. Chartrand & Bargh, 1999; Platek et al., 2003), it might be that the sensitivity of mimicry to social factors gradually develops during childhood as an effect of increasing social cognition and experience. However, it should be considered whether the social manipulation could have been ineffective. A limitation of the present study was that the social manipulation and behaviors were recorded as separate video clips with different background settings. Since Kenward and Dahl (2011) reported that their participants had difficulty later identifying the puppets, we allocated the helper and hinderer models a colored shirt to aid later identification. Nonetheless, the different setting of the two video types may have prevented children from making the link between the model in the social manipulation video and the model in the behavior videos. More support for this notion comes from recent pilot data with 5½-year-olds, which indicated that children older than those in this study often failed to relate the model in the behavior videos to the model in the social manipulation video seen before. A similar limitation was that video presentation prevented participants from actually affiliating with the model, thereby possibly preventing an affiliation-driven social effect, as suggested by Over and Carpenter (2012) regarding an overimitation study by Nielsen, Simcock and Jenkins (2008).

The findings of this study highlight avenues for further research into the neural and cognitive underpinnings of mimicry. Whereas a perception-action matching system founded in imitation research has been suggested to also underlie mimicry (Chartrand & van Baaren, 2009), it is unclear whether neural differences exist between nonconscious mimicry and instances of conscious motor observation and replication. Additionally, cognitive mechanisms have been suggested to contribute to imitative behaviors (e.g. Meltzoff, 2007; Woodward et al., 2009), and future studies should investigate whether similar mechanisms, and the development thereof, are involved in mimicry's reported social sensitivity.

In conclusion, this study is the first to identify uninstructed behavioral mimicry in 40-month-old children.

The spectrum of behaviors for which this was the case reflects the repertoire of mimicked behaviors in the adult literature (Chartrand & van Baaren, 2009), and provides a basis for future research investigating the underlying neural and cognitive processes. It is unclear whether the lack of social modulation of mimicry was a result of experimental design or an effect of social-cognitive development, and this posits further investigation.

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