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Over-imitation is not automatic: Context sensitivity in children's overimitation and action interpretation of causally irrelevant actions



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ABSTRACT

Recent research has documented the robust tendency of children to “over-imitate,” that is, to copy causally irrelevant action elements in goal-directed action sequences. Different explanations for over-imitation have been proposed. Causal accounts claim that children mistakenly perceive such action elements as causally relevant and, therefore, imitate them. Affiliation accounts claim that children over-imitate to affiliate with the model. Normative accounts claim that children conceive of causally irrelevant actions as essential parts of an overarching conventional activity. These different accounts generally hold the same predictions regarding children's imitative response. However, it is possible to distinguish between them when one considers additional parameters. The normative account predicts wide-ranging flexibility with regard to action interpretation and the occurrence of over-imitation. First, it predicts spontaneous protest against norm violators who omit the causally irrelevant actions. Second, children should perform the causally irrelevant actions less frequently, and criticize others less frequently for omitting them, when the actions take place in a different context from the one of the initial demonstration. Such flexibility is not predicted by causal accounts and is predicted for only a limited range of contexts by affiliation accounts. Study 1 investigated children's own imitative response and found less over-imitation when children acted in a different context from

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when they acted in the same context as the initial demonstration. In Study 2, children criticized a puppet less frequently for omitting irrelevant actions when the puppet acted in a different context. The results support the notion that over-imitation is not an automatic and inflexible phenomenon.

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Introduction

“Over-imitation”—that is, the faithful reproduction of causally irrelevant actions in goal-directed action sequences—has received extensive interest in recent developmental and comparative research on action understanding and imitation (e.g., Flynn & Smith, 2012; Horner & Whiten, 2005; Lyons, Young, & Keil, 2007; McGuigan, Whiten, Flynn, & Horner, 2007; Nielsen & Tomaselli, 2010). From this research, we know that over-imitation develops and increases over the preschool years (Hilbrink, Sakkalou, Ellis-Davies, Fowler, & Gattis, 2013; Marsh, Ropar, & Hamilton, 2014; McGuigan, Makinson, & Whiten, 2011; Nielsen, 2006) and seems to be absent in other great apes (Horner & Whiten, 2005; Nagell, Olguin, & Tomasello, 1993; Nielsen & Susianto, 2010).

Why do children over-imitate? Three broad types of accounts have been proposed to explain over-imitation. First, the automatic causal encoding account suggests that over-imitation stems from an automatic tendency to encode all elements of an action demonstrated by a model as causally relevant (Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons & Keil, 2013; Lyons et al., 2007). As an example, think of an action sequence comprising two action elements, A (tapping on a box) and B (flipping a switch), and an effect, E (box opens), such that only B is causally responsible for E. According to the automatic causal encoding account, children confronted with the intentional demonstration of this action sequence would be confused and consider A and B together as causally relevant and, thus, reproduce them accordingly. Second, affiliation accounts see the main reason for over-imitation in a social motivation to affiliate or identify with the model, or to avoid ostracism, by copying as faithfully as possible (Nielsen & Blank, 2011; Over & Carpenter, 2009, 2012). That is, confronted with the A–B action sequence with effect E, children would sometimes perform A not because they consider it necessary for bringing about E but rather because they want to affiliate with someone else, typically the model who had previously performed A himself or herself. Finally, rational normative action interpretation accounts have suggested that over-imitation is based on children’s flexible and rational action interpretation. Children, according to these accounts, do understand that causally irrelevant action elements are, in fact, causally irrelevant, but under certain circumstances they view these elements as conventionally (not causally) essential parts of bigger activities (Herrmann, Legare, Harris, & Whitehouse, 2013; Kenward, 2012; Keupp, Behne, & Rakoczy, 2013). That is, confronted with the A–B action sequence with effect E, children can engage in flexible hierarchical action parsing, individuation, and interpretation; they see each action element, and they see the causal connection $B \rightarrow E$. In addition, under some conditions, they see the whole sequence as constituting a bigger conventional action comprising A, B, and E. In these conditions—for example, when the action sequence has been introduced with a focus on the specific means of behavior and not just the ends (Keupp et al., 2013), with a specific label, or with a “ritual” rather than purely instrumental stance (Herrmann et al., 2013) (see below)—children will over-imitate,¹ acting on the assumption that the task is to

¹ Importantly, the account does not claim that these are the only conditions under which children over-imitate. The account leaves room, of course, for cases where children do not see A–B–E as somehow conventionally connected but rather have some other reason for performing A—for example, to please someone else who likes to see A (as the affiliation account claims). This makes the relation between the rational normative action interpretation account and the affiliation account quite complex. The accounts are surely not strongly mutually exclusive, and the latter might actually be just a special case of the former (or the former might be an extension of the latter)—a special instance of a rational action interpretation account claiming that children engage in rational action parsing and interpretation but that restricts itself to postulating only one specific motivation for over-imitation, namely affiliation.

reproduce this bigger action sequence. In addition, children will normatively expect third parties to reproduce the whole sequence as well and will protest in the case of omission of action element A (Kenward, 2012; Keupp et al., 2013). According to such accounts, from watching the A–B–E action demonstration, children extract and retain representations of different hierarchically related actions; there is the action “bringing about E” that can be variously realized but most simply by performing only B. In addition, there is the action “A–B–E” that comprises B and the bringing about of not only E but also A. So bringing about E is considered a proper part of A–B–E, and A–B–E is considered one specific (but not most efficient) way of bringing about E.

These different kinds of accounts often hold the same predictions regarding children’s imitative response. However, it is possible to distinguish between the accounts when additional experimental manipulations and dependent variables are considered. One such variable is spontaneous protest against norm violations (e.g., Rakoczy, Warneken, & Tomasello, 2008). Only the rational normative action interpretation account straightforwardly predicts the occurrence of such third-party critique after the omission of irrelevant actions by the third party, in particular protest that occurs after having seen that omitting the irrelevant action step does not affect instrumental success. Results that speak in favor of the normative account of over-imitation along these lines were recently found by Kenward (2012) and Keupp and colleagues (2013). Another respect in which the accounts diverge is their predictions regarding the flexibility of over-imitation, in particular regarding context sensitivity. The automatic causal encoding account predicts no such flexibility; an irrelevant action step is encoded as causally relevant regardless of the context in which it has been introduced (as long as it is performed intentionally) and regardless of the context in which imitation takes place. In contrast, the affiliation and rational normative action interpretation accounts predict more or less wide-ranging context sensitivity; pure affiliation accounts would predict some context sensitivity yet be limited to affiliation-relevant factors. For example, the presence or absence of the model can influence the rate of over-imitation; in a model-absent context, there is no one to affiliate with and over-imitation might be reduced (e.g., Nielsen & Blank, 2011). The rational normative action interpretation account, finally, predicts very wide-ranging flexibility and context sensitivity. On the one hand, it predicts sensitivity regarding the *introduction of the action*; children should be sensitive to the context in which the action sequence is introduced when parsing and interpreting it, in particular when deciding whether A is an obligatory element of a bigger integrated action A–B–E (in addition to and beyond the mere bringing about of E) or whether it is just an optional element. Numerous studies have shown that children are selective and context sensitive in their (over-)imitation in this way. First, children take into account the physical circumstances when interpreting an actor’s actions: they imitated bizarre means to an end faithfully more often when the actor could have achieved the end more efficiently than when he or she had no choice (Gergely, Bekkering, & Kiraly, 2002; Schwier, van Maanen, Carpenter, & Tomasello, 2006; Zmyj, Daum, & Aschersleben, 2009). Second, socioemotional factors surrounding the action demonstration have been shown to modulate children’s (over-)imitation such that, for example, contexts that emphasize the interaction between model and imitator more lead to more over-imitation (Marsh et al., 2014; Nielsen, 2006; Over & Carpenter, 2009; Watson-Jones, Legare, Whitehouse, & Clegg, 2014). Third, children are sensitive to the communicative context of the action demonstration, imitating more faithfully when an action sequence is introduced communicatively in ostensive ways than when it is performed non-communicatively (Király, Csibra, & Gergely, 2013). Fourth, going beyond mere sensitivity to the presence or absence of communication, some recent studies have found that children interpret and (over-)imitate action sequence A–B–E differently depending on *how* it was introduced communicatively; they tended to view A as merely optional when the whole action sequence was introduced with an instrumental focus (on bringing about E) but viewed A as an essential and binding part of a bigger activity when the whole action sequence was introduced with a conventional focus (Herrmann et al., 2013; Keupp et al., 2013; Watson-Jones et al., 2014). For example, in the study by Herrmann and colleagues (2013), higher imitative fidelity was accompanied by children providing more conventional explanations for their actions. In addition, children in the study by Keupp and colleagues (2013) criticized a puppet for omitting an irrelevant action more often in the conventional condition than in the instrumental condition. This difference in norm enforcement

can be attributed only to the framing of the demonstration given that the action sequence itself was the same for both conditions.

On the other hand, children should be sensitive to the context of *action performance*; it is a fundamental feature of conventional norms that they apply in context-specific ways such that one and the same action can be perfectly appropriate in one context while constituting a mistake in another context (Rakoczy & Schmidt, 2013; Turiel, 1983). For example, playing (touching) a ball with one's hand is appropriate behavior when playing handball but constitutes a rule violation when playing soccer. In the case of over-imitation according to the rational normative action interpretation account, the child has seen the action sequence A–B–E and has formed different representations of potential action types, notably bringing about E and A–B–E, and now the question is which of these two represented action types ought to be realized. Well, it depends on what the task is; this is what context relativity amounts to here. When the task is to bring about E as efficiently as possible, one ought to perform just B. In contrast, when the task is to perform the whole action sequence A–B–E, the performance of A is mandatory.

Such context sensitivity in the sense of flexible action selection as a function of context has been shown in cases where children were confronted with two completely separate activities; for example, 3-year-olds can switch from pretending X with an object in one context (puppet house 1) to pretending Y in another context (puppet house 2) and back again when it had been established that the two kinds of actions are to be performed at the two respective locations (Wyman, Rakoczy, & Tomasello, 2009). The structure in the above-mentioned over-imitation case, however, is more complex; the question is not whether to perform act X or the totally separate act Y as a function of context but rather whether to perform the whole action sequence (A–B–E) or only some part of it (bringing about E by performing B).

The first evidence for this more complex form of context sensitivity comes from a recent study by Nielsen and Blank (2011). When confronted with an agent (X) who performed an A–B–E sequence and an agent (Y) who performed only a B–E sequence, children adapted their own action during a second phase to the presence/absence of the two models; when they were with X, they over-imitated (performing A–B–E), but when they were with Y, they performed only B–E (Nielsen & Blank, 2011). The rational normative action interpretation account, however, predicts context sensitivity in an even broader sense, going beyond these findings. First, children should be able to form representations of the different potential actions (A–B–E vs. bringing about E), map them onto explicit verbal or other representations (e.g., bringing about E vs. some linguistic label for A–B–E), and then select an appropriate action as a function of task instructions. Second, children should be able to use these very same action representations to normatively evaluate third parties' actions. In more concrete terms, when children are confronted with an apparatus that they know can produce effect E and see someone perform an A–B–E action sequence (where it is clear that A is doing no causal work) and label it, say, "daxing," they assume that A and B are conventionally essential parts of the activity called daxing. So when they are later requested to "dax," they will perform A–B–E, and when they see someone else being requested to dax and then performing only B–E, they will consider this a conventional mistake and tend to criticize the agent for the omission of A. In contrast, when they are asked to bring about E, children will consider A merely optional and perform it less, and when someone else is asked to bring about E and performs only B–E, children will consider this appropriate and will not object.

The aim of the current research, therefore, was to test for such context sensitivity in children's action interpretation, over-imitation, and normative evaluation. Children were introduced to an apparatus and the fact that it produced effect E and then saw a demonstration of an action sequence—called, for example, daxing—consisting of elements A and B, of which the latter produced E. During the test phase, the action context varied between conditions; an actor was instructed either to dax (*same context condition*) or to bring about E (*different context condition*). In Study 1, the child himself or herself was the actor and the dependent measure was the child's differential over-imitation in the two conditions. In Study 2, the child watched a third party (puppet) acting and the dependent measure was differential protest against omission of A in the two conditions.

Study 1

Method

Participants

Participants were recruited from a local database of parents, who had volunteered to participate in child development studies, and were from mixed socioeconomic backgrounds.² A total of 32 preschool-aged children ($M_{\text{age}} = 54$ months, range = 43–65, 17 girls and 15 boys) participated.

Design and materials

In a within-participant design, children were administered a block of two tasks in the *same context* condition and a block of two tasks in the *different context* condition. The order of conditions and the assignment of tasks to conditions were counterbalanced across children. Each child participated in four tasks, two of them consisting of a main apparatus on which goal-relevant actions were performed and a physically disconnected part on which irrelevant actions were performed. For the other two tasks, irrelevant actions were performed at the main apparatus (e.g., knocking on it with a stick). These two types of tasks were counterbalanced across conditions and children. All tasks were designed to be equally intuitive and causally transparent (see Fig. 1 for details). A recent study (Keupp et al., 2013) reported that the rate of over-imitation was equally high compared with other studies despite using spatially disconnected irrelevant actions (on structurally similar tasks as those in the current study). Therefore, we did not expect this difference between our tasks to influence the results.

Procedure

The procedure consisted of a warm-up and familiarization phase and a test phase. The test session began with a brief warm-up in which a female experimenter (E) and the child played and talked together in the course of jointly completing a puzzle game. This was followed by a familiarization phase in which E told the child that today she would sometimes perform “extra and silly” actions. E used three transparent containers, each with a toy animal inside, which she opened after performing an irrelevant action on them (e.g., knocking on the container with a straw). After E got an animal out of a container, she asked the child about the causal relevance of each of the two actions (relevant action: opening the lid; irrelevant action: knocking on the container). If the child categorized the irrelevant action as relevant, E demonstrated its causal irrelevance (by opening the container without performing the irrelevant action). This familiarization was included because over-imitation is such a strong spontaneous tendency in humans and we wanted to prevent an “automatic” ceiling effect that would make it impossible to distinguish different over-imitation situations.

Regardless of the child's performance during the training phase, the child then participated in the four test tasks. The two conditions differed with regard to the instruction the child was given by E (see Fig. 2).

In both conditions, E introduced the activities as tasks that needed to be completed for instrumental reasons, and she suggested that the child could help her (e.g., look for all of the missing pieces and finish the puzzle). E first introduced the main apparatus and overall instrumental goal; she brought about the desired effect (E) twice by using two freely accessible items that were available (*prior demonstration*). For example, E took a puzzle piece that was not hidden under a cup and put it in place on the puzzle board. Importantly, exactly two such freely accessible items were prepared to be available in each task, which meant that after the two items were gone, the effect E could be produced only in different and more complicated ways. Then the experimenter showed what else one could do; this demonstration included calling the activity by a novel made-up name (e.g., “daxing”) and performing an “A–B–E” sequence of irrelevant and relevant actions leading toward the fulfillment of the task's goal (*full demo*, e.g., another puzzle piece in place on the puzzle board). (See Fig. 1 for details regarding the particular actions for each task.) There are two important details to be noted: The relevant action B

² Socioeconomic status was not formally recorded, but children came from different day-care institutions in a mid-sized city that typically spans diverse socioeconomic backgrounds.

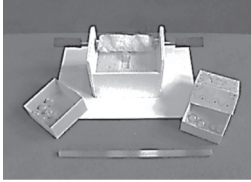

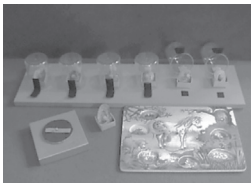

Task	Material	Irrelevant action (A)	Relevant action (B)	Effect (E)
<p>Task A</p> 	<p>Marble cleaning machine: a wooden box with a sponge and a movable small feather duster. The overall task was to clean all marbles and make them shiny.</p>	<p>The irrelevant action consisted of tapping on the side of the cleaning machine with a stick.</p>	<p>Put a dusty marble into the machine and clean it by moving the feather duster back and forth.</p>	<p>Marble is clean and can be put into the box with shiny marbles.</p>
<p>Task B</p> 	<p>Six transparent tubes within a transparent box. Inside each tube lays a plastic ball containing a chip. The overall task was to collect the chips into a chip savings box.</p>	<p>There was an orange lid, physically disconnected from the main apparatus. The irrelevant action consisted of brushing the lid with a paintbrush (no paint!).</p>	<p>Insert the long stick tool into a tube and push the plastic ball out on the other side of the box.</p>	<p>Get a chip ball within reach and collect the chip into the chip savings box.</p>
<p>Task C</p> 	<p>Long board with six transparent upside down cups. Cups are held in place by Velcro and cover a puzzle piece. The overall task was to get all missing pieces and finish the puzzle.</p>	<p>A little box, physically disconnected from the main apparatus, had a clock hand attached to it. The irrelevant action consisted of turning the clock hand manually.</p>	<p>Open the Velcro, turn over a cup.</p>	<p>Puzzle pieces become available to finish the puzzle.</p>
<p>Task D</p> 	<p>Wooden frame with eight rectangular compartments; six can be closed with a transparent plastic cover, two have no cover. The overall task was to tidy up some objects from the table to prevent them from getting lost.</p>	<p>The irrelevant action consisted of stroking the side of the frame with a felt-tipped stick.</p>	<p>Put an object into one of the compartments and close plastic cover.</p>	<p>Objects are stored properly and cannot get lost.</p>

Fig. 1. The four test tasks, including main apparatus and irrelevant parts.

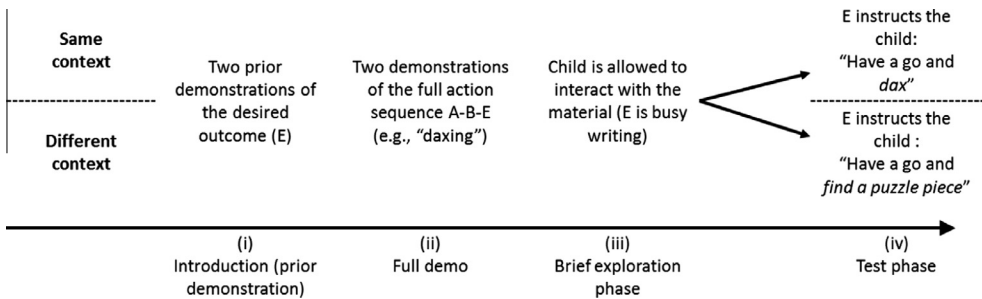


Fig. 2. Schematic procedure of an experimental task in Study 1.

produced in the A–B–E sequence was shown here for the first time, and it was only ever shown as part of the bigger A–B–E sequence. Crucially, B was different from the action that was used in the prior demonstration to produce the desired outcome (E) when that effect could be produced in different and much simpler ways. For example, whereas the two puzzle pieces were freely accessible in the prior demonstration (and, thus, one could simply grab them), the remaining puzzle pieces were each contained under a transparent cup; here, the crucial outcome-relevant action B in the A–B–E sequence consisted of removing a Velcro strip and turning over the cup in order to gain access to the puzzle piece. This is important from a theoretical point of view because it means that children cannot have simply mapped the action descriptions “bring about E” and “dax” in simple associative ways on representations of what they have seen; they only ever saw B produced in the action sequence A–B–E that was called “daxing” and never in a sequence of only B–E that would have been labeled “bringing about E.”

This general procedure, inspired by Southgate, Chevallier, and Csibra (2009) and adapted from Keupp and colleagues (2013), served to emphasize that (a) new information was being provided, thereby helping participants to focus on and identify the irrelevant step as part of the general activity, and (b) the conventional activity (e.g., daxing) stood in contrast to the mere instrumental goal and even had its own name, thereby stressing its conventional character. After the full demonstration, E turned to some papers that she had next to her on the table and pretended to be busy. During this brief period (*exploration phase*), the child was free to explore the objects and apparatus on the table (for ~10–15 s or until the child had finished with an ongoing action). Whatever the child did was not interrupted by E. This resulted in some children using the last available object for the task and some children waiting patiently until E turned back to them. Regardless of the child’s explorative behavior, E then instructed the child according to condition (she either pointed out the last available object on the table or provided an additional one from her pocket) (*test phase*). The exploration phase was added because during the pilot testing we observed a strong tendency to immediately touch and explore all objects and material on the table. The exploration phase helped to distinguish general explorative behavior from specific over-imitation in our scenarios. At the end of a test round, E stressed that the task was completed successfully now and thanked the child again for helping. This procedure was repeated for each of the four tasks.

Coding

All sessions were videotaped and coded by a single observer. A second person, who was blind to condition and the hypothesis of the study, coded children’s imitative response for 25% of the data. Coding of over-imitation was binary, looking at whether or not a child performed the irrelevant action or an approximation of it (e.g., *tapping* with the brush on the apparatus instead of *brushing*). This could happen either before or immediately after the relevant action. Inter-rater agreement was very good ($\kappa = .944$).

Results and discussion

For each child, the proportion of trials with over-imitation was computed for each condition. Due to experimenter error, 2 children saw three trials of the different context condition and 1 child saw three trials of the same context condition. These participants were included only in the analyses of children’s performance on Trial 1 of each condition (excluding the children from the other analyses did not alter the results). Because preliminary analyses revealed no effect of age and block order, these factors were not considered further.

Main analysis

All children receiving two trials per condition ($N = 29$) reproduced at least one irrelevant action across their four trials. Differentiating according to conditions, in the same context condition all children over-imitated at least once, whereas in the different context condition 16 children never did so (see Table 1). A Wilcoxon signed rank test revealed that children’s rate of over-imitation was significantly higher in the same context condition ($M_{\text{same}} = .74$) compared with the different context condition ($M_{\text{different}} = .29$), $z = -3.84$, $p < .01$, $d = 1.43$. This effect held even when we compared only the first

Table 1

Number of children who over-imitated in 0, 1, or 2 trials of each condition.

	0 Trials	1 Trial	2 Trials
Same context	0	16	13
Different context	16	9	4

trial of each condition; whereas 15 children over-imitated only on their *same condition* Trial 1 (and not on their *different condition* Trial 1), only 3 children showed the reverse pattern (over-imitation only on the *different condition* Trial 1) (McNemar's test: $N = 32$, $p < .05$, exact two-tailed). Of the remaining 14 children, 9 did not over-imitate in the first trial of either condition and 5 over-imitated in both of their first trials.

Complementary inspection of over-imitation in different context condition

Children performed the irrelevant action considerably less in the different context condition than in the same context condition. So when they did over-imitate, did this reflect a lack of context sensitivity and flexibility, such that children thought that over-imitation was causally or otherwise mandatory simply in order to bring about the effect (e.g., to find a puzzle piece)? A closer inspection of the data suggests a different interpretation. In 6 of the 17 cases of over-imitation in the different context condition, children explicitly stated that they were, in fact, performing the conventional activity (e.g., they explained that they had been daxing after E had instructed them to find a puzzle piece), indicating that what they were doing was not just trying to bring about the effect but also doing so in a specific (not the most efficient) way.

Taken together, these findings suggest context sensitivity in children's own performance of over-imitation; children tended to conceive of an irrelevant action element in a bigger sequence as a binding part of the overall conventional activity in the same context condition but as an optional part of the merely goal-oriented activity in the different context condition.

Study 2

In the first study, children performed more irrelevant actions when they were instructed to perform a conventional activity compared with a goal-oriented activity after having seen the same action demonstration by the experimenter in both conditions. Study 2 aimed to complement the picture of context-sensitive action interpretation in over-imitation scenarios by looking at third-party protest as a measure of children's generic normative understanding of the action in question. We predicted that children would likewise criticize a puppet for omitting irrelevant actions when the puppet acted in the same overall conventional context but would show less such protest in cases where the puppet explicitly announced that she would not perform the conventional activity.

Method

Participants

Participants were recruited from the same database as in Study 1 but had not participated in the first study. Data of 30 children ($M_{\text{age}} = 50$ months, range = 38–62, 15 girls and 15 boys) were included in the final sample. One additional girl was tested but excluded because she was distracted during the experimental situation.

Design and materials

The materials and general procedure were the same as in Study 1. The crucial difference was that children witnessed a third party's omission of the causally irrelevant action A. There were two between-participant conditions; in the *puppet same context* condition, the puppet announced that she would perform the same activity as the experimenter had shown in her full demonstration (e.g., "daxing"), whereas in the *puppet different context* condition, the puppet announced that she

would perform a different activity. Children were randomly allocated to the two conditions and participated in three test rounds (the A, B, and C tasks from Study 1; see Fig. 1). The order of tasks was counterbalanced across children and conditions.

Procedure

First, there was a warm-up phase in which the main experimenter (E1), a puppet (operated by E2), and the child played together, engaging in three games (a puzzle, a fishing game with a magnetic rod, and an animal-matching game). Throughout this phase, the puppet made some mistakes (e.g., trying to fit a puzzle piece into the wrong slot) in order to familiarize the child with the situation and encourage him or her to interact with the puppet and intervene when necessary.

The child then participated in the three test tasks, each with the same basic structure in both conditions (see Fig. 3). The two conditions differed only with regard to the context in which the puppet was performing the activity (test phase). This contrast was realized by the puppet applying a different verbal label to the activity she was performing.

As in Study 1, E1 first introduced the activities as tasks that needed to be completed and suggested that the child could help her. The introduction and demonstration phases were the same as in Study 1 (*prior demonstration* and *full demo*). Unlike in Study 1, E1 always instructed the child by referring to the conventional activity (e.g., “have a go and dax”) after her second demonstration. (Children’s own imitation behavior, in fact, was not of interest in the current study. The sole reason to have children engage in the task as well was to prevent boredom.) E1 then turned away and was busy writing something (*Imitation Phase 1*). Only when E1 believed that the child had difficulties because he or she did not even touch the apparatus did the experimenter turn around after approximately 20 s and encourage the child to take a turn (“Did you dax already? It’s your turn now. Go on, you can just give it a try, it’s fun”).

The crucial experimental manipulation occurred when it was the puppet’s turn to have a go (*test phase*). The puppet, who had been absent since the start of the round, returned and took two turns at performing the activity. On both of her turns, she omitted the irrelevant action. Depending on condition, the puppet used different labels for the activity she was going to perform. In the *same context* condition, the puppet announced that she was going to dax before she began to act. In contrast, in the *different context* condition, the puppet announced that she was not going to dax but rather was going to collect a puzzle piece. During the test phase, E1 was turned away and did not pay attention to the puppet’s actions. The puppet reacted in a neutral way to any protest utterances or explanations from the child (i.e., acknowledging that the child was explaining something but not reacting to it in a specific way). This procedure was repeated for each of the three tasks.

Coding

All sessions were videotaped and coded by a single observer. Relevant interventions and utterances in response to the puppet’s omitting irrelevant actions could fall into three hierarchical categories (Rakoczy et al., 2008):

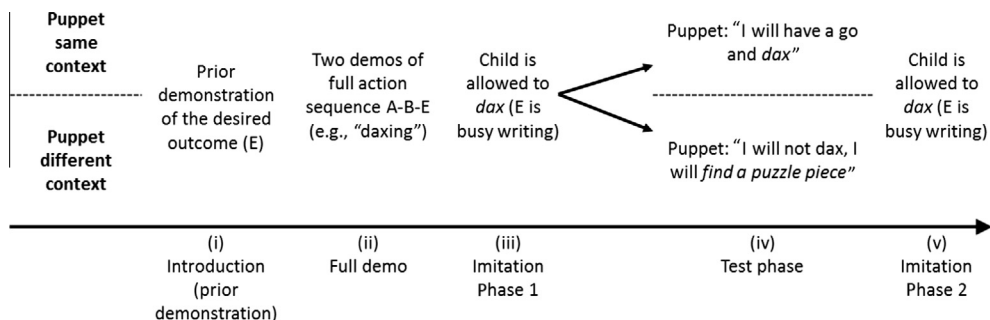


Fig. 3. Schematic procedure of an experimental task in Study 2.

1. *normative* protest (i.e., the child used explicit normative vocabulary to criticize the puppet, e.g., “No, you must do it like this”);
2. *imperative* protest (the child requested the puppet to act a certain way, e.g., “No! Knock here!”); and
3. *hints* of protest (ambiguous language [e.g., “No!”], directing the puppet non-verbally to an object that she did not use, etc.).

Both normative and imperative protests were considered a clear sign of critique against the puppet’s behavior. The only difference lay in the vocabulary used by the participant; explicit normative wording provided the most unambiguous indication of calling out a normative transgression and, hence, was considered a hierarchically higher category.

Following the hierarchical coding scheme, each trial (i.e., each of the puppet’s turns) then got as its code the highest category code that had been observed (e.g., when all three types of protest occurred, the trial got “normative protest” as its overall code).

We were also interested in the timing of children’s protest; protest against omitting the irrelevant action *before* the puppet brought about the effect could theoretically be based on causal confusion (i.e., the child assumed that the causally irrelevant act was relevant and, thus, criticized the puppet for failing to use a necessary means to an end). However, this is not the case for protest *after* the puppet has produced the effect. Therefore, we coded protest separately for the whole trial and specifically only after the effect was brought about. An independent reliability coder, blind to the hypotheses of the study, coded 25% of the data. Inter-rater agreement was excellent (linear weighed $\kappa = .94$).

Results

Preliminary analysis of children’s own over-imitation

Because children’s own imitation behavior was not the focus of the current study, we checked only whether children’s own rate of over-imitation in Phase 1 was comparable between the conditions and to the rate of over-imitation found in the same context condition in Study 1 (the condition comparable in instruction to Imitation Phase 1 in Study 2). Over-imitation occurred to a comparable degree (85% of the trials) as in the same context condition in Study 1 and with no significant difference between conditions, $t(28) = -1.71, p = .10$.

Children’s protest

For statistical analysis regarding children’s protest against the puppet’s failure to over-imitate, only protest episodes with clear forms of protest (i.e., normative or imperative category) were considered. First, on an individual level, 47% of children protested at least once in the same context condition, significantly more than in the different context condition (13%), $\chi^2(1) = 3.97, p < .05$ (see Table 2). The odds of children protesting at least once after the puppet omitted the irrelevant action were 5.68 times larger when the puppet acted in the same context condition than when she acted in the different context condition.

Second, regarding analyses on the frequency of protest, for each child the proportion of trials in which protest occurred was computed across the three tasks and compared across conditions (all reported p values are exact one-tailed because we expected more protest for the conventional condition). Considering any protest episodes, a Mann–Whitney test revealed a trend for children to protest more often in the same context condition ($M_{\text{same}} = .20$) than in the different context condition ($M_{\text{different}} = .09$), $U = 77.5, z = -1.80, p = .05, d = 0.36$. More important, in a second step, the only protest episodes considered were those most indicative of normative critique (i.e., protest occurring *after* the

Table 2
Number of children who protested at least once against omission of irrelevant actions.

		Same context condition	Different context condition
Protest in at least 1 trial?	Yes	7	2
	No	8	13

puppet had been successful in contributing to the overall goal of the respective activity). This form of protest is the most stringent measure of normative critique against omission of the causally irrelevant action A because the puppet is clearly not criticized for not bringing about effect E and children's protest was clearly not based on any form of causal confusion (to the effect that omission of A might jeopardize production of E). The corresponding Mann–Whitney test revealed a significant effect of context, with more protest occurring in the same context condition ($M_{\text{same}} = .18$, with 6 children protesting at least once) compared with the different context condition ($M_{\text{different}} = .02$, with 1 child protesting once), $U = 74.0$, $z = -2.16$, $p < .05$, $d = 0.44$ (see Fig. 4).

Additional analysis of co-occurrence of over-imitation and protest

There was no significant correlation between children's general rate of over-imitation and their protest against the omission of irrelevant actions by the puppet (puppet same context: $r = -.06$, $p = .85$; puppet different context: $r = .25$, $p = .37$); that is, children who over-imitated criticized the puppet to the same degree as children who did not over-imitate. Similarly, children who criticized the puppet did not over-imitate more or less during Imitation Phase 2 than children who did not criticize the puppet (puppet same context: $r = -.09$, $p = .74$; puppet different context: $r = .27$, $p = .33$).

Discussion

The pattern of protest against omission of irrelevant actions parallels the over-imitation response pattern in Study 1. Children in Study 2 rarely saw a norm violation in not performing irrelevant actions in the different context condition. However, they spontaneously criticized the puppet for omitting irrelevant actions when she was performing the overall conventional activity in the same context condition. The pattern is similar to what was found in another recent study (Keupp et al., 2013), where children criticized the omission of irrelevant actions more frequently in a conventional condition compared with an instrumental condition. However, compared with that study, the general protest rate was slightly lower in the current study. This could be due to two differences between the material and the actions used in the difference studies. First, whereas the activities and effects in Keupp and colleagues' (2013) study were very obviously conventional and playful, the actions of the current study were more of an instrumental type. Thus, the default mind-set evoked by the current activities might have been more goal-oriented than means-oriented compared with the previous study, resulting in less conviction that causally irrelevant action elements were truly mandatory. Second, in the previous study, children might have been more aware of, and alerted to, the possibility that mistakes could occur because in that study there was also an explicit verbal measure regarding the correctness of the puppet's actions. Thus, participants might have been more encouraged to pay attention to the correctness of the puppet's behavior and to interfere if necessary.

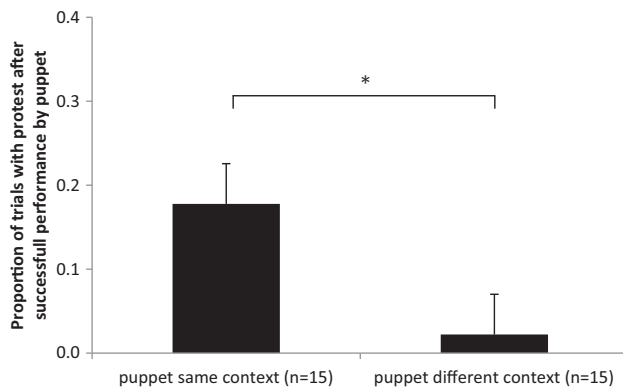


Fig. 4. Proportions of protest after successful performance by the puppet (\pm SE) for both conditions. (Note: * refers to a significant difference between conditions, $p < .05$).

General discussion

In the two experiments reported here, we tested for flexibility and context sensitivity in children's over-imitation and action interpretation. Results support the notion that over-imitation is the outcome of a flexible and rational action interpretation and that children are not rigid over-imitators. In each experiment, we compared children's responses in two conditions (same context vs. different context). Children saw a model demonstrate a conventional goal-directed activity (e.g., "daxing") in both conditions. Study 1 looked at children's own imitative response (over-imitation), and Study 2 looked at their third-party critique against a potential norm violator (protest). The children in Study 1 over-imitated at different rates, depending on whether they were acting in the same action context or a different action context as the model—with more over-imitation occurring in the same context condition. In Study 2, children criticized a puppet more often for omitting irrelevant actions when the puppet acted in the same context. When confronted with an action sequence introduced conventionally as daxing consisting of action elements A and B, of which only B brought about an effect E, children conceived of the irrelevant action element A as causally irrelevant for bringing about the effect E and, therefore, as an optional step when one merely aims at bringing about E. In contrast, they conceived of it as a necessary part of the bigger conventional activity daxing that is not equally optional when one aims at daxing.

Now, what are the implications of these findings for the dispute between the different theoretical explanations of over-imitation? First, this pattern of results is not in any obvious way reconcilable with the automatic causal encoding explanation, which predicts equivalently high rates of over-imitation for both conditions (because action sequence and intentional demonstration were identical for both conditions). In contrast, it is easily compatible with, and actually follows from, the rational normative action interpretation account. But what about the affiliation account? On the one hand, it is hard to see how the account would fit to the current data. If children's motivation is to affiliate with the model, why would they not simply affiliate by always performing the whole action sequence? Why would they criticize others at all? On the other hand, it might be argued that with suitable additional premises, the affiliation account is perfectly compatible with the current data. First, affiliation seeking might be sensitive to what another person wants one to do in a given situation. Second, children might expect others to act in affiliation-seeking ways. Although the second premise seems somewhat ad hoc and unmotivated, the first premise is not implausible at all. In some sense, it presupposes what the rational normative action interpretation account claims, namely that children can flexibly parse and interpret action sequences as a function of context; is it merely about bringing about the effect or about producing the whole sequence?

All in all, the current data cannot finally decide between the affiliation account and the rational normative action interpretation account. But there are potential cases where the predictions of the two types of accounts diverge that can be tested in future studies. Among such potential cases are those where action contexts and what they demand point in opposite directions from the affiliation contexts and their demands. For example, in a conventional action context, which demands the performance of the whole action sequence, a social partner (potentially to be affiliated with) confines himself or herself to only bringing about the effect. A pure affiliation motivation would lead one to do what pleases the person to be affiliated with and, thus, to the omission of causally irrelevant action elements, whereas normative considerations about what ought to be done in the action context in question would lead one to perform the whole sequence.

Regardless of what this future research may find, the current findings clearly show that early over-imitation is not a rigid and inflexible phenomenon. Rather, over-imitation is characterized by context sensitivity not only with regard to differential goal interpretation following differing action introductions but also with regard to action production itself and third-party intervention. These results so far are compatible with normative, affiliation, and ritual accounts of over-imitation, all of which predict that children are sensitive to the level of conventionality and potential social pressures associated with the activity in question. In fact, these accounts might well turn out to complementary rather than mutually exclusive in the end.

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