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PAPER

Young children attribute normativity to novel actions without pedagogy or normative language

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Abstract

Young children interpret some acts performed by adults as normatively governed, that is, as capable of being performed either rightly or wrongly. In previous experiments, children have made this interpretation when adults introduced them to novel acts with normative language (e.g. 'this is the way it goes'), along with pedagogical cues signaling culturally important information, and with social-pragmatic marking that this action is a token of a familiar type. In the current experiment, we exposed children to novel actions with no normative language, and we systematically varied pedagogical and social-pragmatic cues in an attempt to identify which of them, if either, would lead children to normative interpretations. We found that young 3-year-old children inferred normativity without any normative language and without any pedagogical cues. The only cue they used was adult social-pragmatic marking of the action as familiar, as if it were a token of a well-known type (as opposed to performing it, as if inventing it on the spot). These results suggest that – in the absence of explicit normative language – young children interpret adult actions as normatively governed based mainly on the intentionality (perhaps signaling conventionality) with which they are performed.

Introduction

Human culture is unique in the animal kingdom in the way that it accumulates modifications over historical time (Tomasello, Kruger & Ratner, 1993). This accumulation has sometimes been called the 'ratchet effect', since a key aspect of the mechanism is that modifications are taken up by others faithfully and continue in faithful replication until still newer modifications come along. This faithful transmission is partly due to the especially powerful skills of social learning employed by human children (Tomasello, 1996; Whiten, Horner, Litchfield & Marshall-Pescini, 2004), along with the fact that adults explicitly teach children things as well.

But human children do not just learn from adults effective and efficient ways of doing things to achieve instrumental goals, they also learn the 'right' way to do things, the way things 'ought' to be done, the way 'we' do things (Bruner, 1993) – and this is another part of the cultural ratchet. Adults do not just serve as passive models, or even active teachers, of children, but rather they expect children to do things the 'right' way – the way one does them in this society – and are ready with sanctions if the children do not do them in this normatively prescribed way. During the late preschool period, children come to recognize and respect such *social norms* (Piaget, 1932), and by school age they are even able to explicate in language the normative dimensions of certain social roles and activities (Kalish, 1998), including the distinction between norms based on moral principles and those that are merely conventional (Turiel, 1983).

Recently, however, researchers have uncovered another dimension of children's normative stance toward the world. Children do not just respect social norms, but they actively enforce them on others as well. This is a critical dimension of the process because simply conforming to social norms could occur for many different reasons, including the desire to please adults and avoid their sanctions. But it is not immediately clear why preschoolers should wag their finger at others for breaking social norms and object that this is not the way one should be doing this activity. Such 'third-party enforcement' suggests the possibility that young children are identifying with the social norms of their culture in a way that transcends their own individual interests, and indeed, for some philosophers the essence of morality and normativity in general is its agent-neutral perspective (e.g. Nagel, 1970).

The first experimental study involving children's active enforcement of social norms was performed by Rakoczy, Warneken and Tomasello (2008). In this study, 2- and

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3-year-olds were taught simple novel rule games with novel objects. They were then given the opportunity to imitate the modeled actions, and subsequently witnessed a third party (a puppet) performing a different action with those same objects. In the experimental condition, this action constituted a mistake in the context of the game. In control conditions, the same action was performed, but in different contexts outside the rule game so that it was now appropriate. Children (especially the 3-year-olds) intervened normatively with protests, critiques, and teaching when the puppet violated the rules of the established game, but did not do so when the same action was performed outside the game. Young children thus not only learn how to perform normatively rule-governed activities from adults, but they already understand them *as* rule-governed and enforce these rules on third parties.

A critical question that has not so far been answered is how children identify activities and roles that are governed by normative rules. Virtually all previous studies have used *explicit normative language* when introducing children to rule-governed activities (Casler, Terziyan & Greene, 2009; Rakoczy *et al*., 2008), including using novel names for the game or the tool (e.g. 'This is how *daxing* goes'; 'See, this is how you use a *meedle*'). Previous studies have also used a collection of pragmatic and contextual cues regarding the logical status of the action observed: usually the nature of the objects suggested that they were to be used in specific conventional ways (i.e. they looked like artifacts explicitly designed for a specific activity or purpose), and the model conveyed the impression that the action performed was not just an idiosyncratic act made up on the spot, but a token of an existing conventional action type. And finally, in prior studies adults have exposed children to the novel activities in a basically pedagogical format, verbally instructing them that 'this is how daxing goes', for example, by making heavy use of a variety of ostensive cues (e.g. eye contact, addressing the child by her name).

Some recent theoretical proposals have stressed the species-uniqueness of humans' learning of generalized information (e.g. that this is how such things work in general; so-called semantic information), and speculated that such learning occurs exclusively in the context of 'natural pedagogy' (Csibra & Gergely, 2006, 2009; Gergely & Csibra, 2006; Gergely, Egyed & Kiraly, 2007). The basic claim of this account is that humans have a domain-specific cognitive machinery for cultural learning (something like a 'pedagogy module') that functions such that a few low-level ostensive cues by a model performing an action in front of a child trigger a generic (in contrast to individual) or semantic (in contrast to episodic) interpretation of the action on the part of the child (see Hypothesis 3 of natural pedagogy in Csibra & Gergely, 2009).

Although there is some research consistent with this proposal (e.g. Gergely *et al*., 2007), the various aspects of pedagogy as it typically occurs in the real world – normative language, artifacts and actions suggesting that they are tokens of a type, and ostensive cues – have not been systematically investigated. Which of these factors lead children to a generic or normative interpretation of an act is a crucial question, as it sheds light on the nature of the underlying cognitive mechanism: Is it a case of social learning of normativity from adults' normative descriptions only, or a triggering of a prepared interpretation, or a kind of classification of adult acts based on aspects of their intentionality and conventionality?

In the current study, therefore, we investigated how these three factors influence 3-year-old children's attributions of normativity. First, we asked whether young children attribute normativity to novel game-like actions without any explicit normative language by the model (i.e. this variable was not manipulated, but rather, in contrast to previous experiments, no normative language was used to introduce the novel games). Second, we systematically varied the context of observation – that is, whether the model performed the act for the child, using ostensive cues, or whether the child incidentally observed the model performing the act for himself. Third and finally, we systematically varied the marking of the action, that is, whether the model expressively marked the action as a one-shot act made up on the spot only (by looking curiously and cluelessly at the objects initially, exploring them in playful ways before settling on one action) or whether the model expressively marked the action as a potential token of an existing (potentially conventional) type he recognized (by looking confidently and with recognition to the novel objects before and during acting).

In each of the four conditions of this 2×2 design, the child (i) first saw the model perform the target action A_1 on some novel objects, (ii) was then allowed to act on the objects herself, and (iii) then watched as a third party (a puppet) performed an alternative action (A_2) with the objects. Children's actions with the objects during the second phase and their protest responses to the A_2 action during the third phase were recorded. If children need normative language to infer normativity, then they should show no normative-like responses in any condition of the experiment. If the 'natural pedagogy' account is correct, then there should be a main effect of context of observation: the use of ostensive cues should trigger a semantic reading of the modeled act, leading to more imitation by the child herself and to more normative intervention in response to deviant acts by third parties. Finally, if children infer normativity simply from the way adults perform actions – whether they appear to recognize the novel objects and associated acts as tokens of a type – then the marking manipulation should lead to the most imitation and normative intervention.

Method

Participants

Sixty-four 3-year-olds (age range = 34–38 months) participated in the study.

There were four conditions: each comprised 16 children (seven girls, nine boys, respectively), each with a mean age of 36 months (35 months, 20 days; 36 months, 0 days; 35 months, 22 days; 36 months, 3 days, respectively). Children came from mixed socioeconomic backgrounds and were recruited via urban daycare centers (in which testing took place). All participants were native German speakers, except for two who were bilingual (German and another language). Four children were excluded from the final sample due to uncooperativeness ($n = 3$), or experimenter error ($n = 1$).

Materials

A hand puppet called 'Max', a paperboard box, three *warm-up tasks* (see Appendix A for details), and four *target tasks* consisting of partly novel objects (see Appendix B for details) were used to conduct the experiment. Figure 1 provides an overview of the experimental setting.

Design and procedure

The study followed a 2 (context of observation: ostensive communication vs. incidental observation) × 2 (marking of action: recognizing vs. inventing) between-subjects design with 16 children being tested in each condition. In each condition, children received the same four target tasks, whose order was systematically varied (in each condition via Latin-Squares). The order of the three warm-up tasks was fixed. Two (ostensive communication conditions) or three (incidental observation conditions) experimenters conducted the experiment, which lasted between 20 and 30 minutes.

Warm-up tasks

In each warm-up task, the experimenter leading the session (E1 in the ostensive communication, E3 in the incidental observation conditions; see below) performed an instrumental action (*without* using normative language) which the child could reproduce. When it was Max's turn, in some trials, he made a mistake by failing to use a (causally) necessary means to perform the action correctly. The purpose of the warm-up tasks was to familiarize participants with the hand puppet and the fact that mistakes can happen and children may intervene.

Target tasks

Each target task consisted of three phases: a *model phase*, an *action phase*, and a *test phase*.

The general course of actions was as follows (see Table 1 for an overview): (i) E1 performed an action (A_1) in the model phase in the absence of Max (Max went to sleep). (ii) The child was given the opportunity to act on the objects (e.g. reproduce A_1) in the action phase. Importantly, this was done without hinting at a rule-governed game context or conveying the impression that there was a right thing to do (the experimenter handed the objects to the child saying 'Now, you can *have* that'). (iii) In the test phase, Max returned and performed an alternative action (A_2) with the objects (see Appendix B for procedural details).

The focus of the experimental manipulation was the model phase, with the action and test phase kept constant across conditions (see Table 1). In the two *ostensive communication* conditions, E1, Max, and the child sat together at a table, and E1 called the child by her name before performing A_1 and established eye contact three times while performing A_1. In the two *incidental observation* conditions, E1 was unknown to the child, E3, and Max, never established eye contact with anyone, was busily working, and sat at a separate table performing A_1 'for himself'. In these conditions, children's attention to the model's action A_1 was drawn by two bottom-up, non-pedagogical cues: (i) E1 produced noise when fetching objects out of the box; (ii) E1 soliloquized about the objects (see Table 1).

In the *recognizing* conditions, E1 appeared to know and recognize the objects and E1's marking of the action A_1 looked like performing an existing action that one usually does with the objects. Hence, E1's behavioral expressions indicated that he knew 'how the game goes'. Importantly, E1 never used any explicit normative language.

In the *inventing* conditions, E1 obviously appeared not to know the objects and E1's marking of the action A_1 looked like inventing a new action with the objects. In

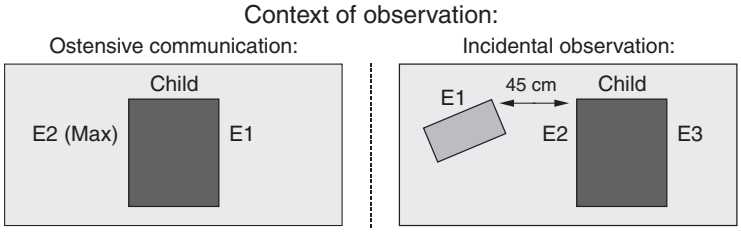

Figure 1 *Experimental setting. In the ostensive communication conditions (left), E1 sat to the child's left at one table. In the incidental observation conditions (right), E1 sat at a separate small table to the child's right, and E3 sat to the child's left.*

Table 1 *Basic structure of the target tasks with the experimental manipulations in the model phase presented for each condition separately*

	Ostensive communication		Incidental observation	
Phase	Recognizing	Inventing	Recognizing	Inventing
Model phase	E1 uses ostensive cues toward the child. E1 knows and recognizes the objects in his box ('Look what I have here. [Name], I'll show you something, look') and performs A_1 as if it were an existing action.	E1 uses ostensive cues toward the child. E1 'fortuitously' finds box, does not know the contained objects ('Huh, what's that? Hmm, well, [Name]') and performs A_1 as if he was just inventing it impromptu.	E1 is unknown to child, E2, E3, and does not use ostensive cues. E1 knows and recognizes the objects in his box (soliloquizing: 'I look at what I have here. I'll do that now, yes') and performs A_1 as if it were an existing action.	E1 is unknown to child, E2, E3, and does not use ostensive cues. E3 places 'unknown' box next to E1. E1 does not know box and objects contained in it (soliloquizing: 'Huh, what's that? Hmm, well') and performs A_1 as if he was just inventing it impromptu.
Action phase	Child is prompted by E1/E3 to act on the objects: 'Now, you can *have* that.'			
Test phase	Max announces 'Now I have that', and performs A_2 (accompanying it with a humming sound) for approximately 20 s.			

A_1 = first action performed by E1; A_2 = second (alternative) action performed by Max
Note: The model's action A_1 was identical in all conditions (i.e. E1 had no difficulty performing A_1 in the inventing conditions). Only the way E1 marked A_1 and the social-pragmatic context (E1 was familiar with objects in his own box vs. E1 did not know the objects in the 'unknown' box) differed between recognizing and inventing conditions.

other words, E1's behavioral expressions indicated that he did not know what purpose, if any, the objects were made for.

In one target task, for example, the objects were a Styrofoam board with a gutter at one end, a small building block, and a suction head. The model's action (A_1) was to put the building block on the board, and push it across the board with the suction head, until it fell into the gutter. The alternative action (A_2) was to put the block on the board, and lift the board so the block slid into the gutter.

Coding and reliability

All sessions were recorded, transcribed and coded from videotape by a single observer. A second independent observer coded a random sample of 20% of all sessions for reliability (see Appendix B for details on children's attention to E1's action A_1 during the model phase).

Target tasks: imitation

In the action phase, children's imitations of E1's action A_1 were given one of the following three mutually exclusive (and jointly exhaustive) codes (see Appendix B for details): (i) *full imitation*, (ii) *partial imitation*, and (iii) *no imitation*. Reliability was very good: weighted Kappa = .97. Sum scores of *full imitation* (0–4) and for *partial imitation* (0–4) over the four tasks per condition were computed for each child.

Target tasks: protest responses

The test phase of each target task was divided into six subphases for which all relevant verbal and behavioral responses were described and assigned to one of two protest categories (hierarchically ordered): (i) *normative protest*, that is verbal and/or behavioral protest, critique, or correction (including teaching) making use of normative vocabulary (e.g. 'No! It does not go like this!' or 'You must use this!'); (ii) *imperative-referential protest*, that is verbal and/or behavioral protest without normative vocabulary, but using imperative phrases (e.g. 'Take the thing!' or 'No! Don't put it there!'), pointing gestures toward missing objects or parts of objects that E1 had used, giving 'missing' objects to Max, or tattling to E1/E3 (indignantly) that Max did not use an object. There were two further categories: *hints of protest* (behaviors suggestive of protest, but not explicit enough) and *irrelevant* (e.g. purely descriptive statements). Reliability was very good: weighted Kappa = .95. Each task received as its final code the hierarchically highest category code that appeared in its subphases. For purposes of statistical analyses, a sum score (0–4) over the four tasks with one of the two clear forms of *protest* (i.e. normative *or* imperative-referential protest) was computed for each child.

Results

Protest responses in the test phase of the target tasks

The mean sum scores of tasks per condition (0–4) with normative or imperative-referential protest can be seen in Figure 2.

To investigate the impact of the factors marking of action and context of observation on children's protest behavior, a 2 (marking of action: recognizing vs. inventing) × 2 (context of observation: ostensive communication vs. incidental observation) between-subjects ANOVA on children's mean sum scores (0–4) of protest responses was computed. This ANOVA yielded a significant main effect of marking of action, $F(1, 60) =$

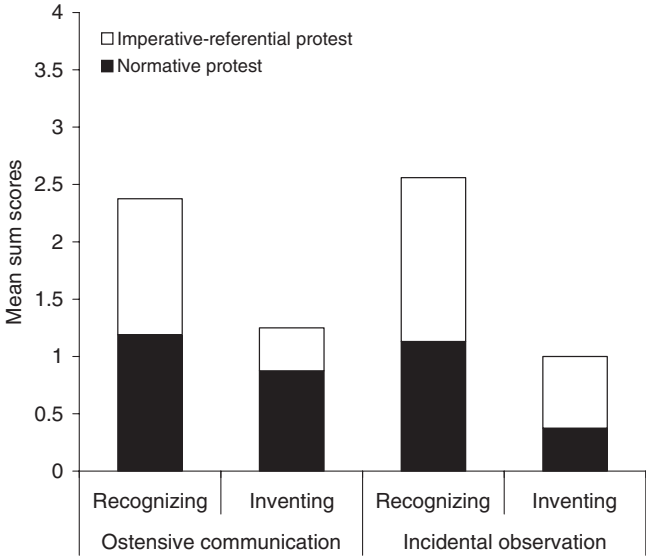

Figure 2 *Mean sum scores (0–4) of the different forms of protest in the test phase of each condition.*

15.95, $p < .001$, $\eta_p^2 = .21$, no effect of context of observation, $F(1, 60) = 0.01$, $p = .93$, $\eta_p^2 = 0$, and no interaction effect (*ns*). Children thus protested significantly more often in the recognizing conditions ($M = 2.47$, $SD = 1.32$) than in the inventing conditions ($M = 1.13$, $SD = 1.34$) irrespective of the context of observation.

Individual-level analyses confirmed this pattern: In the ostensive communication-recognizing condition, 15 children intervened in at least one task, compared to 14 in the incidental observation-recognizing condition; nine children intervened in the ostensive communication-inventing condition, and eight in the incidental observation-inventing condition, $\chi^2(3, N = 64) = 11.44$, $p < .03$.

Imitative responses in the action phase of the target tasks

Figure 3 depicts the mean sum scores over the four tasks per condition for children's imitative responses (partial imitation, full imitation).

As partial imitation is a too inconclusive measure, only full imitation was considered in the target analysis. To investigate the impact of the factors marking of action and context of observation on children's tendency to perform full imitation in the action phase, a 2 (marking of action) × 2 (context of observation) ANOVA on the mean sum scores (0–4) of full imitation over the four tasks was thus performed. This ANOVA yielded a significant main effect of marking of action only, $F(1, 60) = 10.61$, $p < .005$, $\eta_p^2 = .15$, and no further significant effects (*ns*), with children performing significantly more often full imitation in the recognizing conditions ($M = 2.56$, $SD = 0.91$) than in the inventing conditions ($M = 1.75$, $SD = 1.08$) irrespective of the context of observation.

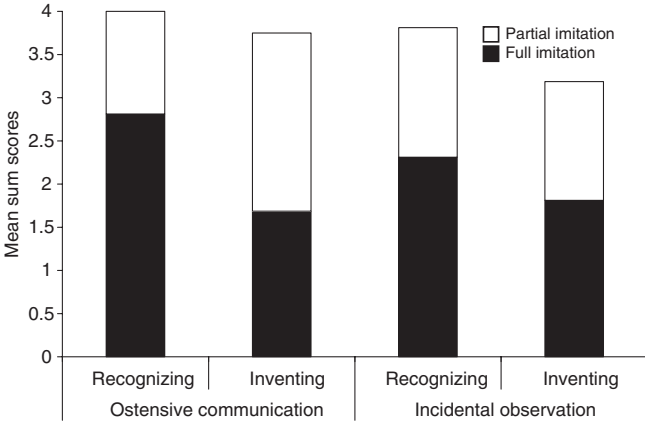

Figure 3 *Mean sum scores (0–4) of imitative responses over the four target tasks as a function of condition.*

Protest responses when controlling for imitation

There are thus significant main effects of marking of action both on imitation and on protest: Children both imitate and protest more in the recognizing conditions versus the inventing conditions. That means, however, that the effect on protest might be purely driven by the effect on imitation (i.e. imitation might be a mediator or moderator variable): Children might imitate more in the recognizing conditions, and hence simply protest when a third party acts differently than they themselves did.

To test for this possibility, we compared the proportional incidence of protest in the recognizing versus the inventing conditions separately for trials in which children performed full imitation, and for trials with partial imitation. If the effect on protest was purely driven by the effect on imitation, there should be no significant effects in these comparisons. The two independent samples *t*-tests (Bonferroni-corrected), however, revealed that children performed significantly more protest in the recognizing conditions ($M = .70$, $SD = .35$) than in the inventing conditions ($M = .42$, $SD = .45$) both when having performed full imitation in the prior action phase, $t(51.26) = 2.66$, $p < .02$, and when having performed partial imitation in the prior action phase (recognizing conditions: $M = .48$, $SD = .46$; inventing conditions: $M = .16$, $SD = .35$), $t(45.90) = 2.90$, $p < .01$. Across conditions, only 11 children performed no imitation in some trials ($n = 20$), and except for one trial, all subsequent test phase trials were devoid of protest. Hence, in contrast to partial and full imitation trials, children's proportional protest in the test phase was at floor ($M = .02$, $SD = .08$) in no imitation trials.

Discussion

In the current study we found that young 3-year-old children jumped to a normative interpretation of an adult action based mainly on the way it was performed

in terms of its intentionality, and possibly conventionality. More specifically, in the *recognizing* conditions the adult acted as if he recognized the novel objects and knew exactly what to do with them, presumably based on his past individual or conventional experience, whereas in the *inventing* conditions he looked as if he had no idea what to do with these strange new objects. This expression of attitude – intended to indicate familiarity and past (normative) experience – was the most efficient cue for children to conclude that this is the way this act is done. Importantly, children made normative interpretations based on these social-pragmatic cues irrespective of whether they themselves imitated the action during the second phase of the experiment.

The adult used no normative language in any condition of the experiment, and did not even label the novel actions with any piece of language. So it does not seem to be the case that young children need actions to be explicitly marked normatively, with normative language, to identify them as normatively governed, nor do they need them to have conventional labels. It also did not matter to children whether the adult was performing the action pedagogically for their benefit, addressing them directly as he performed it. They did jump to a normative interpretation when addressed in this way fairly often, but they did so just as often when they simply observed the adult performing the action at a separate table and not addressing (or even looking at) them at all. Contra natural pedagogy theory (Csibra & Gergely, 2006, 2009; Gergely & Csibra, 2006; Gergely *et al.*, 2007), it is apparently not the case that young children use pedagogical cues that something is being done for them as a reliable marker that the accompanying actions are normatively governed. In particular, our findings do not lend support to one of the main claims of the natural pedagogy account (claim 3 in Csibra & Gergely, 2009), namely, that there is a rigid 'interpretation bias to preferentially encode the content of ostensive-referential communication as representing generalizable knowledge'. In contrast to this claim, in the current study the context of observation turned out to be irrelevant: Children generalized the acquired piece of conventional knowledge to the third party (the puppet) without having been exposed to ostensive cues at all (incidental observation-recognizing condition), just as much as they did after exposure to ostensive cues (ostensive communication-recognizing condition). And conversely, children were not inclined to make normative interpretations when the model appeared to perform an idiosyncratic non-conventional act even when it was marked with the main ostensive cues (ostensive communication-inventing condition).

One could potentially hypothesize that children protested the puppet's alternative action A_2 because they simply preferred the originally modeled action A_1. But if this were the case, one would expect this preference to be consistent across conditions – both in terms of imitation and protest – and it was not. Further, following Csibra and Gergely (2009), one might stretch the natural pedagogy account and argue that pedagogical cues were actually present even in the incidental observation conditions – given that the adult was sitting at a table near to the child, and performing actions with toy-like objects while overtly expressing an attitude (even if not at the child directly). But these are clearly not the main pedagogical cues that have been previously discussed, such as eye contact or addressing the child by her name. Moreover, the inventing-recognizing variable had an effect irrespective of the presence of the normal pedagogical cues.

Interestingly, rather than a binary picture (protest in one condition, no protest in the other), the present study documents a gradation of normative interpretation, with more normative interpretation and intervention in the recognizing compared to the inventing conditions. But even in the inventing conditions, it was not the case that children did not intervene at all (there was protest in roughly 25% of the trials, with about half of the children protesting in at least one trial). One reason for this considerable 'baseline level' of protest might be that, before the target tasks, children in all conditions witnessed the puppet making some instrumental mistakes in the warm-up phase, which might have generally alerted them to be very vigilant and critical regarding the puppet's actions. Even though priming might have played some role, it is remarkable that in the absence of any explicit linguistic or even intentional-conventional cues within a given test trial, children sometimes jump to normative conclusions: They assume that what they see an adult doing is not just a random act but an instance of an established, normatively structured action type. Perhaps children have a default assumption that others' actions are normatively governed. In other words, perhaps young children start off as 'promiscuous normativists' – wildly projecting normative structure onto adult actions they see – in quite in the same way as they have been argued to start off as 'promiscuous teleologists' – projecting purpose onto all kinds of things they encounter (Kelemen, 1999). Further research is thus needed to investigate under what conditions young children do *not* make any normative interpretations at all (e.g. when being exposed to clearly accidental acts or acts marked explicitly as idiosyncratic).

And so the question becomes why adults' expressive marking of the novel objects and associated action as things they recognize leads children to a normative interpretation. Most simply, in the recognizing conditions the adult behaved in a more pre-planned fashion. But it is clearly not the case that children interpret all pre-planned actions as normatively governed; in their daily lives they must use this interpretation more selectively. In our view, the key is that the adult clearly recognized the novel objects and knew immediately what to do with them, suggesting familiarity with them from past experience. This familiarity could have been based simply on past individual experience, but given

the nature of normativity and its connection to conventionality – this is the way we in this culture do this – it is also possible that children saw the adult's familiarity with the materials as an indication that these objects and this action had conventional status in the culture. Future research is needed to determine if our manipulation did indeed elicit some kind of judgment of conventionality. However, indirect evidence for this link might be seen in recent findings on epistemic trust, as children in this age range prefer to learn conventional behaviors (such as the conventional names for novel objects) from reliable, confident, knowledgeable models as opposed to unreliable, uncertain, ignorant models (Birch, Akmal & Frampton, 2010; Cimpian & Markman, 2008; Harris, 2007; Koenig & Harris, 2005; Matsui, Yamamoto & McCagg, 2006; Pasquini, Corriveau, Koenig & Harris, 2007; Rakoczy, Warneken & Tomasello, 2009; Stock, Graham & Chambers, 2009).

In recent accounts of the evolution of human cooperation and culture, social norms play a critical role. Not only do social norms reinforce the cultural ratchet by inducing conformity by all the members of the group, they also maintain cooperative interactions in situations in which individuals are tempted to pursue their own selfish ends by threatening sanctions for nonconformity (Boyd & Richerson, 2005; Fehr & Fischbacher, 2004; Fehr & Gachter, 2002; Richerson & Boyd, 2005; Tomasello, 2009). Work by Kalish and Cornelius (2007) suggests that from a fairly young age children do not just respond to social norms when they detect them, but they seek out such norms – even those that are merely conventional – to know what they are supposed to do in new situations. And our own previous work suggests that from a fairly young age children identify with conventional social norms enough to want to enforce them on others (Rakoczy *et al.*, 2008), perhaps based on some kind of identification with, and investment in, the social group and its smooth functioning. The current results add to these findings the fact that children identify actions governed by conventional social norms on the basis of minimal behavioral cues, essentially those suggesting that this action is one that is well known to mature members of the culture. Whether children would jump to the same interpretation on the basis of the same behavioral cues if the action was performed on different objects (yet of the same kind) by another child, in another (less structured) context, or by someone from outside the culture (as well as children's potential tolerance or equal treatment of 'outgroup deviators') are questions for future research.

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Appendix A

Warm-up tasks

Table A1 *Overview of the three warm-up tasks*

Task	Material	Procedure
'Hammer task'	Wooden, hollow cuboid with four holes, four wooden balls, wooden hammer	Correct action: use hammer to push the balls into the cuboid. Instrumental mistake: Max tries (but fails) to push ball into cuboid with his nose.
'Disk-and-peg task'	Wooden disks (with circular holes), pegs (vertically positioned on small board)	Put disks on the pegs.
'Pencil task'	Sheet of paper, colored pencil	Correct action: draw something with the pencil. Instrumental mistake: Max holds the pencil upside down and fails to draw.

Procedure

In each warm-up task, E1/E3 performed an instrumental action (*without* using normative language – instead using descriptive language like 'Look what I have here') which the child could reproduce. Then it was Max's turn. In the first and third warm-up tasks, Max failed to use a (causally) necessary means to perform the action correctly. Hence, Max made an instrumental mistake and the child was given the opportunity to intervene spontaneously. In cases of no intervention, Max asked the child 'How does this work?' If the child did still not intervene, E1/E3 would ask her to help Max. In the second warm-up task, Max did not make any mistakes. The purpose of the warm-up tasks was to familiarize participants with the hand puppet and the fact that mistakes can happen and children may intervene.

The warm-up tasks were presented in a fixed order (mistake, no mistake, mistake), beginning with a hammer task, in which Max 'forgot' to use the hammer and tried to push a wooden ball through a hole with his nose. This was followed by a disk-and-peg task, in which disks were put on pegs (Max made no mistakes). The third task was to draw something on a sheet of paper with a colored pencil. Here, Max tried to draw with the wrong end of the colored pencil.

Appendix B

Target tasks

Table B1 *Overview of the four target tasks*

Target task	Material	Procedure
'Daxen'	Styrofoam board with gutter at one side, wooden building block, black suction head	A_1: Put building block on board, use suction head to push building block across the board into the gutter. A_2: Put building block on board, lift board so that building block slides into the gutter.
'Laften'	Glas container covered with air cushion material attached to a paper base, kitchen roll paper tube attached to container via elastic bands, rectangular paperboard platform on top of tube, tennis ball cut in half, peg	A_1: Attach peg to tennis ball, put both on platform, grab black region of tube and pull it down, then release, so ball and peg are catapulted away. A_2: Attach peg to base, put tennis ball on platform, turn container around, hit back of platform, so ball is catapulted away.
'Schacken'	Cylindrical plastic case with two pink cords, two frogs on red paperboard	A_1: Put the two frogs into plastic case, take the cord and pull it around, lift the cord, so frogs fall out. A_2: Put the frogs close together, cover the frogs with the upside-down positioned plastic case, slide the case back and forth, push it so the frogs fall out.

Target task	Material	Procedure
'Toffen'	Little bucket with cover, rolling wheel with bell, rubber brick	A_1: Put bucket on its side (horizontally), use rubber brick to push wheel into the bucket, put bucket upright and put cover on. A_2: Put bucket upside down, push wheel with nose (without using the brick) close to bucket, take wheel and put it on top of bucket, put cover onto the wheel.

Note: The target task labels were not used during the experiment.

Procedure

E1 was an 'unknown' person in the *incidental observation* conditions. Therefore, E1 had already been present in the experimental room before E3, Max, and the child arrived, and E3 addressed E1 formally ('Good morning! Excuse me, we would like to sit at this table, OK?'), while E1 was busily writing something down answering, 'Yes OK. I am just working here.' Except for the model phase, E1 was always busy writing something down in the incidental observation conditions during the whole experiment.

Model phase. In the *ostensive communication conditions*, E1 looked to the child three times while performing A_1 (see below for instances of the ostensive cue 'child's name'). In the *incidental observation conditions*, E1 did not look at anyone during the whole experiment. With respect to E3 (who had a purely coordinative, non-pedagogical role), she was busy writing something down before the model phase began. After E1 produced considerable noise fetching objects out of the box, E3 alternated between looking to E1 neutrally and looking back at her paper, writing something down. E3 did not direct the child's attention to E1 and did not look at the child either, so no social referencing could occur.

In the *recognizing conditions*, E1 raised his index finger three times while performing A_1, and accompanied the steps of A_1 with long hums (with rising intonation). The finger gesture and utterances were non-verbal, non-ostensive cues to indicate that E1 should present a familiar token of a well-known type. Further, the box containing the target task objects was placed right next to E1 (to E1's left in the ostensive communication-recognizing condition, and to E1's right in the incidental observation-recognizing condition, respectively), so it appeared as if the box and the objects belonged to E1. Before performing A_1, E1 fetched the corresponding objects of the target task out of the box off the reel announcing, 'Look what I have here' and '[Name], I'll show you something, look', while looking at the child during the latter sentence (ostensive communication-recognizing condition) or, 'I look at what I have here' and 'I'll do that now, yes' (incidental observation-recognizing condition).

In the *inventing conditions*, E1 briefly held his index finger at his chin while looking at the objects and subsequently performed A_1 uttering short hums and slightly shrugging his shoulders after each step of A_1. The gestures and utterances were non-verbal, non-ostensive cues to indicate that E1 should spontaneously invent an action on the spot. Moreover, E1 'accidentally' discovered the 'unknown' box with the target task objects in a corner of the room (ostensive communication-inventing condition), or E3 put the 'unknown' box in front of E1's separate table, because she was bothered by it (incidental observation-inventing condition). Thus, the social-pragmatic context implied that the box did not belong to E1 (to make it plausible that he would not know the novel objects). Before performing A_1, E1 fetched the corresponding objects of the target task out of the box with three 'random' gasps, and said, 'Huh, what's that?' Then, E1 said, 'Hmm, well, [child's name]' (ostensive communication-inventing condition) or 'Hmm, well' (incidental observation-inventing condition).

Across conditions, E1 laughed shortly after having performed A_1 and raised both hands (palms flipped outward) performing a 'voilà-gesture' while looking at the child (ostensive communication conditions), or looking at the objects (incidental observation conditions). Note that E1 had no difficulty performing A_1 in any condition. A_1 was the same action across all conditions. That means the manipulation of the factor marking of action did not refer to the target action A_1 *per se*, but to the manner in which the model E1 performed this action accompanying it with expressions of familiarity and confidence (recognizing conditions) or curiosity and spontaneity (inventing conditions).

Action and test phase. Before the action phase began, E3 collected the objects from E1's table in the incidental observation conditions and put them in front of her on the main table. Then, E1/E3 put the objects in front of the child saying, 'Now, you can *have* that.' Note that this makes the paradigm more 'conservative', because any linguistic hints toward normativity (e.g. a game context as indicated by the phrase 'It's your *turn*') were avoided. After the child's turn (the child could act once), E1/E3 put the objects back in front of her (which was the start of the test phase), whereupon Max returned (saying 'Well'), looking at the material and asking 'Oh, can I have that now?' E1/E3 looked at the child and then stated, 'Yes, now Max can have that', putting the objects in front of Max. E1/E3 then turned away from the table and pretended to write something down, and Max announced 'Now, I have that.' Max performed A_2 (accompanying it with a humming sound) for approximately 20 s. Thereafter, E1/E3 turned to the table and put away the objects, before the next target task trial began.

Coding, reliability and results

Model phase. For a random sample of 20% of all sessions, children's attention to E1's action A_1 (consisting of four sub-actions) in the model phase was coded by the primary observer (and a second, independent observer; reliability: Kappa = 1.0) in each target task (yielding a total of 16 possible sub-actions observed per child). Attention to the model's action A_1 was very high in all conditions (99%, i.e. 15.83 of 16 sub-actions, collapsed across conditions).

Target tasks: imitation. The code *full imitation* was applied if the child reproduced all of E1's four sub-actions in the right order. *Partial imitation* was applied if the child reproduced at least one of the four sub-actions. *No imitation* was applied if the child did not reproduce any sub-action.