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What Is a Conventional Object Function? The Effects of Intentionality and Consistency of Use

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By preschool age, children have a sophisticated assumption about the conventional nature of various kinds of information. The present studies investigated the role of two cues in 2- and 3-year-olds’ determination of what is conventional, namely the intentionality and intra-individual consistency in the use of objects. Overall, in Study 1, both 2- and 3-year-olds were more likely to say that the expected use and purpose of an object was a function intentionally and consistently demonstrated. In Study 2, 3-year-olds but not 2-year-olds generalized their expectation about the conventionality of an intentionally demonstrated function to another agent’s learning of the function. These findings shed light on how children’s assumption of what is conventional gets refined via children’s intuitive interpretive dispositions regarding human actions.

A fundamental assumption children must make in order to function adaptively in society is that there are preferred forms with which to express certain concepts. For example, if you are at a friend’s house and want a
container from which to drink water, you should ask for a “cup.” The word “cup” is the most direct path from your desire to getting your friend to fulfill that desire, and a cup is the most appropriate object for you to drink from. These are not facts about the world but rather conventions about how a particular social world works. This particularity notwithstanding, knowing these conventions, and assuming that others know them as well, is crucial for successful social interactions.

There is mounting evidence that from a young age, children make this assumption about the conventionality of some of the knowledge they possess. The clearest evidence so far comes from the domain of language, especially object names (see Clark, 1988, 1990). For instance, 3-year-old children assume that an absent speaker likely knows the names of objects they have been taught (Diesendruck & Markson, 2001); 19-month-old infants expect different individuals to refer to a novel object with the same name (Graham, Stock, & Henderson, 2006; Henderson & Graham, 2005); 16-month-olds are surprised if an adult uses the wrong name to refer to a familiar object (Koenig & Echols, 2003); and even infants as young as 13 months are surprised if an adult labels an object with a name another adult used to refer to a different object (Buresh & Woodward, 2007; see also Dewar & Xu, 2007, for related evidence with 9-month-olds). Thus, from a young age, children believe that common object names are conventional knowledge, at least for speakers of their own language.

Importantly, a number of studies indicate that children in fact hold a nuanced assumption of conventionality. Namely, whereas they expect some forms—even outside the domain of language—to be known by others, they assume other forms—even within the domain of language—to be unique and thus not necessarily known by all others (see Kalish & Sabbagh, 2007, for a review). In particular, children assume that there are conventional definitions of how to play games (Rakoczy, 2007) and what objects are for (Casler & Kelemen, 2005; German, Truxaw, & Defeyter, 2007), but children admit that people might have different preferences (Graham et al., 2006) or goals (Buresh & Woodward, 2007) and not know the proper names of unfamiliar entities (Birch & Bloom, 2002; Diesendruck, 2005) or arbitrary facts about objects (Diesendruck & Markson, 2001).

This broadening of the scope of conventionality on the one hand and the boundaries that nonetheless exist in this regard on the other have spurred questions about the origins of conventionality. In particular, how do children determine which forms are conventional and which forms are not? According to one proposal, children receive cues from the input about how to treat a certain form. Specifically, the claim is that adults often indicate to children that there are preferred ways to express certain concepts or use objects (Callanan & Sabbagh, 2004; Callanan, Siegel, & Luce, 2007;
A second proposal suggests that young children’s assumption of conventionality derives from their limited capacity to understand that others have a subjective representation of reality (Sabbagh & Henderson, 2007). Consequently, the argument goes, young children may operate under the assumption that everything they know, others know as well. A final proposal is that children might in fact be born with an assumption that knowledge conveyed to them by means of pedagogical cues is likely to be semantically general and thus known universally (Csibra & Gergely, 2006). Thus, similar to the previous proposal, this latter position also argues that children start off with a “liberal” assumption of conventionality.

Although all these proposals make valuable contributions to what children’s default assumption regarding the shared status of acquired knowledge might be, they seem insufficient to account for the nuances in this assumption, briefly mentioned above, that children eventually develop. The goal of the present studies is to address additional sources for children’s assumption of conventionality, which may contribute to its eventual fine-tuning. Following Tomasello and colleagues’ appraisal of cultural learning (Tomasello, Carpenter, Call, Behne, & Moll, 2005), we suggest that children apply an assumption of conventionality primarily to human-produced forms that lack a transparent meaning. Language, again, is the paradigmatic case. There is nothing about the word “cup” that makes its meaning transparent—the relationship between the word and its referent is formally arbitrary and functionally opaque. That these forms possess this characteristic invites children to try and figure out their meanings by analyzing how people use these forms. In the present studies, we investigate two cues evident in how people use various forms, which might help children define what is conventional. The cues are the intentionality and consistency with which a form is used.

One of the reasons to focus on these two cues is that they conform to a developmental prerequisite entailed by the above proposal. Namely, there is abundant evidence that the mechanisms for interpreting these cues are available to children by the age at which they are manifesting the nuanced assumption of conventionality described above. For instance, studies show that prior to their 1st birthday, infants already analyze people’s actions not only in physical terms but also in terms of intentions and goals (Baldwin, Baird, Saylor, & Clark, 2001; Woodward, 1998). Beginning in the middle of their 2nd year, children also rely on cues about intentionality for acquiring words (see for instance, Akhtar & Tomasello, 2000; Baldwin, 1991; Bloom, 2000, for reviews), naming objects and representations (Bloom & Markson, 1998; Diesendruck, Markson, & Bloom, 2003; Gelman & Bloom, 2000), and figuring out the functions of artifacts (Kelemen, 1999). None of these studies, however, have directly addressed the impact of intentionality
on children’s assumption about the conventionality of the acquired knowledge. One goal of the present study is to assess whether children will be more likely to treat forms embedded in intentional acts, compared with forms embedded in accidental acts, as candidates for being conventional.

Regarding consistency, there are numerous studies showing that infants are quite good at detecting statistical regularities in the ambient input and that this sensitivity fosters their acquisition of formal patterns (Gomez & Gerken, 2000; Saffran, 2003). In fact, there is evidence that young children rely on this cue for determining whether or not a form is conventional. For instance, Siegel and Callanan (2007) found that 5-year-olds’ determination of what an object is for was influenced by the number of people reported to use the object in a specific way—the more people agreed on the use of an object, the more likely children were to believe everybody would use the object in that way. Our hypothesis regarding this cue is that children might be influenced by consistency even within the same individual. The idea is that children will be more likely to assume that a form is conventional if a person uses the form in precisely the same way multiple times rather than if the person varies her use of the form every time.

In the present two studies, the investigation focused on the domain of artifact function. This is an intriguing domain for investigating these questions because while constituting a basic cultural domain and arguably being susceptible to the same learning mechanisms as other cultural domains, there is potential variation in the extent to which children conceive of artifact functions as being conventional. Regarding learning mechanisms, there are studies indicating that children’s acquisition of artifacts’ functions is driven by similar learning and inferential mechanisms as their acquisition of words. For instance, 2-year-olds assign exclusive functions to objects (Casler & Kelemen, 2005), 2.5-year-olds believe that the functions of artifacts are extended to other objects of similar kind (Childers & Tomasello, 2003), and 3-year-olds define object kind by relying on cues about the intent of an object’s creator (Diesendruck et al., 2003). Moreover, as mentioned above, 5-year-olds are sensitive to distributional information in determining whether a particular use of an artifact constitutes its conventional function (Siegel & Callanan, 2007). At the same time, however, studies reveal that kindergarteners may hold more flexible ideas about how to actually use objects (Defeyter, German, & Hearing, 2009; German & Defeyter, 2000). In other words, children might know what the conventional function of an object is but find it less binding in terms of prescribing an exclusive use to the object. This variability in children’s conception of artifact functions thus provided a fertile ground on which to test the potential effects of behavioral cues on children’s concepts.
The goal of the present studies was to assess whether the intentionality and consistency with which a user operates an object impact children’s decision as to whether or not the use is conventional. In light of the findings mentioned above regarding the impact of these factors on children’s acquisition of artifact concepts, we decided to investigate this question among 2- and 3-year-olds. On the one hand, as noted above, the relevant learning mechanisms seem to be already in place at this age range, and thus, even 2-year-olds may benefit from them in deriving an assumption of conventionality. On the other hand, to the extent that children may need to fine-tune these mechanisms to the particular domain of artifact functions, it is possible that developmental changes occur (e.g., Casler & Kelemen, 2005, 2007).

In Study 1, we directly assessed the extent to which 2- and 3-year-old children’s assumptions about the conventionality of object functions would be affected by the intentionality and/or consistency of an actor’s use of objects. In that study, we asked children a series of questions about a given object’s demonstrated use in order to obtain a comprehensive appraisal of children’s assumption of conventionality. In Study 2, we asked a somewhat different question. Namely, we investigated the extent to which children apply the same criteria they use for learning whether or not an object function is conventional to someone else’s learning of this information. In other words, we asked whether children monitor others’ learning of information and use the same cues for evaluating others’ learning that guide their own learning. It has been argued that children learn much of what they know about the world by trusting the testimony of experts (Harris & Koenig, 2006). In a sense, Study 2 addresses whether children are sensitive to how someone acquired their knowledge when deciding whether to accept that person as a reliable teacher of that knowledge.

**STUDY 1**

The goal of Study 1 was to investigate to what extent children determine the conventionality of an object’s function based on the intentionality and consistency with which an adult uses the object. In this study, children were exposed to an experimenter using a novel object to perform a novel function. There were four between-subjects conditions in this study, consisting of the cross-over of the two main factors: a) whether the adult used the object in an intentional versus an accidental fashion, and b) whether the adult used the object consistently in the same way versus in different ways. The full $2 \times 2$ design allowed us to evaluate the relative weight of each of the cues to children’s decisions.

After exposure to the experimenter’s demonstration, children were asked four questions addressing different aspects or implications of an assumption
of conventionality. The first question addressed the “contrast implication” of conventionality (Clark, 1988). Namely, if there is a conventional form available and an agent uses a different form, then the addressee may infer that the agent has a different meaning in mind. The second and third questions asked children about how they and others would use the object. The last question asked children about the purpose of the object.

Method

Participants

The participants in this study were 128 children: 64 2-year-olds (\(M = 2;7, SD = 2.8\) months, \(range = 1;11–2;11\)) and 64 3-year-olds (\(M = 3;4, SD = 2.6\) months, \(range = 3;1–3;11\)); 76 were boys and 52 were girls. Children were recruited from local preschools after receiving permission from the preschool directors and local authorities. Only children with signed parental consent participated in the study. All participants were native Israeli monolingual Hebrew-speaking children from middle-class secular Jewish families.

Materials

The same four pairs of novel objects unfamiliar to children were used in each condition. Table 1 provides descriptions of the objects used and the functions applied to each object pair. Two important considerations in selecting objects and functions were: a) the objects could both be used to perform easily understandable functions, and b) the objects could perform both functions equally well. A hand puppet was manipulated by the experimenter in a manner that conveyed that the puppet was another “live” participant.

Design

Sixteen children from each age group were randomly assigned to one of four conditions, resulting from the crossing of the two experimental variables: a) the intentionality, and b) the consistency of object use. Thus, the four conditions were: Intentional + Consistent (mean age of 2-year-olds \([M_{2s}] = 2;6, SD = 2.5\) months; mean age of 3-year-olds = 3;3, \(SD = 2.3\) months), Intentional + Variable (\(M_{2s} = 2;8, SD = 2.9\) months; \(M_{3s} = 3;4, SD = 1.6\) months), Accidental + Consistent (\(M_{2s} = 2;7, SD = 3.0\) months; \(M_{3s} = 3;3, SD = 2.6\) months), and Accidental + Variable (\(M_{2s} = 2;7, SD = 3.2\) months; \(M_{3s} = 3;5, SD = 3.8\) months). There were no significant age differences between conditions, and there was a similar gender distribution across conditions.
The procedure in each condition consisted of four trials, with each trial being composed of two parts: 1) an information phase in which children and a puppet observed an experimenter apply a function to a novel object, followed by 2) a test phase in which an experimenter asked the child four questions.

**Procedure**

All children were tested in a quiet corner of their preschool where the experimenter had previously set up a table with two chairs and placed the experimental materials. Prior to testing, the experimenter played with the group of children to be tested for approximately 30 minutes in order

### TABLE 1

List of Objects Used in Study 1, Their Associated Functions, and the Variations in Function 1 Used in the Variable Conditions

<table>
<thead>
<tr>
<th>Pair</th>
<th>Description of objects</th>
<th>Functions 1 and 2</th>
<th>Variations in function 1</th>
</tr>
</thead>
</table>
| A    | White, flat, plastic square with a curved tip  
      Blue plastic handle | Bounce (1)/roll (2) ball | • bouncing ball from Object 1 up in the air*  
                   • bouncing ball from edge of table and into Object 1  
                   • bouncing Object 1 with the ball inside |
| B    | Yellow plastic handle with a split end  
      Large silver tweezers | Move (1)/pick up (2) sticks | • placing sticks within Object 1 and moving them across table*  
                   • pushing the sticks with Object 1 turned sideways  
                   • pushing the sticks with Object 1 face up |
| C    | Large wooden drawer knob with a circular ditch  
      Black plastic handle with metal piece attached | Stamp (1)/cut (2) play-dough | • stamping play-dough with bottom part of Object 1*  
                   • stamping play-dough with edges of Object 1  
                   • inserting paper clips into top part of Object 1*  
                   • inserting paper clips into bottom part of Object 1 |
| D    | Round glass bowl with a green slotted top  
      Ceramic dish with a round ditch | Hold paper clips (1)/paper weight (2) | • inserting paper clips into Object 1, turned upside down |

* = function used in the Stable conditions.
for the children to get acquainted with her. After this, she asked one child at a time to join her and a friend (the puppet) in a new game.

**Information phase.** After a short introductory warm-up between the experimenter, the puppet, and the child, the experimenter said: “Now I will show you two (child and puppet) some interesting things that I brought.” The experimenter then put two novel objects on the table in front of the child and the puppet and pointed to both objects. The experimenter then picked up one of the objects (Object 1), and without labeling it, proceeded to use it for a specific function (Function 1) in accordance with the child’s condition. The experimenter repeated Function 1 three times (e.g., using one of the objects to bounce a ping-pong ball), not verbalizing her actions but using utterances and body language in a manner that varied according to the child’s condition (e.g., exclaiming, “Oops!” with a startled expression in the accidental conditions and exclaiming, “There!” with a satisfied expression in the intentional conditions; see Akhtar & Tomasello, 2000, for a review of similar manipulations of intentionality). In the Intentional + Consistent condition, the experimenter performed this function intentionally and repeatedly in the same way. In the Intentional + Variable condition the experimenter performed this function intentionally but in a slightly different way each time. In the Accidental + Consistent condition the experimenter performed this function in an accidental manner but repeatedly in the same way. In the Accidental + Variable condition, the experimenter performed this function in an accidental manner and in a different way each time. The experimenter did not label Function 1 at this phase, so as to not give children in the Accidental conditions the impression that her actions were intentional. In the two Variable conditions, the variation was primarily in the manner or path of the action (see Table 1 for descriptions). The experimenter did not handle or discuss Object 2 during this phase.

**Test phase.** In all conditions, after the demonstration of Function 1, the experimenter again placed the two objects in front of the child. The experimenter then manipulated the puppet voicing his desire to perform a different function (Function 2, e.g., “I want to roll the ball”), and the experimenter asked the child a **disambiguation** question (i.e., “Which of these two objects should the puppet use to <Function 2>?”). Function 2 was only verbally expressed, because demonstrating it with one of the objects would evidently bias children’s choices. After each child’s response, the experimenter asked three additional questions, verbally labeling the functions and handing the object to the child so as to encourage him/her to demonstrate: 1) “What would you do with this (Object 1): Would you do Function 1 or Function 2?”; 2) “If a friend of mine comes here, what
would she do with this (Object 1): Would she do Function 1 or Function 2?"; and 3) “What is this (Object 1) for: Is it for Function 1 or Function 2?” Children’s answers, whether verbally or physically expressed, were observed and recorded (5% of the 2-year-olds and 8% of the 3-year-olds responded verbally only). After the final question, the experimenter told the child she would now bring out some more things. She proceeded to clear the table and place the next pair of objects. The same procedure was repeated with the other three pairs of objects. After the entire procedure, the child was thanked, given a sticker, and returned to his/her preschool activity. The order of presentation of the pairs and which object within each pair served as Object 1 was counterbalanced across participants. The right/left placement of the objects was counterbalanced within participants.

Children’s responses were scored according to the pattern predicted by an assumption of conventionality. Namely, if children treated Function 1 (the demonstrated function) as the conventional function of Object 1, then in the disambiguation question, they should have picked Object 2, and in the three additional questions, they should have picked Function 1. On each set, children received a score of 1 for a response according to this pattern in each question and 0 for the opposite response. Children’s scores in each set (0–4) were averaged across sets, such that a Conventionality Score of 4 overall meant that children answered all questions in a manner consistent with conventionality, and a score of 0 meant that they answered all questions in a manner opposite to that stipulated by conventionality.

Results

The goal of Study 1 was to investigate whether children’s assumption of conventionality with respect to object use is affected by the intentionality and consistency of the use and whether there are developmental differences in this regard. The dependent measure used to assess these questions was children’s Conventionality Score.¹ A preliminary analysis revealed no effect of gender ($p > .6$), and therefore, gender was not included in the subsequent analyses.

¹We also conducted a multivariate analysis of variance (MANOVA) with the two experimental factors (intentionality and consistency) as independent variables, using children’s scores on each of the four questions as dependent measures (see Table 2). This analysis revealed that neither of the factors had a significant effect on the disambiguation scores. In turn, both intentionality and consistency significantly affected children’s responses on each of the remaining three questions, replicating the effect reported in the text in terms of the Conventionality Scores. For the sake of brevity, we report in the text only the results on the Conventionality Scores.
A three-way analysis of variance (ANOVA) on children’s Conventionality Scores was conducted, using the variables age (2 year-olds, 3-year-olds), intentionality (Intentional, Accidental), and consistency (Consistent, Variable) as between-subjects factors. Figure 1 displays the means for the experimental variables. A significant effect was found for intentionality, $F(1, 120)=47.49$, $p<.001$, $\eta^2_p=.28$, such that children in the Intentional conditions were more likely than children in the Accidental conditions to respond according to conventionality. A significant effect was also found for consistency, $F(1, 120)=4.94$, $p<.05$, $\eta^2_p=.04$, such that children in the Consistent conditions were more likely than children in the Variable conditions to respond according to conventionality. There was no significant effect of age, and there were no significant interactions ($ps > .2$).

To estimate the relative power of the experimental variables in guiding children’s responses, we performed $t$-tests against chance (chance = 2) on children’s Conventionality Scores in each condition separately. These

<table>
<thead>
<tr>
<th>Question type</th>
<th>Intentional/consistent</th>
<th>Intentional/variable</th>
<th>Accidental/consistent</th>
<th>Accidental/variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disambiguation</td>
<td>2.03 (0.93)</td>
<td>2.34 (0.97)</td>
<td>1.78 (1.36)</td>
<td>1.94 (1.04)</td>
</tr>
<tr>
<td>Your use</td>
<td>3.16 (0.81)</td>
<td>2.59 (1.19)</td>
<td>2.03 (1.06)</td>
<td>1.63 (0.97)</td>
</tr>
<tr>
<td>Other’s use</td>
<td>2.97 (1.12)</td>
<td>2.56 (0.95)</td>
<td>1.94 (0.98)</td>
<td>1.47 (1.05)</td>
</tr>
<tr>
<td>Purpose</td>
<td>2.78 (1.04)</td>
<td>2.47 (0.92)</td>
<td>2.34 (0.83)</td>
<td>2 (1.05)</td>
</tr>
</tbody>
</table>

FIGURE 1  The effect of intentionality and consistency on children’s responses in Study 1. Note. Error bars represent SDs.
analyses revealed that children’s scores were significantly greater than chance in both the Intentional + Consistent condition, $t(31) = 7.05$, $p < .001$, and the Intentional + Variable condition, $t(31) = 4.59$, $p < .001$. In turn, in the Accidental + Consistent condition, children’s Conventionality Scores did not differ significantly from chance, $p > .8$, and in the Accidental + Variable condition, children’s scores were significantly lower than expected by chance, $t(31) = -2.19$, $p < .05$. One conclusion we can draw from these analyses against chance is that while intentionality sufficed for children to treat an action as conventional, consistency did not.

Discussion

The goal of Study 1 was to investigate whether children base an assumption of conventionality on the intentionality and consistency with which an object is used and whether there is a developmental progression between ages 2 and 3 years in these respects. The findings revealed no significant effect of age, and in both age groups, children were more likely to treat a demonstrated function as conventional when an experimenter intentionally used the object than when she accidentally did so and when an experimenter was consistent in her demonstrations of the function than when she was not. Given this lack of age differences, it would be interesting to examine these questions with even younger children. In fact, recent studies using nonverbal procedures found evidence consistent with a notion of conventionality in infants prior to their 2nd birthday (Buresh & Woodward, 2007; Graham et al., 2006). It would be valuable to devise appropriate methods to assess the contribution of intentionality and consistency in these very early stages of the development of an assumption of conventionality. It is important to point out in this regard that the 2-year-olds in the present study were mostly “old” 2-year-olds—the mean age was 2 years, 7 months.

A further finding from Study 1 was an indication that intentionality is a stronger cue than consistency in defining what is conventional. It is unclear whether this differential weighting of cues indeed results from their relative conceptual relevance or from more mundane issues having to do with the particular operationalization of these cues. Nonetheless, the fact that intentionality came out as having such a powerful effect fits a general notion that children’s concepts of artifacts are influenced by sensitivity to creators’ and users’ intentions (Bloom, 2000; Jaswal, 2006; Kelemen, 1999).

A final intriguing finding from Study 1 is that children in the Accidental + Variable condition in fact selected the demonstrated use as the conventional function significantly less often than expected by chance. In other words, it is as if these children inferred that if a given object is presented as having two possible functions and one of the functions is
ostensibly not the conventional one, then the other function is likely to be the conventional function.

**STUDY 2**

Whereas Study 1 revealed that children’s *own* inferences about the conventionality of an object’s function were influenced by the intentionality of an adult’s use, in Study 2, we asked whether children expect *others* to draw inferences about the conventionality of an object’s function based on this cue. In particular, we asked whether 2- and 3-year-olds would expect someone else to learn how to use an object based on intentional demonstrations of an actor but not based on accidental demonstrations. This is an original extension of the notion of conventionality because it assesses not only whether children believe others *have* the same knowledge as they do about certain cultural forms but whether they *acquire* the cultural forms in similar ways. A lot of attention has been devoted lately to children’s sensitivity to the reliability of others’ knowledge (e.g., Harris & Koenig, 2006). Here we ask whether children are sensitive to the reliability of how others *acquire* their knowledge. Furthermore, children seem to have a preference for learning from models who are reliable (Birch, Vauthier, & Bloom, 2008; Koenig, Clement, & Harris, 2004) and for interacting with members of their in-group (Kinzler, Dupoux, & Spelke, 2007). In Study 2, we also asked whether children have a preference for interacting with agents who are adequate learners of conventional knowledge.

In Study 2, children along with two puppets watched videos of two adult actors using the same object in different ways. One of the actors used the object in an intentional fashion, whereas the other used the object in an accidental fashion. After watching the videos, the experimenter handed the object used by the actors to the two puppets. One of the puppets used the object in the same way the “intentional” actor had used it, while the other puppet used the object in the same way the “accidental” actor had used it. Children were then asked a series of questions about the puppets, tapping the accuracy of their use, the conventionality of their use, and children’s preference for interacting with the puppets. The hypothesis was that children would respond that the puppet who imitated the intentional actor used the object correctly and conventionally and that this puppet would be favored as a social partner.

Our decisions to use videos instead of live performances and puppets instead of people were primarily for the sake of methodological rigor. The use of videos guaranteed that all children were exposed to exactly the same modeling. Moreover, using videos allowed us to move from one trial to the next smoothly, without having people come in and out of the testing room.
multiple times. Although we are aware that children’s learning from video is somewhat less effective than their learning from live performers (Troseth, Saylor, & Archer, 2006), recent studies indicate that young children can learn information about people and objects from video presentations (Scофield & Williams, 2009; Shutts, Kinzler, McKee, & Spelke, 2009). Moreover, notice that in the present study children ultimately had to evaluate the puppets, not the videos. Our choice to use puppets derived in part from the need to use four different pairs of “imitators” across the four trials. Moreover, we suspected that children would feel more comfortable observing and subsequently evaluating puppets’ use of novel objects than they would be observing and evaluating adults.

Method

Participants

The participants in this study were 16 2-year-olds ($M = 2;9$, $SD = 2.7$ months, $range = 2;3–2;11$), and 16 3-year-olds ($M = 3;9$, $SD = 3.6$ months, $range = 3;1–4;0$); there were 15 boys and 17 girls. Children were recruited from similar preschools as those in Study 1 after receiving permission from the preschool directors and local authorities. Only children with signed parental consent participated in the study. None of the children had participated in Study 1. Children in Study 2 had the same demographic characteristics as those in Study 1.

Materials

Four novel objects from Study 1 were used in Study 2. The objects were used in the same way as specified in Study 1 (see Table 1). Eight different puppets were used across the four trials. The puppets in each pair looked substantially distinct, and the experimenter changed her voice when speaking for each puppet, so as to encourage children to treat the puppets as separate agents. In addition, a laptop computer was used to show children video clips of the actors. Each of the video clips consisted of four parts: 1) a zoom in–zoom out of the object; 2) one of the actors using the object for a unique function; 3) zoom in–zoom out of the object once again; 4) the second actor using the object for a different function.

Design

All children underwent the same procedure. The main independent variable was the within-subject manipulation of which actor the puppets imitated.
The procedure consisted of four trials, with each trial being composed of three phases: 1) an exposure phase in which children watched a video clip of two actors performing a novel function on an object; 2) a puppet-imitation phase in which children observed two puppets, each imitating one of the actors in the video clip; and 3) a test phase.

**Procedure**

All children were tested in a quiet corner of their preschool, where the experimenter had previously set up a table with the laptop computer on it, two chairs, and the experimental materials. Prior to testing, the experimenter played with the group of children to be tested for approximately 30 minutes to familiarize herself with the children. After this, she asked one child at a time to join her in a new game. Children completed the three-phase procedure for each trial before moving on to the next trial.

**Exposure phase.** Each of the four trials started with the experimenter introducing the child to two puppets by having a short conversation with both of them, changing her voice when talking for the puppets so as to animate the puppets. The experimenter then showed the child and the puppets a video clip. In each video clip, two female actors were seen using a novel object. The actors were dressed in a different-colored T-shirt, and each was filmed using the same novel object. Each clip for each object was composed of four scenes: Scene 1 was a zoom-in and zoom-out of the object on a table (3 seconds). In Scene 2, the “intentional actor” (or “Accidental” depending on the order of actors’ appearance) was seen coming into the room and sitting at the table where the object was placed. The actor picked up the object and looked at it with interest, saying, “Hmmm.” She then used the object intentionally three times (e.g., saying, “There!” while smiling in satisfaction, as in the Intentional conditions of Study 1) but with a slight variation each time. This scene lasted for approximately 10 seconds. Scene 3 was a repeated zoom-in and zoom-out of the same object on the table (3 seconds). Finally, in Scene 4, the “accidental actor” (or “intentional”) was seen coming into the room and sitting at the table with the object on it. She picked up the object and looked at it with interest, saying, “Hmmm,” just as the intentional actor had done. She then used the object in a different way, unintentionally, three times (e.g., saying, “Oops!” while nodding her head in disappointment as in the Accidental conditions of Study 1) and with a slight variation each time. This scene lasted for approximately 10 seconds. While watching the videos, the experimenter sat next to the child. Every time the object appeared on the screen, the experimenter pointed to it and verbally called the child’s attention to it (e.g., saying, “Look at this thing.”).
All scenes were filmed at the same place with a plain white backdrop, a round table where the object was placed, and a chair for the actor. Order of actors' appearance (intentional first/accidental first) and the role of each actor (intentional/accidental) were counterbalanced within and between children. Thus, for each child, one of the female actors acted intentionally on two of the trials and accidentally on the other two. The order of trials was counterbalanced between children.

**Puppet-imitation phase.** After watching the actors, the experimenter announced that she had the object that the women on the video played with. She placed the object on the table and said, “Now everyone will get a chance to use this thing,” handing it to one of the puppets. The puppet picked up the object and used it once in the same way as one of the actors had, while saying, “Look what I’m doing!” The second puppet then picked up the object and used it once in the same way as the other actor had done, while saying, “Look what I’m doing!” Order of puppets was counterbalanced within children, such that on two of the trials, the first puppet imitated the intentional actor, and on the other two trials, the first puppet imitated the accidental actor. Two different puppets were used on each trial to avoid creating a preference for one puppet from one trial to the next.

**Test phase.** After watching the puppets, the experimenter asked children three questions: 1) a “correct puppet” question: “Which puppet did the right thing: this one (pointing to the puppet who had imitated the “intentional” actor) or this one (pointing to the puppet who had imitated the “accidental” actor)?”; 2) a “your use” question, similar to the one used in Study 1: “What would you do with this (the object): [the demonstrated use, or the undemonstrated use from Study 1]?”; and 3) a “preference” question: “Which puppet would you like to play with: this one (pointing to the puppet who had imitated the “intentional” actor) or this one (pointing to the puppet who had imitated the “accidental” actor)?” Order of puppets mentioned was counterbalanced across children, such that the “intentional-imitator” puppet was mentioned first in half of the trials, and the “accidental-imitator” puppet was mentioned first in the other half. Children’s answers were recorded. After the last question, the experimenter told the child that she was now going to show the child and other puppets a new clip. She proceeded to clear the table and showed the next video clip. The same procedure was repeated with the three other objects. Order of clips was counterbalanced across participants. After the entire procedure, the child was thanked, given a sticker, and returned to his/her preschool activity.
Results

The goal of Study 2 was to investigate whether children expect others to learn about the appropriate uses of artifacts by relying on the same cues that they do, namely, the intentionality of an actor’s use. Moreover, we were interested in exploring whether agents’ learning strategy would influence children’s social preference. The dependent measures used to assess these questions were the means of answers to the three questions children were asked. These measures all ranged from 0 to 4, such that 4 corresponded to the answer most consistent with an assumption of conventionality. For the “correct puppet” and “preference” questions, the measure was the mean number of trials in which children selected the intentional-imitator puppet. For the “your use” question, the measure was the mean number of trials in which children selected the function performed by the intentional actor. Figure 2 displays the means for these questions in each age group.

A one-way MANOVA on the above dependent measures was conducted, using age (2-year-olds, 3-year-olds) as the between-subjects variable. A significant effect was found for age overall, $F(3, 28) = 3.39, p < .05, \eta_p^2 = .27$, such that 3-year-olds were more likely than 2-year-olds to expect others to learn objects’ functions from an intentional rather than from an accidental user.

The ANOVAs allowed us to evaluate the effects of age on each of the questions separately. The ANOVA on the “correct puppet” question revealed a significant effect of age, $F(1, 30) = 5.00, p < .05, \eta_p^2 = .14$, such
that 3-year-olds were more likely than 2-year-olds to say that the puppet who imitated the intentional actor did the correct thing. A significant effect of age was also found for the “preference” question, $F(1, 30) = 8.60, p < .01$, $\eta^2_p = .22$, such that 3-year-olds were more likely than 2-year-olds to say that they would prefer playing with the puppet that imitated the intentional actor. There was no effect of age on the “your use” question ($p > .1$).

To evaluate whether children indeed have an expectation that others should learn from intentional actors, $t$-tests against chance (chance = two choices of the intentional puppet/function out of four trials) were performed for all questions in each age group. Given our coding scheme, responses above chance meant that children expected the puppet to learn from the intentional actor. We found that 2-year-olds did not answer significantly differently from chance on any of the questions ($ps > .7$). In turn, 3-year-olds answered significantly above chance on the “correct puppet” question, $t(15) = 2.61, p < .05$, as well as on the “preference” question, $t(15) = 3.90, p < .01$, but not on the “your use” question, $p > .5$.

**Discussion**

The goal of Study 2 was to investigate whether children extend their inferences about intentional uses being conventional to others’ learning of object functions. We found a significant developmental difference in children’s inferences, such that 3-year-olds but not 2-year-olds expected others to rely on the intentionality of an actor’s use of an object to infer the appropriate way to use an artifact. In fact, 3-year-olds responded that the puppets who imitated the intentional use performed the correct function, thus attributing normative status to intentionally demonstrated object functions (see also Casler, Terziyan, & Greene, 2009, on this topic; and Rakoczy, 2008, on game rules). Moreover, we found that 3-year-olds but not 2-year-olds showed a preference to befriend a puppet that learned from an intentional actor more than a puppet that learned from an accidental actor. While there are a number of possible explanations for this finding—which we will discuss in the General Discussion—it extends other findings on children’s preference to learn from reliable models (Birch et al., 2008; Koenig et al., 2004) and to befriend people who share some of their conventions (Kinzler et al., 2007).

The findings regarding the “your use” question presented a more complicated pattern. On the one hand, replicating the findings from Study 1, we found no difference between 2- and 3-year-olds in their responses to the “your use” question. This was the case despite the fact that 3-year-olds in Study 2 ($M = 3;9$) were slightly older than those in Study 1 ($M = 3;4$). In itself, this suggests that the finding of differences between 2- and 3-year-olds on the other two questions of Study 2—in contrast to the null
developmental findings of Study 1—was probably not due solely to the older age of the 3-year-olds in Study 2.

On the other hand, different from the findings in Study 1, we found that neither 2- nor 3-year-olds had firm expectations about how they should use an object. One major design difference between the two studies that may have contributed to this pattern of findings is that whereas in Study 1, intentionality was manipulated between subjects, in Study 2 it was manipulated within subjects. In other words, in Study 1, children had to evaluate only the actions of one actor; whereas in Study 2, children had to evaluate and then discriminate between the actions of two actors. In fact, Study 2 included not only the two actors but also two puppets, acting intentionally on the same object. It is possible that given this within-subjects design of Study 2, both 2- and 3-year-olds may have been somewhat confused as to whether the accidental-imitator puppet’s use was in fact inappropriate. The lack of age differences suggests, nonetheless, that this design feature impacted 2- and 3-year-olds equally. We will return to this issue in the General Discussion.

GENERAL DISCUSSION

There are a number of proposals about the scope of children’s default assumption of conventionality, some arguing for a conservative scope (Callanan et al., 2007) while others for a liberal scope (Csibra & Gergely, 2006; Sabbagh & Henderson, 2007). The goals of the present studies were: a) to assess the potential cues children might use to refine whichever default assumption they start off with, and b) to evaluate whether children rely on one of these cues when assessing others’ learning of what is conventional.

In Study 1, 2- and 3-year-old-children were exposed to novel artifact functions in one of four conditions, which manipulated the consistency and intentionality with which a function was demonstrated by an adult. After exposure to this demonstration, children were asked four questions regarding the conventional use of the objects. Overall, children determined what an artifact’s function is and how it should be used by them and others on the basis of the intentional and consistent manner in which they observed it being used. Furthermore, Study 1 revealed no differences in 2- and 3-year-olds’ reliance on these cues for establishing conventionality.

The importance of intentionality in children’s understanding of artifact concepts has been previously demonstrated (see Bloom, 2000, for a review). The present findings extend these findings and reveal that children also rely on intentionality for determining whether an object’s function is normative. Recent findings also suggest that children rely on inter-individuals
consistency of use for generating expectations about the conventionality of an object’s function (Siegel & Callanan, 2007). The present results reveal that even intra-individual consistency also constitutes a cue to the conventionality of an object’s function.

Interestingly, some of our findings indicate that while intentionality in itself is sufficient for children to determine that a function is conventional, intra-individual consistency is not. In other words, there is a hierarchy of weights between these cues. Given that this “hierarchy” was produced by a single manipulation of each of the factors, we need to be cautious in drawing broad conclusions from it. Nonetheless, it is possible that given the strongly communicative/interactive nature of the present task, children were extra attentive to intentional cues. This interpretation is in line with models of word learning, according to which children modulate the deployment of their available learning tools—such as an understanding of intentions and capacity to detect statistical regularities—depending on a number of factors, such as context (Hollich, Hirsh-Pasek, & Golinkoff, 2000). For instance, statistical capacities may be favored in contexts somewhat devoid of social stimulation, and intentional understanding may be favored in contexts rich in social stimulation.

While the present studies assessed the importance of two cues evident in people’s behaviors, it is quite likely that there are more cues that children rely on for establishing the conventionality of a form. In other words, by no means do we claim that intentionality and consistency are the sole determinants of conventionality. In fact, a more plausible account is that children start off with some type of default assumption, either conservative or liberal as discussed in the literature, and refine it based on behavioral cues, distributional data, and conceptual beliefs. For instance, as children develop, they likely become more sensitive to who is modeling the form and about constraints in the affordance or malleability of the forms.

The fact that no developmental differences were found in Study 1 is compatible with the idea that an assumption of conventionality emerges early in development. In the domain of language, there are indications that even during their 2nd year of life children respond to labeling in a way consistent with an assumption of conventionality (Buresh & Woodward, 2007; Graham et al., 2006). Regarding artifact functions too, there are indications that 2-year-olds treat intentionally demonstrated uses as being somewhat normative (Casler & Kelemen, 2005, 2007). The novelty in the present findings is that 2- and 3-year-olds may develop this expectation about artifact use by relying on the same mechanisms (i.e., the intentionality and consistency of the use). The fact that these mechanisms in themselves emerge early in development is supportive of this account.

The goal of Study 2 was to extend this line of inquiry in yet a further direction. Namely, Study 2 assessed not how children themselves evaluate...
which information is conventional and which is not but rather how children evaluate others’ assessments of what is conventional. In this study, children observed how two puppets imitated either an actor who had intentionally used an object for a given function or an actor who had accidentally used the same object for a different function. We found that 3-year-olds but not 2-year-olds believed that the puppet who imitated the intentional actor used the object correctly. As we noted in the Introduction, one of the defining aspects of conventional knowledge is that “everyone expects everyone else to conform” to it (Lewis, 1969, p. 42). In a sense, the present findings indicate that by 3 years of age, children have expectations not only about what others know but about how others are supposed to acquire that knowledge.

Analyzing the findings from Study 2 in light of the findings from Study 1 indicates that whereas by 3 years of age children generalize their inferences about the conventional use of objects onto others, 2-year-olds do not do so. The picture that emerges is of children’s developing ability to not only detect intentionality for the sake of their own learning, as is observed in very young children (Carpenter, Call, & Tomasello, 2005; Gergely, Bekkering, & Kiraly, 2002; Meltzoff, 1995), but to gradually harness those insights for the evaluations of others’ learning about the world. At 2 years of age, children might be able to imitate and learn an intentional behavior but are yet incapable of relying on their assessments of intentional actions to evaluate others’ learning—something they achieve a year later. It is plausible that this development is related to other advances in children’s general perspective-taking and mind-reading capacities (see, for instance, Wellman & Liu, 2004).

The second significant finding from Study 2 is that 3-year-olds but not 2-year-olds manifested a preference to befriend a puppet that imitated an intentional actor over a puppet that imitated an accidental actor. Previous studies have shown that children prefer a reliable model over an unreliable one for the sake of learning new information (Birch et al., 2008; Koenig et al., 2004). Other studies have found that children, and even infants, have a preference for interacting with members of their linguistic community over speakers of foreign languages (Kinzler et al., 2007). In a sense, these findings indicate that children have a preference—both in a learning and a social context—to interact with people who have the kind of knowledge they need or are familiar with. What is innovative about the present finding is that by 3 years of age, children prefer to interact with agents who are competent learners of conventional information.

One possible explanation of this finding is that children might simply prefer to interact with agents who are “correct.” In fact, the fixed ordering of questions in Study 2 may have made this preference even more salient—a limitation of the present design that needs to be examined in the future.
Importantly, nonetheless, the fact that children can ascertain correctness in others’ arbitrary actions by the same means that they establish correctness in their own actions is a significant developmental achievement that might eventually aid children in selecting worthwhile models from whom to learn cultural conventions. In this respect, selectively attending to good learners of information may indeed be a smart strategy. After all, it might be more adaptive to ensure that one’s social partners reason in the same way as oneself than to ensure that they have the same thoughts and preferences as one does. Given the amount of information children arguably have to acquire via trusting the testimony of experts (Harris & Koenig, 2006), this is a crucial developmental achievement. It would be interesting in future studies to assess directly whether children’s decisions about the trustworthiness of a model are differentially influenced by the reliability of a model’s reasoning process (i.e., how one thinks) versus reasoning content (i.e., what one thinks).

A final finding from Study 2 was that there was no difference between 2- and 3-year-olds’ answers to the question about how they would use the target object, and in fact, at both ages, children responded randomly. Evidently, it is not trivial to interpret null findings. Nonetheless, the finding that it was precisely on this question that these null findings were achieved may be revealing. One possible interpretation is that while an expectation of conventionality may be especially applicable to prescriptive aspects of artifact function (e.g., what is the correct way to use an object?), it is less determinant of how one actually uses an object. Consistent with this possibility, recent findings indicate that while children take the intended function of an object as critical for determining the category membership of an object, they rely on this type of information more loosely for deciding how to use an object (Defeyter et al., 2009; see also Jaswal, 2006). Further studies are needed to examine this issue more directly.

In conclusion, we noted in the Introduction that within the first years of life, children manifest a nuanced assumption of conventionality, such that they assume that some cultural forms to which they are exposed are shared knowledge by members of a community (e.g., object names), while other forms are particular and local (e.g., proper names and preferences). The present findings suggest that one of the ways by which children differentiate between these forms, and thus define the scope of conventionality, is by analyzing the ways in which people use the forms—particularly their intentionality and consistency. This conclusion bodes well with a general account of cultural learning, which emphasizes that children’s acquisition of cultural forms is to a large extent driven by children’s intuitive interpretive dispositions of human action.
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