

## **The role of modelling and request type on symbolic comprehension of objects and gestures in young children\***

TRICIA STRIANO

*Max Planck Institute, Leipzig*

PHILIPPE ROCHAT

*Emory University*

MARIA LEGERSTEE

*York University*

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### ABSTRACT

In a first study, we considered whether modelling and the type of an adult's request influenced children's ability at 1;8 and 2;2 to comprehend gestures and replica objects as symbols for familiar objects. In a second study, we evaluated whether modelling and type of request influenced children's ability at 1;8 ( $N=24$ ) to understand unfamiliar (i.e. unconventional) objects as symbols. Results of Study 1 indicated that children at 2;2 comprehended a gesture as a symbol in the absence of any previous model demonstration. All children comprehended a replica as standing for another object, although modelling marginally improved children's performance at 2;2 and decreased performance at 1;8. In general, the type of request did not influence children's comprehension of gestures or replicas as symbols. Results of Study 2 showed that modelling and request type did not influence children's understanding of objects that are unconventional and novel, as symbols. The studies converge to suggest that symbolic comprehension is a highly context-dependent ability that continues to develop over the second year.

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## INTRODUCTION

Children are commonly thought to engage in symbolic play by the middle of the second year (Bretherton, 1984; Harris & Kavanaugh, 1993). At around this age they participate in play activities like putting their baby dolls into beds, talking to their friends on toy telephones, and pushing and crashing their plastic racecars. Such activities are considered as symbolic in nature because it is assumed that children are using toys to stand for other real objects in the world.

Despite much observational data suggesting young children's penchant for pretend-play (i.e. Nicholich, 1977; Fenson, 1984; Shore, 1986; Fiese, 1990), the existence of young children's ability to use an object to stand for another is debatable. For instance, children's performance in symbolic comprehension tasks is often determined by the type of objects used – e.g. whether the object that is symbolized looks like the object used in play (i.e. Jackowitz & Watson, 1980), or whether the object has clearly defined functions that make the elicitation of particular actions more likely (i.e. Pederson, Rook-Green & Elder, 1981). In fact, research seems to show that until nearly three years of age children may find it difficult to engage in symbolic types of behaviour. For example, they have difficulty using a scale model room as a symbol for an identical looking real room (i.e. DeLoache, 1995).

It has been proposed that difficulty in using one object to stand for another is due to a problem of DUAL REPRESENTATION (DeLoache, 1995). According to such proposal, children have difficulty appreciating that objects are physical entities that can be explored and manipulated and that at the same time objects can be used symbolically to stand for something else (dual representation). Interestingly, many experimental findings that seem to support the idea of dual representation do not fit with more naturalistic observations of children's pretend-play. Such discrepancies have led to research addressing such questions more systematically. It was hypothesized that researchers have used tasks that require fundamentally different information processing abilities from children. For example, traditional scale model tasks include many objects and may require more complex spatial skills than natural pretend play does.

To control for this problem, recent investigators have kept spatial complexity to a minimum, asking instead whether young children can comprehend objects as symbols when they are presented one at a time. In such situations, children at 2;0 are better able to comprehend a replica as a symbol for another single object when it is placed behind a plexiglass window. Similarly, when given the opportunity to manipulate a scale object before a test phase, children at 3;0 have difficulty to later perceive the object as a symbol. These findings provide strong support for the dual representation problem (DeLoache, 2000).

Other research has considered whether early pretend-play might actually not be symbolic at all, but rather is an expression of imitative learning and a

perception of what objects afford for action. Testing groups of children at 2;0, 2;6 and 3;0, Striano, Tomasello & Rochat (2001) showed that at all ages, children engaged in significantly more pretend-play activities when these activities were previously modelled by an experimenter compared to when there was no model demonstration. Furthermore, children manifested a marked increase in pretend-play with toy objects that were replicas of real objects specifically designed to stand for other objects. For instance, children increased their pretend play when they had a doll represent a person compared to having a rock or a pencil represent a person. These results suggest that symbolic functioning in early pretend games is in part imitative, and determined by cultural affordances (objects with well known functions) attached to objects (Tomasello, 1999).

Recent findings also point to interesting differences in apparent symbolic comprehension depending on the form of the symbol used. For instance, at 1;6, children are reported to understand both new words and new gestures as representing specific objects. In contrast, at 2;2 infants appear capable of readily mapping new words, but not new gestures to objects (Namy & Waxman, 1998). These results point to an early developmental trend from general to more linguistically focused symbolic functioning.

In an experimental situation where objects were referred to only via gestures or miniature 3-D replicas, Tomasello, Striano, & Rochat (1999) found that for children of 1;6, 2;2 and 2;11, performance in understanding requests for an object tended to be significantly better when gestures were used. It appears that DeLoache's dual representation problem is exacerbated in the context of the use of an object as symbol. Tomasello *et al.* (1999) found, for example, that when the replica is presented to request another object children tend to reach for the replica, but rather than treating it as a symbol, they treated it as an object to be manipulated and explored.

Considering that young children appear more prone to understand gestures, rather than replicas as symbols, questions remain whether this difference is exclusively a result of the dual representation problem as proposed by Tomasello *et al.* (1999), or whether gestures provide more information to children.

In the research by Tomasello *et al.* (1999), the experimenter first modelled how to use the particular target objects that the replica object or gesture would represent. During testing, the replica was always presented to the child in a STATIC way. The gesture request, on the other hand, provided DYNAMIC information. These task differences between the replica and gesture requests made it difficult to determine whether gestures are easier for children to understand as symbols, or whether the presentation of the gestures provided infants with more information. That is, children might not understand the gestural request as symbolic *per se*, but may be better able to associate such requests to objects because of the additional dynamic information that is

provided. If this interpretation is correct, one might expect to link young children's early referential understanding to the degree of resemblance between gesture and its referent, whether based on static or dynamic information.

In support of this idea, O'Reilly (1995) showed that children of 3;0 comprehend symbolic gestures that involve body parts resembling objects (extended index finger to represent a toothbrush) more readily than gestures in which the action alone is represented (i.e. closed fist pretending to hold a toothbrush). Such difference is less marked in four- and five-year-olds' performance. Similarly, Mandler & McDonough (1996) provide evidence that even by 1;2, infants may not be constrained by perceptual information when generalizing across object categories (however, see Rakinson & Butterworth, 1998; Rakinson, 2000). This developing independence away from perceptual similarity would correspond to what Werner & Kaplan (1963) coined the progressive perceptual 'distancing' of symbols from referents. Such trends are also observed in language development, as children become more linguistically focused with age and actually start to have difficulty using more perceptually salient gestures to label novel objects in the world (i.e. Namy & Waxman, 1998).

In the present research, the nature and determinants of early symbolic comprehension were investigated. In a first study, we considered the role of modelling and request type on children's comprehension of gestures and objects as symbols. We assessed the role of modelling by providing half of the children with a demonstration on how the objects that would later be requested in the test phase worked. We assessed the role of request type by asking for the target objects in a way that was highly conventional (i.e. familiar), such as asking for a pair of scissors using either the closing motion of index and middle fingers or by requesting these objects in a manner that was less conventional (i.e. novel), such as movements of opening and closing forearms. In a second study, we considered how prior modelling and type of request influenced children's ability at 1;8 to comprehend unconventional and novel objects as symbols.

There were 3 general working hypotheses guiding the two studies. First, children at 2;2 may rely less on modelling of symbolic activities compared to children at 1;8. Second, children at 2;2 will be less sensitive to the type of symbolic request compared to those at 1;8. Third, the effect of modelling and request type will depend upon the conventional use attached to objects.

The rationale for these hypotheses was that the developmental decalage in favour of gestures over replicas (i.e. Tomasello *et al.*, 1999) might rest on the fact that gestures, in comparison to static replica presentations, add dynamic information and resemblance between symbols and their referents. Furthermore, considering that symbolic comprehension might develop first in a social context through imitating others (i.e. Tomasello *et al.*, 1999; Striano

*et al.*, 2001), we construed that the influence of previous modelling would become less of a factor in determining symbolic comprehension as a function of age.

To examine these hypotheses, children were introduced to two object sets. In the first study, we used one set of objects to address children's comprehension of gestures as symbols and another set to address their comprehension of replicas as symbols. Following the general procedure of Tomasello *et al.* (1999), children played a game where the task was to pick one of four objects requested by the experimenter. To establish whether children comprehended gestures and replicas as symbolic, we first modelled for half of the children at each age how to use the target objects (i.e. banging with a hammer). No demonstration was provided for the other half of the children.

According to our first hypothesis, if children's competence in understanding gestures is due to a learned association between a gesture (e.g. pounding fist on floor to request a hammer), and a previously observed action demonstration (hammer hitting floor), only children who observed the action demonstration would comprehend the experimenter's gesture during testing. To test our second hypothesis, we examined whether children's comprehension of a gesture and object request was enhanced when the symbolic request was most conventional resembling the target object it was standing for. We expected that, with developing symbolic abilities, children at 2;2 would be less influenced by the conventionality of the request and previous modelling than children at 1;8.

In the second study, we further investigated the role of conventional action that could be attached to an object, and how such conventional action might impact young children's understanding of symbols. In relation to this hypothesis, we expected that early symbolic functioning depended on the intentional affordances and conventional design of objects.

## STUDY 1

The relative resemblance between symbol and their referents, and the influence of previous model of action afforded by the referent were considered as potential factors of early symbolic comprehension. The resemblance factor was assessed in a gesture and object as symbol context. Children were presented with gestures or replicas that were more or less conventional to the referred object. For example, children were requested to put scissors down a slide based on a gesture using either the closing motion of index and middle fingers, or the less conventional body movements of opening and closing forearms. In the replica condition, children responded to a request based either on the mere static presentation of the replica, as in the Tomasello *et al.* (1999) study, or in the more conventional presentation of a replica with appropriate motion (e.g. replica hammer in appropriate hammering motion).

In addition, to control for the potential role of modelling as a factor, in both gesture and replica request conditions, children were either previously exposed or not exposed to modelled affordances of the object of the experimenter.

## METHOD

### *Participants*

Sixty-four participants were recruited from a list of parents who had volunteered to participate in studies on child development. There were 32 children at 1;8 (15 females,  $M = 1;8.02$ ) and 32 children at 2;2 (15 females,  $M = 2;2.16$ ). Ninety percent of participants were white middle-class and 10% were African-American middle-class. Children received a small gift for participating. Ten additional children were tested (6 at 1;8 and 4 at 2;2), but were excluded from the study because they refused to participate ( $N = 8$ ) or because of experimental error ( $N = 2$ ).

### *Materials*

The apparatus was a colourful slide with a 10 in. by 16 in. aperture at both ends, inclined to about  $25^\circ$ . The higher end, the child's end, was about 18 in. above the floor and had next to it a small platform on which the objects could be placed. The lower end, the experimenter's end, led to a plastic tray on the floor. The child's task in all phases of the experiment was to assess which one of four target objects on the platform the experimenter wanted, and then to throw it down the slide or chute (see Tomasello *et al.* 1999 for similar procedure and apparatus).

Three object sets were used in the game. For the purpose of clarity, we used TARGET OBJECTS to refer to the objects that the child chose, during the warm-up and test phases, and use REPLICA OBJECTS to refer to those replica objects used by the experimenter to request objects from the child. For the warm-up phase, four target objects were used: keys, spoon, block, and sock. For the gesture phase, four target objects were used: toy hammer, plastic brush, plastic scissors, and a baby bottle. The target objects were approximately 6 in. tall. For the object phase there were four target objects: baseball hat, plastic fork, toothbrush, and a plastic cup. The target objects were 4 to 6 in. in dimension. There were also four corresponding replica objects: hat, fork, toothbrush, and cup. The replica objects were 1–2 in. tall, and were analogous to the corresponding target objects, but about two-thirds smaller, differing slightly in colour and material.

### *Procedure*

Each child was videotaped and tested individually. The child sat on the floor and the accompanying parent sat behind the child who was facing the

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TABLE 1. *Actions performed on target objects for the gesture and object phase*

Object	Action
Gesture phase	
hammer	bang on floor
brush	brush hair
scissors	cut (no substrate)
bottle	drink
Object phase	
hat	hat on head
fork	fork to mouth
toothbrush	brush teeth
cup	drink

apparatus and the experimenter. Parents were told they could encourage their child to play the game, but otherwise not to help them. The testing sessions consisted of a warm-up task, followed by two test phases. For all trials, the location of the target object was randomly determined, never appearing in the same location more than twice in a row. The phase (gesture phase or object phase) and type of request was counterbalanced within children of each age group.

Following a warm-up session, testing began. Children were randomly assigned to one of two model conditions. For children in the no-model condition, the experimenter introduced the objects by placing the tray in front of the child and then enhanced each object by touching it successively for 4–5 s while saying, ‘Look at this’. For children in the model condition, the experimenter placed the tray of objects in front of the child and then used each in its conventional fashion (e.g. hammering with the hammer, see Table 1). After the experimenter touched the object or modelled an action, she placed it back on the tray in front of the child.

For each trial, the experimenter, who was naive regarding the predictions of the study, requested an object to be put down the chute, by asking the child, ‘Can I have your ... down the slide?’ Children were given a maximum of 60 s to respond to the experimenter’s request, with the verbal request repeated 3–4 times during the trial if necessary. The trial was repeated once if the child did not respond by throwing any object down the slide after the first request.

*Warm-up phase*

In the warm-up phase, the experimenter introduced the child to the slide, calling it a ‘slide game’. The experimenter first showed the child how objects could be thrown down the slide. The child was then instructed how to play the game, and asked to throw only the object requested by the experimenter down the slide. The child was then presented with four objects on a tray. The

experimenter would ask for each one in turn by name: keys, block, spoon, and sock. Mothers could assist their children during this warm-up phase, and help them understand that they could put only one object at a time down the slide. Children passed the warm-up phase if they responded correctly for three requests in a row without help from their mother. The warm-up phase continued until children met this criterion.

### *Gesture phase*

In the gesture phase, the experimenter requested the target object by performing a high-conventional or a low-conventional gesture. For the high-conventional gesture, the experimenter used one hand to stand for the object (see O'Reilly, 1995). For the low-conventional gesture she held her hand open and used one arm as the object – for requesting the brush she used one arm to brush her hair, for the scissors she moved both arms to represent the blades of the scissors (with her elbows as a hinge), for the hammer she used one elbow to bang on the floor like a hammer, and for the bottle she brought an arm with opened hand to her mouth (no thumb pointing toward the mouth). Note that a random sample of 10 naïve adults systematically ranked the high-conventional request as more conventional for all gestures. For a given child, the experimenter asked for each of the four target objects using one type of request (high-conventional or low-conventional), then asked for each of the four objects a second time using the other type of request. On each trial and for both request types, the experimenter asked the child, 'Can I have your ... down the slide?' as she performed the corresponding gesture.

### *Object phase*

In the object-phase, the experimenter requested the child's target object by holding up either a static or a dynamic replica object. For instance, when requesting the target hat, the experimenter held up a replica plastic hat, for the fork she held up a replica plastic fork, for the toothbrush she held up a replica toothbrush, and for the cup she held up a replica cup. The experimenter would ask for each of the four target objects using one type of request, then asked for each of the four objects a second time using the other request type. On each trial and for both request types, the experimenter asked the child, 'Can I have your ... down the slide?' as she either statically held up the replica object or performed an action with it. The experimenter asked for each of the four target objects using one type of request (static or dynamic), then asked for each of the four objects a second time using the other type of request.

### *Dependent measures and coding*

For each trial, the experimenter recorded the child's response. The response was operationally defined as the first object the child sent down the chute. The



response was coded as incorrect if the child threw an incorrect object down the chute. If the child did not respond within 60 s of the given trial, it was also considered as incorrect. If the child pushed more than one object down the slide at a given time, the trial was repeated. Failure to respond on a given trial and pushing down more than one object were relatively rare (less than 5% of all trials). The repeated trial was scored and used in the final analysis. For reliability, an independent observer coded again all video records. For discrepancies between the live coding and video records, the observer viewed the video records a second time (a discrepancy occurred for 0.007% of all trials) to determine which object the child tossed down the chute. For reliability, two independent observers also measured the number of reaching attempts for each trial. Reaching was coded from video records and defined as one or both of the child's arms coming forward toward the experimenter's hand as she performed a gesture (gesture phase) or toward the object the experimenter was holding (object phase). Children received a score of 0 to 4 for each phase of the study, 0 if they never reached and 4 if they reached for all 4 objects. Based on 20% of the tested children, inter-observer reliability was 99.2%.

## RESULTS

### *Overall performance*

To assess whether children comprehended the experimenter's request, we compared their performance to chance of 0.25 (given that there were 4 objects to choose from) using a series of one-sample *t*-tests. Analyses were performed separately for each phase (gesture or object), age group (1;8 and 2;2), request type (high-conventional and low-conventional for gesture, dynamic and static for object), and demonstration type (model or no-model). As indicated in Table 2, children at both ages performed above chance for all phases regardless of demonstration type. The only exception was for the group of 1;8 children in the no-model condition when the experimenter requested the target objects in the gesture condition. To ensure that these null findings were not due to chance, we performed a retrospective power analysis (Tomas & Juanas, 1996). The analysis revealed that power was high: 0.77 for the high-conventional group and 0.99 for the low-conventional group. Therefore, it is unlikely due to lack of power, rather this reflects special difficulty in the comprehension of objects as symbols for children at 1;8 when no model demonstration is provided.

### *Comparison of performance by age, perceptual similarity, and modelling conditions*

To assess the role of age, request type, and model demonstration on children's symbolic comprehension, we performed a (2) age: 1;8 vs. 2;2  $\times$  (2) request

TABLE 2. *Children's performance by age, model demonstration, phase, and request type*

Request type Model type	Age	M (S.D.)	<i>t</i>	<i>p</i>
Gesture high-conventional				
model	1;8	1.68 (0.87)	3.15	0.007*
model	2;2	2.00 (1.10)	3.46	0.003*
no-model	1;8	1.25 (0.25)	1.00	0.333
no-model	2;2	1.37 (0.71)	2.08	0.054*
Gesture low-conventional				
model	1;8	1.62 (0.71)	3.48	0.003*
model	2;2	1.56 (0.96)	2.33	0.034*
no-model	1;8	1.06 (0.57)	0.436	0.669
no-model	2;2	1.75 (1.10)	2.53	0.023*
Object static				
model	1;8	1.62 (0.71)	2.30	0.036*
model	2;2	2.56 (1.30)	4.75	0.000*
no-model	1;8	2.50 (1.30)	4.39	0.001*
no-model	2;2	2.06 (1.20)	3.78	0.002*
Object dynamic				
model	1;8	1.43 (0.81)	2.15	0.048*
model	2;2	2.75 (1.20)	5.91	0.000*
no-model	1;8	1.87 (1.10)	3.05	0.008*
no-model	2;2	2.12 (0.95)	4.70	0.000*

\*  $p < 0.05$ . $N = 16$  for each cell.

type: high-conventional vs. low-conventional for gesture or dynamic vs. static for object  $\times$  (2) model demonstration: no-model vs. model mixed design analysis of variance (ANOVA) on the number of correct responses. Overall analysis of variance treating order as a variable (gesture phase first or object phase first, conventional first or dynamic first) yielded no significant main effect of order ( $p > 0.20$  in all cases). This variable was not considered in further analyses. Below are the results obtained in relation to gesture and object.

### *Gesture*

The analysis on the number of children's correct responses in the gesture phase yielded a significant main effect of model,  $F(1, 60) = 4.65$ ,  $p < 0.035$ , with children performing better when they saw a model ( $M = 1.72$ ) compared to the no-model demonstration ( $M = 1.36$ ). This finding indicates that, overall, modelling facilitated children's comprehension of the experimenter's gesture. There were no other significant main effects, nor any significant interactions for the gesture phase.

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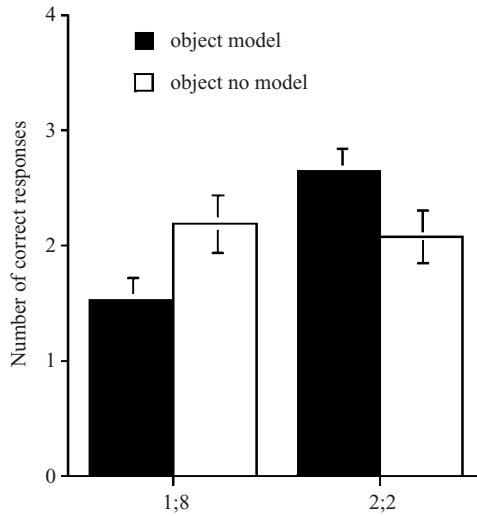


Fig. 1. Mean number of correct responses as a function of age and condition.

*Object*

The analysis on the number of children's correct responses in the object phase yielded a significant main effect of age  $F(1, 60) = 0.03, p = 0.03$ , with the children at 2;2 ( $M = 2.37$ ) performing reliably better than those at 1;8 ( $M = 1.85$ ). There was also a significant age  $\times$  model interaction,  $F(1, 60) = 6.90, p = 0.01$ . This interaction rests on the fact that the performance of children at 2;2 was marginally enhanced ( $F(1, 30) = 2.98, p = 0.095$ ) in the model condition compared to the no-model condition whereas the performance of children at 1;8 was hindered ( $F(1, 30) = 3.94, p = 0.056$ ) in the model condition compared to the no-model condition (see Figure 1). There were no significant main effects or interactions in relation to the request type variable.

*Object phase: reaching*

We performed a (2) age: 1;8 vs. 2;2  $\times$  (2) model type: no-model vs. model  $\times$  (2) request type: static vs. dynamic mixed design ANOVA on the number of times children reached for the replica object. Note that we did not analyse reaching for the gesture phase because children never reached when the experimenter was not holding an object. The ANOVA yielded a significant main effect of request type  $F(1, 60) = 19.26, p < 0.0001$ , with children reaching more when the replica object was requested statically ( $M = 1.62$ ) compared to when it was requested dynamically ( $M = 0.844$ ). There was also a significant main effect of age,  $F(1, 60) = 4.43, p = 0.04$ , indicating that children at 1;8

reached more often ( $M=1.53$ ) than those at 2;2 ( $M=0.98$ ). There were no other significant main effects or interactions.

#### SUMMARY AND DISCUSSION

Results pertaining to children's understanding of GESTURES indicate that when children saw the experimenter model, they comprehended her use of a gesture to stand for a target object. When they did not see her model, only the children at 2;2 comprehended the experimenter's gesture. This finding suggests that children's comprehension of gestures at 1;8 might rest on an association between a model and the gesture used in the request. In contrast, because children at 2;2 did not show any influence of previous modelling, the results suggest that they did comprehend the gestures as symbolic. Learning the association between model and request gesture cannot account for the performance of children at 2;2 as they performed above chance regardless of modelling.

Furthermore, the degree of conventionality of the gesture did not appear to play a significant role in children's performance at either age. Rather than conventionality *per se*, and, in light of the model demonstration effect, it is probable that the actual action or vitality of the gesture (e.g. speed and rhythm) associated with the object is the information picked up by children in either their learned association of gesture and object (children at 1;8), or in their mapping of symbol to referent (children at 2;2).

In relation to children's comprehension of replicas as standing for other objects, regardless of model demonstration, or whether the replica was presented statically or dynamically, children at both ages were above chance in their performance. In comparing conditions, however, we found a significant age by model demonstration interaction. This interaction rests on the fact that at 2;2 those children who saw the experimenter's model prior to testing tended to perform significantly better compared to those children who did not see a model demonstration. The reverse trend was found for children at 1;8.

It appeared that for the younger children, previous modelling is a source of confusion, somehow impeding them from identifying the object as symbol. To examine this interpretation, we conducted Study 2. We tested children's (mean age of 1;8) comprehension that objects stand for other objects that have no prescribed cultural functions (e.g. stones and sticks rather than cars or scissors).

The rationale for this second study was the following. We considered that there could be at least two possible explanations for why modelling did not improve the performance of children at 1;8. One is that young children have difficulty comprehending ANY object associated with an action as a symbol due to a general lack of dual representation ability (DeLoache, 1995, see Introduction). An alternative interpretation is that children's performance is linked

to the pre-existing knowledge they have about objects, and in particular, their understanding that certain objects are used in certain conventional ways (e.g. scissors to cut, cars to roll). These conventional ways correspond to what is sometimes called ‘cultural’ or ‘intentional’ affordances of objects (Tomasello *et al.*, 1999; Tomasello, 1999). In the first experiment, children were asked to comprehend replicas as symbols for objects, all having well-known functions and specific actions tied to them (e.g. brushing for toothbrushes, drinking for cups, head covering for hats). It is thus possible that the children at 1;8 in the object condition of the previous study might have expressed particular difficulties in comprehending objects as symbols because the objects were always associated with a conventional function or so-called intentional affordance. The second study was meant to test this conclusion.

## STUDY 2

In Study 2, we tested children’s comprehension of unconventional replicas as standing for objects that had no well-known functions. Half of the children saw a prior demonstration with each of the target objects; the other half did not (see Method of Experiment 1). If conventional actions associated with familiar objects play a role in young children’s symbolic comprehension, then we expected that children would not show the model demonstration effect found in Experiment 1. In other words, if children do not pick up any conventional ways in which a particular object might be used, they might be less subject to distraction by previous modelling. As a working hypothesis, we expected no modelling effects in the context of non-conventional objects used as symbols for other objects.

### METHOD

#### *Participants*

Twenty-four participants were recruited from a list of parents and children who had volunteered for studies of child development. Children were aged 1;8 (6 females and 18 males,  $M = 1;7.30$ , range = 1;6.19–1;9.08). All characteristics of the sample were the same as in Study 1. One participant was excluded due to experimental error.

#### *Materials*

The aperture and warm-up phase was the same as in Study 1. For the testing phase, there were four unconventional target objects and four replica objects: a 4 in. × 3 in. × 1 in. green block with a 0.5 in. piece of black tape placed vertically around it, a 7 in. tree branch with two pieces of colourful 1 in. construction paper wrapped around the centre, a 3 in. rock painted red, a 5 in.

TABLE 3. *Actions performed on non-conventional target objects*

Object	Action
block	back and forth tipping motion 90° on floor, to upright position
stick	side to side flipping motion on the floor, 90° side to side
rock	clockwise motion, 180° around 12 in. imaginary circumference
sponge	clapping motion, side to side motion, moving sponge toward empty hand then back away

jagged piece of yellow sponge. All replicas were approximately 1 in. in size but were otherwise similar in colour, shape, and material.

### *Procedure*

The general method and procedure were the same as in Study 1. There was a warm-up phase, followed by one testing phase. Children were randomly assigned to one of two model conditions. For children in the no-model condition, the experimenter introduced children to their objects by placing the tray of objects in front of them and then enhancing each object successively by touching it and saying, 'Look at this'. For children in the model condition, the experimenter placed the tray of objects in front of children and then performed a novel action with each object before placing it back on the tray (see Table 3). During testing, the experimenter requested the child's object by holding up a small replica that the child had never seen before in either a static or dynamic way.

When requesting the replica in a static way, the experimenter simply held the object in her hand at the child's eye level. When requesting the replica in a dynamic way, the experimenter repeatedly performed the same actions with each replica object as in the model condition demonstration (see Table 3). The experimenter asked for each of the four target objects using one type of request, then asked for each of the four objects a second time using the other request type. For each trial and for both request types, experimenter asked the child, 'Can I have your ... down the slide?' while requesting the objects. If necessary, the experimenter repeated the verbal request 3 to 4 times for a given trial. The experimenter asked for each of the four target objects using one type of request (static or dynamic) then asked for each of the four objects a second time using the other type of request. Order of request type was counter-balanced among children.

## RESULTS

### *Overall performance*

To assess whether children comprehended the experimenter's request, we compared their performance to chance of 0.25 (given that there were four

TABLE 4. *Children's performance by model demonstration and request type*

Request type Model type	Age	<i>N</i>	<i>M</i> (S.D.)	<i>t</i>	<i>p</i>
object static model	1;8	12	1.66 (0.77)	2.96	0.013*
no-model	1;8	12	1.83 (1.1)	2.59	0.025*
object dynamic model	1;8	12	1.83 (0.93)	3.08	0.010*
no-model	1;8	12	1.41 (0.79)	1.82	0.096

\*  $p < 0.05$ ,  $N = 12$  for each cell.

objects to choose from), using a series of one-sample *t*-tests. Analyses were performed separately for each request type (static or dynamic) and demonstration type (model or no-model). As indicated in Table 4, children's performance was above chance in all conditions, although marginally so in the no-model condition when the experimenter requested the object dynamically.

### *Reaching*

We performed a (2) model type: no-model vs. model  $\times$  (2) request type: static vs. dynamic mixed design ANOVA on the number of times children reached for the replicas. The analysis revealed a significant main effect of request type,  $F(1, 22) = 9.14$ ,  $p = 0.006$  with children reaching more for the static compared to the dynamic object ( $M = 1.75$  and  $0.875$  respectively). There were no other significant main effects or interactions.

### *Comparison of performance by request type and modelling conditions*

We performed a (2) model type: no-model vs. model  $\times$  (2) request type: static or dynamic mixed design ANOVA on the number of correct responses. Overall ANOVA treating order as a variable (static first or dynamic first) yielded no significant main effect of order. This variable was not considered in further analyses. The analysis yielded no significant main effects or any significant interactions ( $p > 0.22$  in all cases).

## SUMMARY AND DISCUSSION

Results of Study 2 indicated that when using non-conventional objects as symbols, children at 1;8 do not show a significant model demonstration effect. This result supports the idea that the modelling effect found with children of the same age in Study 1 depended on the functional familiarity of the object. That is, children may have had difficulty to overcome the knowledge they already had about a particular object. Again, as in Study 1, for the object condition, we did not find a significant effect of static vs. dynamic request.

## GENERAL DISCUSSION

The aim of the present research was to explore the nature and determinants of early symbolic comprehension. In the first study, we considered the potential role of modelling and request type on young children's comprehension of gestures and replicas as symbols. The first working hypothesis was that if modelling plays a role in early symbolic functioning, then this role should decrease with age. Consequently, we expected that for older children, previous modelling of symbolic activities performed by an adult would become less important as a determinant of early symbolic comprehension. Results regarding the comprehension of gestures as symbols by children at 1;8 and 2;2 provide some support for this hypothesis. However, it does not hold for the comprehension of objects as symbols.

In the gesture condition, the younger children were only above chance in their symbolic performance following modelling. In contrast, the older group of children was above chance regardless of previous modelling. This developmental trend was not confirmed in the condition where children had to comprehend that replicas could be symbols. In this condition, both groups were above chance regardless of modelling. One possible interpretation for these divergent results across conditions is that the replicas, unlike gestures, provide strong perceptual similarities with the referent, and therefore young children would be less dependent on modelling to engage in symbolic functioning. However, this interpretation needs to take into consideration the fact that young children's performance deteriorated significantly when a model demonstration was provided prior to testing. Thus, modelling may have interfered with younger children's performance perhaps by making them focus on the modelled action to the exclusion of the object itself. The reverse was true for the older children who appeared to get better following such demonstration as was shown by the significant age-by-model demonstration interaction found in the first study.

We hypothesized that such interaction was probably due to the fact that for younger children, the gesture associated with the target object during modelling added information that hindered their performance in comprehending the replica as symbol during testing. Accordingly, younger children might have been distracted by the experimenter's action while demonstrating the conventional use of each target object. The results on children's reaching provide further support for this idea. In particular, children at 1;8 were more likely to reach for the experimenter's replica compared to those at 2;2. These younger children may have difficulty to inhibit reaching during the task, and reaching may have been similarly evoked when the experimenter's model demonstration was seen.

Results of Study 1 suggested that older children are not distracted by previous demonstrations of an object's conventional use, but rather are helped by it. Therefore, modelling appears to have different meanings for children at



1;8 and 2;2: an extra informational load to handle for the younger, and supplemental dynamic information for the older which helps matching the referent object to its symbolic replica.

The results of Study 2 confirm that the demonstrated conventional use associated with an object probably creates a ‘sticky’ obstacle for younger children in their comprehension of objects as symbols. When using target objects that have no specific conventional use, we did not find any evidence of a detrimental effect from previous model demonstrations on symbolic comprehension among children at 1;8. This result confirms that the modelling of a conventional use of a familiar object confuses rather than scaffolds younger children’s symbolic ability to comprehend a replica object as standing for the target object. We interpret this confusion as originating from the powerful attentional pull toward the conventional action on the object (putting a hat on one’s head, brushing one’s hair) rather than the object itself (hat or brush) that the replica is referring to. The previous conventional action modelled on the object somehow takes precedence over the object itself. The difficulties children encountered in our task are analogous to the ‘dual representation problem’ (i.e. DeLoache, 1995) they manifest when considering the use of an object and its physical appearance as two aspects of the same thing; the thing that the replica stands for (i.e. the object that has a particular conventional use or intentional affordance and, at the same time, has a specific appearance). This is in contrast to language, in which the child does not have to overcome the affordances of an object. The comprehension of objects as symbols provides children additional information that is specified not only in the object itself but also in the way in which it is used and manipulated by others. The underlying reason behind using symbols, whether in the form of language or objects seems to be the same – namely to communicate and interact with others (i.e. Tomasello, 1999).

Previous research suggests that children’s symbolic comprehension and production is influenced by the nature of the symbol itself. For instance, infants tend to use gestures before they use linguistic symbols to communicate with others (i.e. Goodwyn & Acredolo, 1993). This developmental lag, however, is generally a small one of less than two months. It is likely that advances in cognitive growth similarly underlie the comprehension and use of both language and gesture (see also Namy & Waxman, 1998). The results of the current study complement prior research on the influence of the type or nature of symbol in symbolic functioning more generally. While the underlying function of symbolic forms to communicate and share experience may be the same across modalities, children’s comprehension of these various symbolic forms appear mediated by a variety of factors.

The fact that in the gesture condition the symbolic comprehension of the children at 1;8 was significantly better following a model demonstration with the target object confirms that the absence of the object in the symbolic request

phase reduces the cognitive load of the symbolic task, thereby decreasing the potential for confusion between action and object, and allowing younger children to benefit from the modelling in their symbolic comprehension. It also provides evidence that younger children might respond accurately to the symbolic request during testing on the mere basis of a mapping of analogous action linked to the demonstrated action on the object (conventional use) and the gesture standing for the object. Because no model demonstration effect in the gesture condition was found with the children at 2;2, this older group of children did not appear to benefit from such modelling in their symbolic comprehension. The absence of reliance on modelling suggests that in contrast to the younger group, older children understand that the gesture can refer to the object *per se* and not simply to the conventional action associated with it. This can be construed as an expression of the developing decontextualization or distancing of a symbol from its referent described by Werner & Kaplan (1963).

Our second hypothesis was that, as a function of age, young children's symbolic comprehension becomes less sensitive to the type of request or the perceptual similarity between symbol and referent. We did not find any evidence supporting this prediction. Our data yielded no effect of conventionality in the gesture condition, nor any effects of static vs. dynamic presentation of the replica in the object condition, or any significant interactions of these effects with age. We conclude that during the request phase, the dynamic profile of the gesture, in particular its vitality contour (i.e. the motion and rhythm of the request) rather than the perceptual resemblance of the body part used by the experimenter to signify the target object, is the information picked up by children at all ages, and on which early symbolic comprehension is based. In contrast, when replicas are involved, it is their physical appearance rather than the relative vitality attached to them that is picked up by children in their symbolic comprehension, at both ages.

Finally, our third working hypothesis was that the impact of modelling in symbolic comprehension depends on the learned conventional use attached to an object. As discussed above, this prediction is confirmed by both studies when considering the performance of children at 1;8. For this young age group, it appears that the model demonstration of the conventional use associated with an object interferes with symbolic comprehension of the replica during testing. Results of the second study show that this interference vanishes when non-conventional objects with no clear intentional affordances are involved.

In all, these results demonstrate that the ability of young children to take a symbolic stance, to refer to objects on the basis of multiple perceptual indices, is a highly context-dependent ability requiring much cognitive flexibility. Modelling does seem to play a role in children's early symbolic comprehension. The effect of modelling, however, depends on the type of

object symbolized, whether it is associated with familiar (conventional) or unfamiliar (unconventional) use.

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