

# **Children's**

## **Understanding and Production of Pictures, Drawings, and Art**

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# **Children's Understanding of Artist-Picture Relations: Implications for Their Theories of Pictures**

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## **Introduction**

The ultimate human social-cognitive behavior is communicating with others through culturally shared symbols (Deacon, 1997; Tomasello, 1999; Wittgenstein, 1953). Just as all roads lead to Rome, much of early infant perceptual, cognitive, and social cognitive development converges upon this behavior dawning toward the end of infancy. The foundations that are built from the development of these basic processes prepare the infant for inclusion in this central social-cognitive goal: intentional communicative exchanges with others. The exquisite design of the human infant goes beyond the perceptual and cognitive abilities that enable independent interaction with the world of objects and events to encompass the unique ability to learn through others (Tomasello, Kruger, & Ratner, 1993). This social cognitive ability includes not only the capacity to reproduce the actions of others, but also the capacity to infer, and then adopt, the mental stance of others. It is ultimately these social cognitive abilities that enable infants to become symbol users.

Tomasello (1999, 2003) presents a cultural learning view of language acquisition that stresses the central importance to this development of understanding others as intentional agents like the self. He provides evidence to suggest that intentional understanding begins to develop during the period of 9-12 months, and it eventually enables infants to understand the communicative intentions of others as these intentions are directed toward them. Intentional understanding also positions infants to be able to interact with others in new ways such as in the establishment of joint attentional frames, which provide an intersubjective framework for communication, or in the ability to engage in role reversal imitation, which allows infants to acquire the symbolic conventions that others are using toward them.

Tomasello (2003) argues that it is the development of these foundations in intentional understanding that accounts for the particular timing of the onset of language toward the end of the first year.

Intentional understanding serves as a foundation in other symbolic domains as well. Tomasello and Rakoczy (2003; Rakoczy & Tomasello, 2006) argue that understanding of the intentions behind others' actions is critical for the development of pretense, which emerges around the second birthday and develops late due to its having the additional requirement that the child understand that pretense involves counterfactual actions. In this chapter and elsewhere, we explore the idea that intentional understanding is the core process that accounts for the onset of functioning with pictorial symbols (see also Callaghan, Chap. 2; 2003; 2004; Rochat & Callaghan, 2005). Thus, it appears that the foundation of intentional understanding, which emerges during the first year, positions infants to become true partners in communicative exchanges across a number of symbolic domains. That this ability develops first in the domain of language, and later in the domains of pretense and pictorial symbols attests to both the additional cognitive demands that these other domains may require, and to the relative importance the culture may place on the symbol systems (Callaghan, Chap. 2; 2003, 2004; Rochat & Callaghan, 2005).

Intentional understanding in the context of symbolic interactions amounts to the child coming to understand both that the communicative partner is using symbols to share meaning, and what the message means. Pictures, like words, are not transparent in their symbolic function. Infants need to learn about that function in some way, and we propose that the way they learn is through others, using the social cognitive skills of intention reading and imitation. In particular, the developmental story we propose is that children's intentional understanding enables them to acquire increasingly sophisticated knowledge about the nature of pictorial symbols from interacting with others who use those symbols in exchanges with them. As children gain communicative experience with the symbols that others have created, they build a theory of what a picture is for and come to be able to produce their own pictorial symbols. Thus, the child's theory of pictures is initially built through an inference of what goes on in the mind of others who use pictorial symbols. Once the child understands the referential function of pictures and begins to produce representational drawings, his theory of pictures can be further refined through symbolic interaction that can now be self-initiated.

Freeman (1995, see also Freeman, Chap. 3) proposes a theory of picture processing that captures the importance of intentional understanding with its claim that mature understanding of the referential function of pictures involves an appreciation of the complex intentional network that links the picture to three other components in the pictorial symbol communication process: The real world referent, the artist, and the viewer. Much of the theory and research on pictorial symbol understanding focuses on the first of these three links; that is, explaining how the picture comes to be linked to the referent by the child (DeLoache, 1995, 2002; DeLoache & Smith, 1999; Liben, 1999). What children understand, or misunderstand, about this symbol-referent

relation at various stages of development, and the situational factors that can influence this understanding, occupies a significant portion of these research efforts. Very little research has focused on the question of the processes through which children come to understand the link. We have explored the question of process in our own research (Callaghan, 1999; Callaghan & Anton, under review; Callaghan & Rankin, 2002; Callaghan & Rochat, 2003, under review; Callaghan, Rochat, MacGillivray, & MacLellan, 2004; Callaghan, Rochat, Lerikos, MacDougall, & Corbit, under review; Rochat & Callaghan, 2005), and will argue in this chapter that the question of *how* children come to understand the referential link between pictures and their referents has to be answered by an exploration of children's understanding of the intentional link between the artist and the picture.

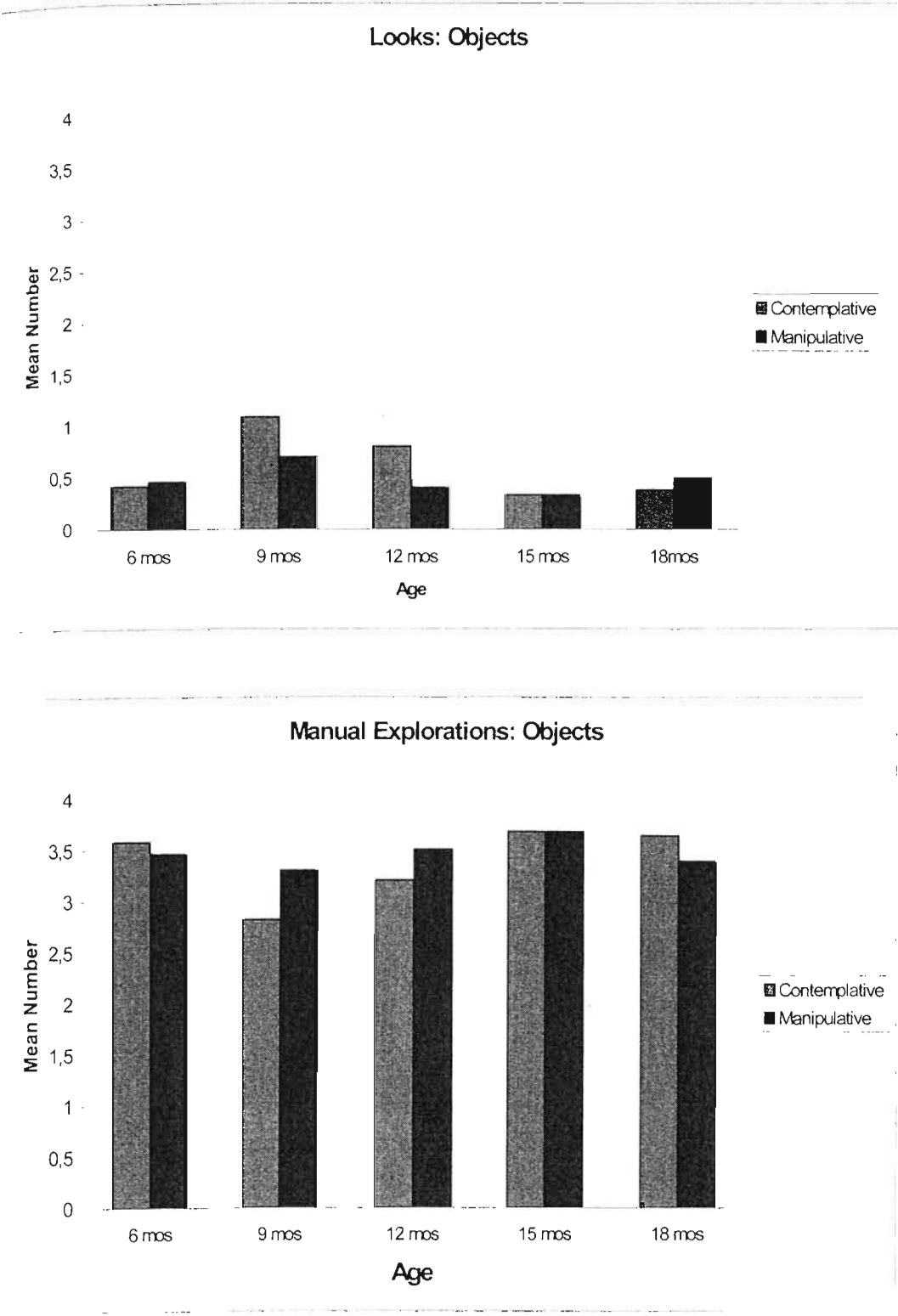
Specifically, we argue that children come to understand the referential function of pictures through others, especially through joint attentional episodes where others are using pictures as symbols in communicative exchanges with children. Through observing the referential actions of others, through inferring their communicative intentions, and through the reproduction of those actions and intentions, children enter the world of pictorial symbols. They come to understand what others use pictures for, thereby achieving referential understanding, and only then can they take on the role of artist. Production of a pictorial symbol is grounded in intention; symbols are intentional artifacts (Goodman, 1968; Wittgenstein, 1953). Children who do not understand the referential function of pictures cannot intend to have their graphic productions function as a symbol. In what follows we provide evidence from our own and others' research for the claim that children's understanding of referential intent is built from their understanding of the referential intentions of others, and that this understanding is initially implicit and only later develops into explicit understanding.

In middle class Western culture even very young infants are exposed to a rich array of pictorial symbols in their home environment. Baby board books, colorful wall decorations, family photo albums, visually attractive packaging, and other assorted pictorial symbols are typically made available for infants' direct sensorimotor interaction. We propose that the active exploration of this world of pictures through visual perception, cognition, and motor action has little impact on the building of referential understanding until it is linked to the exploration of those pictures through others (Szechter & Liben, 2004). Thus, in all of our tasks we present infants and young children with experts using pictorial symbols, challenge them to respond to that symbolic act, and infer through their actions what they take the expert's action to mean. We look for evidence of what infants and children understand about the symbolic behavior of those who produce pictorial symbols in their responses to others' symbolic behavior. These include tendencies to reproduce the actions of the experimenters, to find the pictorial products that the experimenters made, or to make predictions about what actions the experimenter will take next. Rarely do we use a language-based assessment of this understanding because we want to tap into the earliest dawning of the ability to understand pictorial symbols, and language terms for symbolic concepts may be difficult for young children to understand. Learning through others begins in infancy.

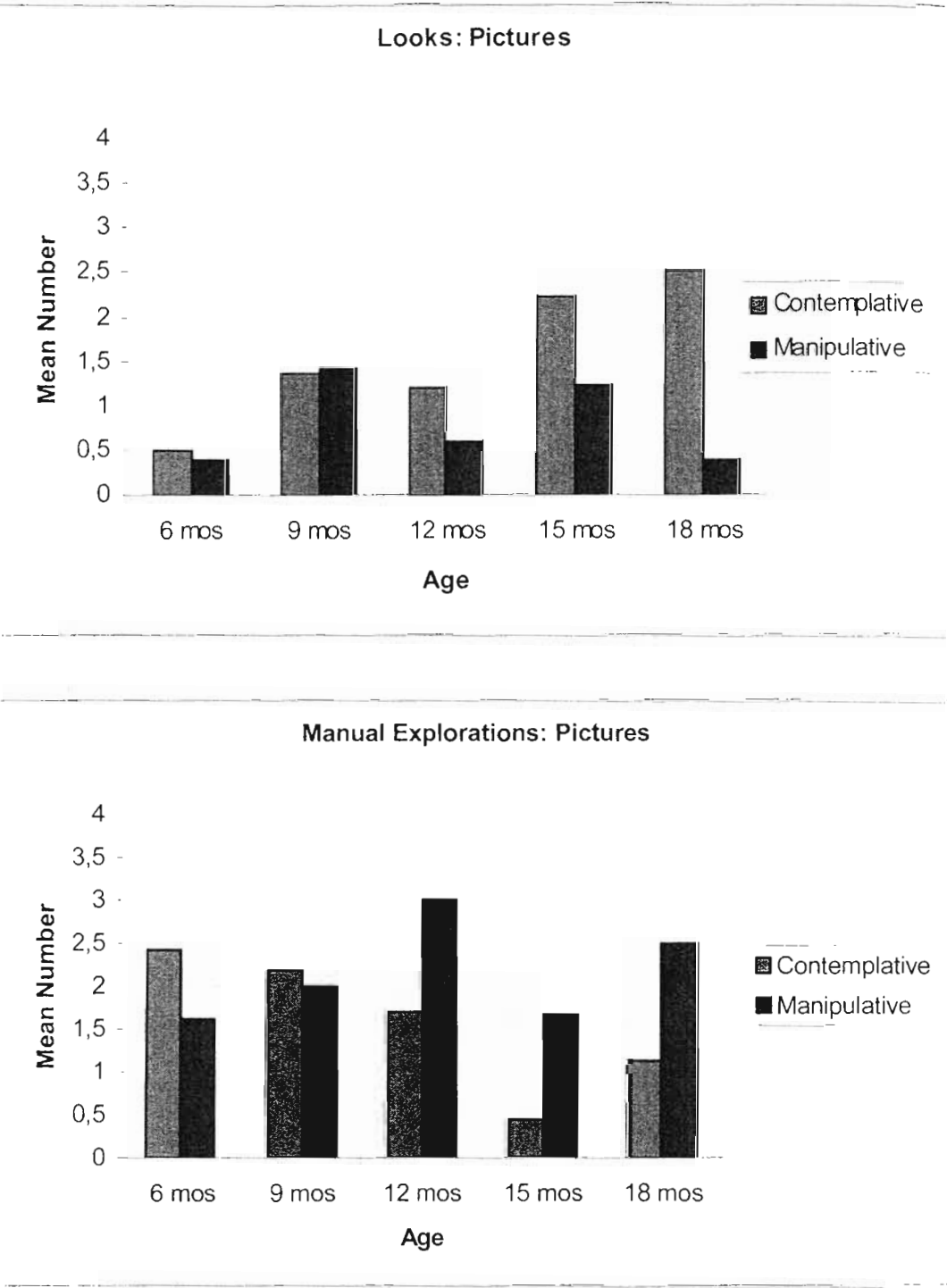
## Infants: action-based knowledge of intentions

Before infants truly understand the referential function of pictures, there is a phase where they will nevertheless model the symbolic actions of others (Callaghan et al., 2004). In this study an experimenter presented infants with two types of items (photos of infant toys and the infant toys depicted in the photos) and demonstrated for eight trials one of two types of actions on the items: one that was referential (i.e., looking and pointing to the picture or object while shifting gaze between infant and item) and another that was manipulative (i.e., flexibly jiggling the picture or object while shifting gaze between infant and item). Following the demonstration trials, the infants were given four test trials that began with another demonstration of the target stance and ended by giving the infant the photo or object of the items. The first action that the infant took toward the item was coded as either referential (i.e., pausing manual action for at least 3 sec to look at the item), or manipulative (i.e., manually exploring the item). On the basis of prior social referencing research (e.g., Campos & Stenberg, 1981), we reasoned that infants would model the experimenter's actions only when the item was novel and they were unsure of what to do with it, and not in cases where the item was of a familiar type and they were confident of what to do with it. Thus, we expected them to model what the adult did with our high fidelity photos (novel stimuli for all children) but not with the infant toys that were depicted in those photos (similar to toys they had in their own environments). Our results confirmed that regardless of what the experimenter did with the toys, the 6- to 18-month-old infants manually explored them (see Figure 9.1). In contrast, beginning at 12 months of age, infants emulated what the experimenter did with photos – they looked at them significantly more following a referential, contemplative demonstration and they manually explored them more following a manipulative demonstration (see Figure 9.2). On the basis of these findings, we proposed that an early stage in developing an understanding of the symbolic function of pictures occurs between 6- to 12-months, wherein infants are acting toward pictures as others do, but without a conceptual understanding of the symbolic function.

Action-based knowledge is a first step in the construction of the more sophisticated knowledge that pictures are symbols; first infants act toward them as others do, later they understand why others act that way toward them. In order to conclude that infants both act on pictures as though they were symbols and also know that they are symbols, we would need to have converging evidence showing that infants can use pictures to cue their behavior in other symbolic tasks. We have completed a great number of these tasks in our lab and find no evidence that children can use pictures as symbols to guide their behavior before 30 months of age (Callaghan, 1999; Callaghan, 2000; Callaghan & Rankin, 2002).



**Figure 9.1** Findings from Callaghan et al. (2004) showing that infants do not imitate actions on objects.

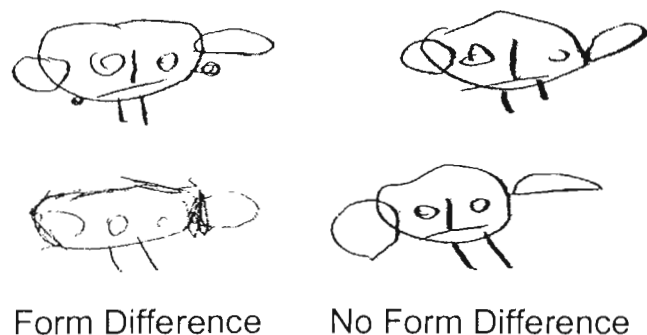


**Figure 9.2** Findings from Callaghan et al. (2004) showing that infants imitate actions on pictures, beginning at 12 months.

## Toddlers: perceptually-based knowledge of symbol-referent links

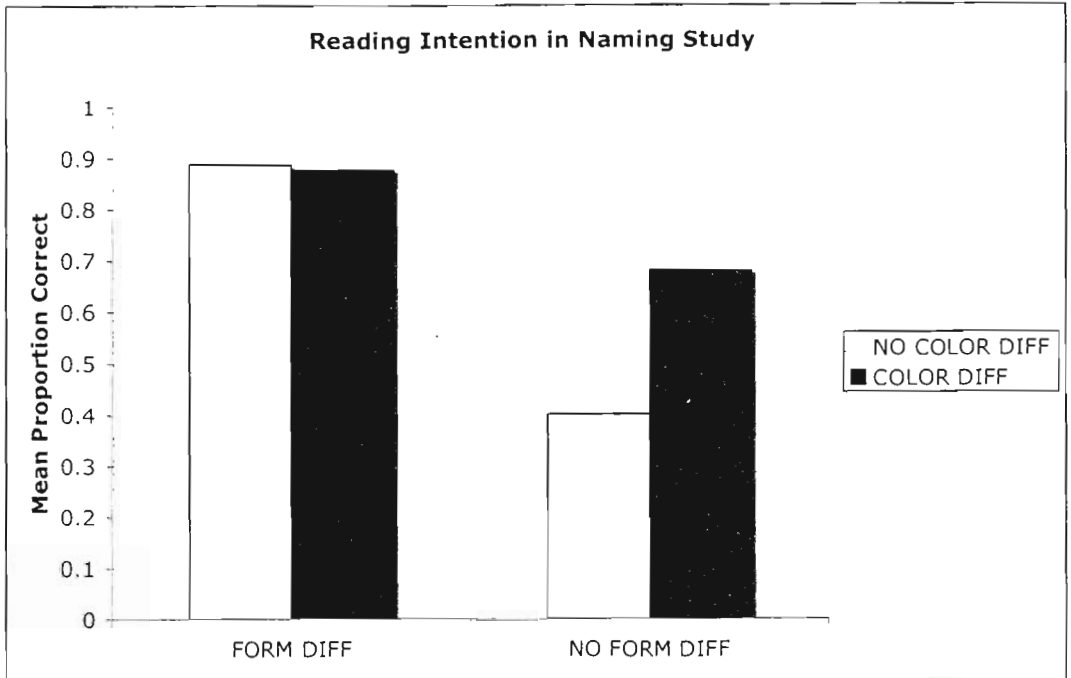
A number of studies investigate children's sensitivity to artists' intent by describing scenarios involving hypothetical artists rather than by having children watch others draw, and then asking children to name the drawing. In one such study, Gelman and Ebeling (1998) asked children between 2.5 and 4 years and adults to name line drawings that were drawn intentionally or happened by accident (spilled paint). They reported that children and adults used shape cues to name pictures they thought were intentionally created, but used these cues less so when they thought the picture was created by accident. In a second study with 4- and 7-year-olds, Browne and Woolley (2001) pitted the drawing's resemblance to an object (i.e., perceptual similarity of form cues) against the intention to draw a particular object and reported that children named on the basis of intention if the resemblance to the object was ambiguous, but on the basis of resemblance if it unambiguously resembled the object. Thus, they ignored intention when the drawing looked unambiguously like a particular referent that was different from the referent cued by intention (e.g., a drawing looks like a rabbit but, according to the story, was 'intended' to represent a dog).

In a study that asked children to name pictures that they had drawn, Bloom and Markson (1998) presented results to suggest that children can name drawings on the basis of intention, even when form cues cannot distinguish those intentions (e.g., drawings of a balloon and lollipop, or of self and the experimenter). In a replication and extension of this study, we uncovered a problem in the original study: Children were given a different color pencil to make each drawing, which introduces the potential confound of naming on the basis of color, and not intention, as the researchers claimed. In our study (Callaghan & Rochat, under review, Study 1), we asked children to draw the four pictures either using four different colors for each picture, or using a single color. We reasoned that children would successfully read their intention (i.e., correctly label their drawings of balloons and lollipops) only when there was a form or color difference between the items in the pair (see sample drawings of self and experimenter in Figure 9.3). Our results confirmed this prediction (see Figure 9.4).



**Figure 9.3** Sample children's drawings of self and experimenter, one pair with form differences and another pair without form differences.

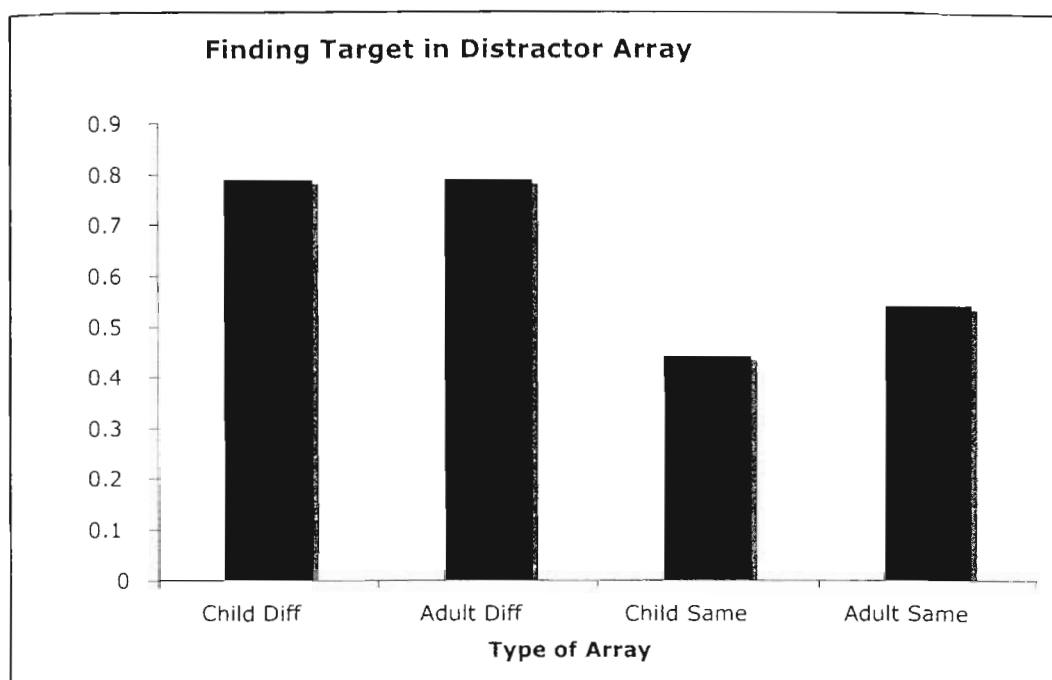




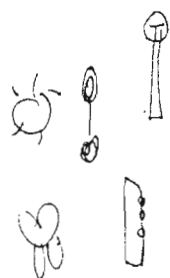
**Figure 9.4** Data from Callaghan & Rochat (under review, Study 1) indicating that children utilize form and color differences between drawings to help them infer intent, and can not name drawings when neither of these types of differences appear across the pair.

Children were best at naming their drawings (i.e., reading intentions) when there were form differences between the items of the pair, but were also able to name drawings with color differences. They were unable to name drawings if there were neither form nor color differences to draw on. Thus, when reading their intentions post hoc from their own productions, children need to have a perceptual cue of that intention, and form seems to be an especially effective one. This conclusion was supported in a second study, where we had 3- to 5-year-old children make their own drawings, or watch an adult draw, and then find these drawings when they were embedded in backgrounds of other people's drawings of the same object or different objects (Callaghan & Rochat, under review, Study 2). When searching for the pictures they had intentionally made a few minutes before in a background of distractors that were drawings of different objects, the difference in form attributes did help to cue intention for children of both ages (see Figure 9.5). Form cues also helped them to infer intention when searching for drawings an adult had just made.

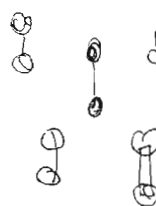
Taken together, what these studies suggest is that by the age of 3 years children can infer intention from hearing about scenarios that describe artists' drawing, by making their own drawings, or by watching an adult draw. For the most part children judge the relation between the picture and the referent when they make this inference; in particular, the resemblance of form cues. What we need to know is whether children can use this knowledge gained from judging the symbolic intentions of others to influence their own symbolic functioning.



**Child Diff**

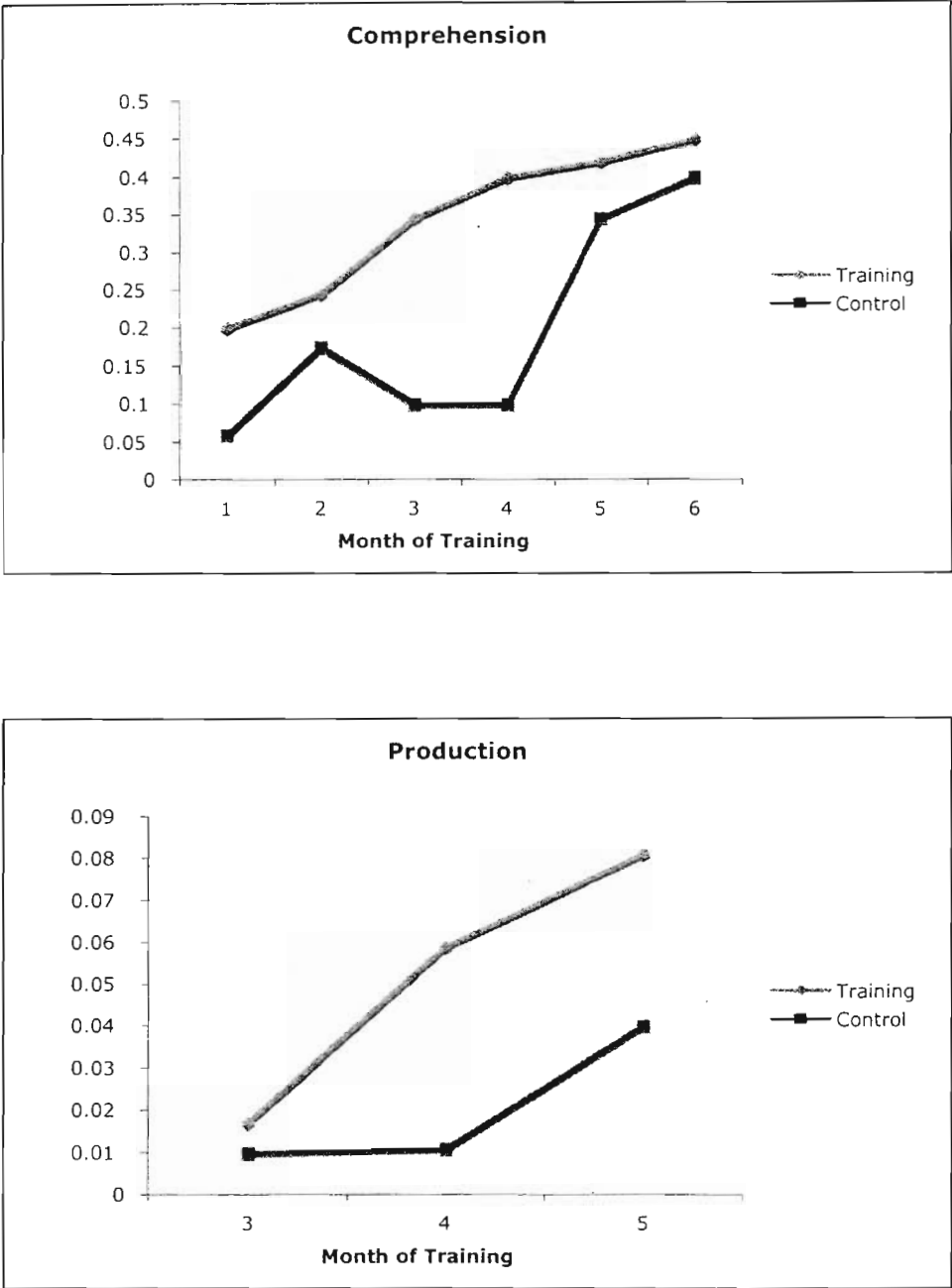


**Child Same**



**Figure 9.5** Data from Callaghan & Rochat (under review, Study 2) indicating that children more easily find drawings in distractors depicting different objects than in those depicting the same object.

In a longitudinal training study from our lab (Callaghan & Rankin, 2002), we exposed children to an artist producing pictures and examined whether this experience would facilitate the emergence of symbolic processing in children who were not yet using pictures as symbols or producing their own pictorial symbols. We found that within 2 months of the beginning of training, 2.5-year-old children who had been exposed in weekly sessions to an adult producing and then using pictorial symbols over 24 trials performed better on picture symbol comprehension and production tasks than children who had weekly sessions interacting with the experimenter and the same objects used in the training group, but who never saw pictures produced or used by the experimenter. These control children did not show the same level of performance as the training group until after they received training in the 5th month of the study (see Figure 9.6). Thus, repeated exposure to an expert who makes pictorial symbols and then highlights the symbol-referent link was enough to accelerate the onset of comprehension and production of pictorial symbols in these young children.



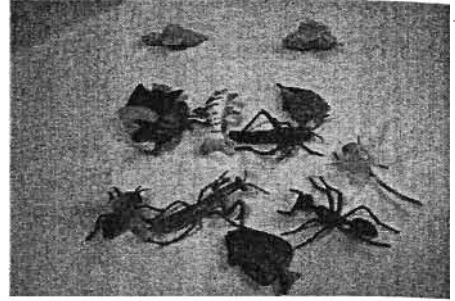
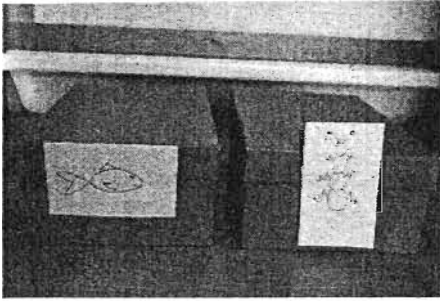
**Figure 9.6** Data from Callaghan & Rankin (2002) showing positive effects of training on comprehension and production of representational pictures.

DeLoache and her colleagues have also tried to accelerate the symbolic functioning of young children in another symbol task using 3D scale models as symbols of rooms where items are hidden. The typical task for the child in her studies is to use the model as a cue to where a toy is hidden in the life-sized room. DeLoache (2002) summarized the findings from a variety of techniques used to try to improve young children’s performance through highlighting the referential intention of the experimenter. Although not directly relevant to the study of pictorial symbol use, what is interesting is that most of these interventions using scale models that aimed to highlight referential intent

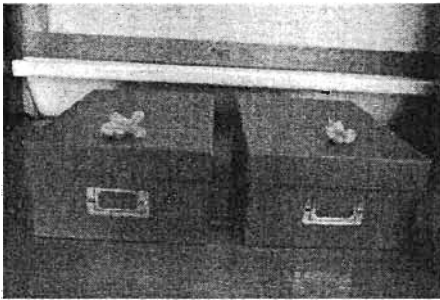
were unsuccessful. In one of their few studies with pictorial symbols, DeLoache and Burns (1994) reported that extensive instructions that focused on the high level of perceptual correspondence between the symbol of the hiding place and the corresponding place in the room (i.e., the picture-referent link) were necessary for 2.5-year-olds to do well on the task. Recently, Salsa and Peralta de Mendoza (2007) replicated this finding but report that highlighting the representational intention of pictures facilitated performance of children far more than highlighting the perceptual correspondence between pictures and referents. In addition to the picture-referent link, children in both of these studies may have been able to support their performance by using the verbal label for the hiding place. Callaghan (2000) has demonstrated that young children will use verbal labels when they can to scaffold their performance in picture symbol tasks, and when they cannot, they typically do not show evidence that they can use pictures as symbols until closer to 3 years. It was also not until 3 years that children who received no informational support about intentions or perceptual correspondence in Salsa and Peralta de Mendoza's study were able to perform the symbolic retrieval task.

With the exception of the production measures in Callaghan and Rankin's (2002) study, the studies discussed so far focus on symbolic comprehension tasks; typically search tasks. While this measures children's understanding of how to use a pictorial symbol made by someone else, it does not illuminate how their symbolic understanding that comes from knowledge of how others use pictorial symbols is applied to their own production of symbols. The evidence from Callaghan and Rankin (2002) suggests that there is an impact, and we explored this question more fully in a recent study that spans the ages of 3- to 7-years.

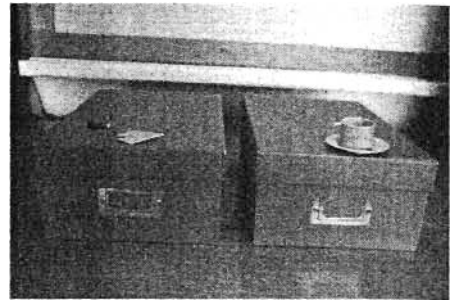
Callaghan and Anton (under review) assessed 3- to 7-year-old children's ability to infer intent from artist's actions, and then act on that inference, under conditions where the intention to symbolize was more or less directly evident in the artist's actions. We measured imitative responses, reasoning that children's use of the artist as a source of information about what to do in a picture symbol task would be evidenced by their tendency to reproduce the actions of the artists. Children first engaged in a sorting game in which they played with, and then categorized, two types of toys. When they had sorted each type into one of two identical boxes, they were presented with one of four scenarios. In the Control condition they sorted a group of balls and sticks into two boxes, with balls in one and sticks in the other, and then were given a pencil and pad of post-it-notes to see whether they would spontaneously draw a picture to symbolize the contents of the boxes. For all remaining conditions the same procedure and stimuli were used on the test trial. Before the test trials on these other conditions, children watched artists as they produced, or tried to produce, visual symbols using different props than those used on the test trial. There were three experimental conditions; Demo (artist drew 2 quick pencil sketches on post-it-notes and placed them on the appropriate box to indicate the contents, see Figure 9.7), Multi-Symbol (artist sequentially made 3 types of symbols to indicate the contents of 3 pairs of boxes; playdough model, photo, replica object, see Figure 9.8), and Failed Attempt (artist tried to make a sketch to label boxes but failed because the pencil was broken).



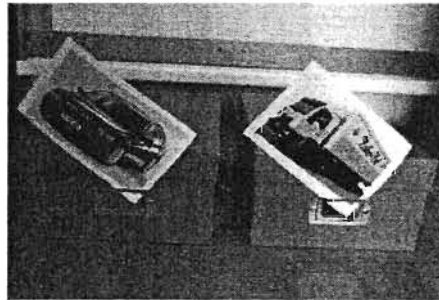
**Figure 9.7** Sample stimuli used in Callaghan and Anton's (under review) Demo condition.



**Playdough model**



**Replica object**

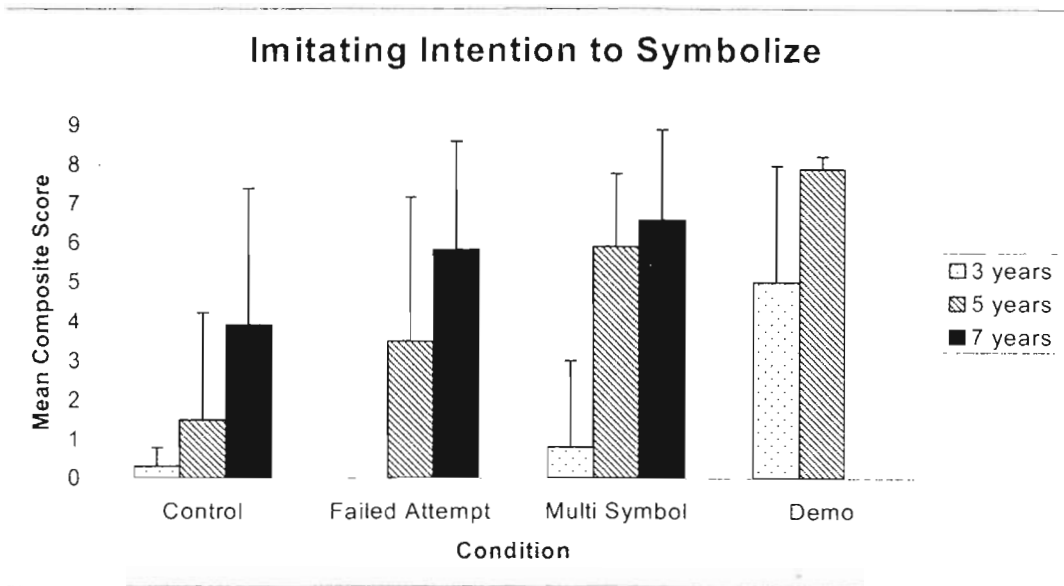


**Photo**

**Figure 9.8** Sample stimuli used in Callaghan and Anton's (under review) Multi Symbol condition.

The results are summarized in Figure 9.9. Children of all ages inferred the intention to make a symbol in the Demo condition, where the intention to symbolize was directly given, readily making drawings to indicate the contents of boxes on the test trial. 5- and 7-year-olds were able to infer the intention to symbolize in the Multi-Symbol condition, where the intention to symbolize with a picture had to be abstracted from actions of the artist making other types of visual symbols. When the intention to symbolize was most obscure, no young children, but about half of the 7-year-olds, were able to infer the intention to symbolize from the Failed Attempt condition. Only two 7-year-olds spontaneously produced pictures in the Control condition, where there

was no intention to symbolize evident in the experimenter's actions. What these results suggest is that children can make an inference about what pictures are for from watching an artist producing pictorial symbols, and they can then translate that knowledge into symbolic actions of their own. They can do this by 3 years when the intention can be imitated from a direct demonstration (Demo), and by 5 years if it the intention has to be inferred from related symbolic actions (Multi-Symbol). Together with the production study of Callaghan and Rankin (2002), this experiment provides support for the claim that children can apply what they learn from an artist who is engaging in symbolic actions with the child to symbolic actions of their own. Toward the end of the preschool period children begin to mirror an artist's symbolic intent.



*Figure 9.9* Findings from Callaghan & Anton (under review).

## School age children: conceptually-based understanding of the symbolic function

There have been a number of interview studies that explored children's understanding of the artist-picture link. Freeman and Sanger (1993) interviewed 7- to 12-year-olds about the impact that the artist would have on the quality of pictorial representations. Their questions included such themes as what made for a beautiful or an ugly picture and whether the feelings or skills of an artist would have an impact on the quality of the product. Young children (7 to 10 years) focused on the picture-referent link suggesting that the only thing that mattered was how beautiful or ugly the referent was. Later on (11-14 years) children believed that qualities of the artist, such as emotional state or skill level, could affect the product. In a related interview study, Parsons

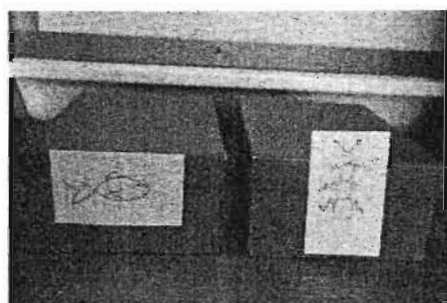
(1987) also found that children in this age range believe that artist's mood would be directly displayed on the canvas. The more mature realization that an artist could transcend felt mood and create an imagined world on the canvas was only rarely reported in these studies among the oldest children (late adolescence) and so may be an insight of the symbolic process that is rarely achieved without specific training. However, the interview task, which may only reveal children's relatively late-developing explicit knowledge (Karmiloff-Smith, 1992) of the factors that affect the picture making process, may be underestimating children's implicit knowledge about how attributes of the artist may have an impact on the picture.

In a series of three studies we explored children's implicit knowledge of the artist-picture link by asking children to identify pictures made by artists who varied in age, sentience, affective style, and emotional state (Callaghan & Rochat, 2003). Only in the last study did we interview children about how the factor of emotion influenced artists' drawings. Using a forced choice procedure in the first study, we presented children between the ages of 2 to 5 years with pairs of drawings that had been done by artists who varied in age (adult vs. older child vs. younger child) and sentience (person vs. machine). Beginning at 4 years, children chose the drawing that was appropriate to the age of the artists and at 5 years children could make machine-person distinctions. In the second study, 3- and 5-year-olds watched videotapes of artists who varied in affective style (agitated or calm) engage in a painting process and then judged which of two drawings were done by a given artist. Five-year-olds were successful at this task. In the third study, we showed 3- to 7-year-olds photographs of artists who differed in expressed emotion (happy vs. sad) and asked them to identify which artist painted each of 12 paintings. In this study we also interviewed children about whether an artist would make a picture that matched the artist's mood, whether an artist could do a picture that was opposite to their mood, and whether an artist could make a picture opposite in emotion of a theme that was personally relevant to the child (e.g., Could an artist make a sad picture of something that made the child happy?). The results of this study indicated that 5- and 7-year-olds successfully matched the emotion expressed in the painting to the emotion of the artist, corroborating earlier findings in this area (Callaghan, 1997; Callaghan & MacFarlane, 1998). In response to the interview questions, most of these children felt that to go against one's felt emotion when creating a picture would be difficult for the artist, and they found that especially unlikely if the theme was personally relevant to the child. We also included a battery of theory of mind tasks in this study to determine whether reasoning about how the attributes of the artist relate to the picture that artist produced would correlate with mental state reasoning. Our false contents task asked children to predict what an experimenter would think was in a crayon box that they had just learned had candles in it. Performance on the false contents task did correlate with performance on the picture judgment task, suggesting that the reasoning that underlies judgments of the mind behind the visual symbol may be linked to onset of basic mental state reasoning.

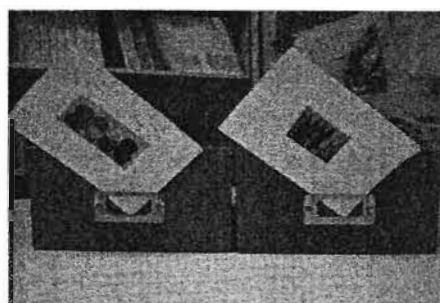
In a final study, we took our exploration of the link between mental state reasoning and children's conceptual understanding of pictorial symbols one step further. In this study, we asked children to make judgments about what an adult would do when a

picture symbolizing the contents of identical boxes had been surreptitiously switched (Callaghan et al., under review). The study was designed to measure children's understanding about what a picture is for, but we tapped into this by asking them to judge how another person would respond to a pictorial symbol. Thus, we investigated children's understanding of the artist-picture link as a means of measuring the depth of their conceptual understanding of the picture-referent relation. To do this we designed a pictorial analog of the false belief task.

In the picture false belief task two adults and a child played with some toys and then one experimenter sorted them into two categories and placed them in identical boxes. Before leaving the room, he highlighted one of the contents and said he would play with these toys later because they were his favorites. When that experimenter left the room, the second experimenter announced she had a good idea and then labeled the boxes with a quick sketch to indicate the contents (see Figure 9.10).



**Generic Symbols**



**Familiar Logo Symbols**

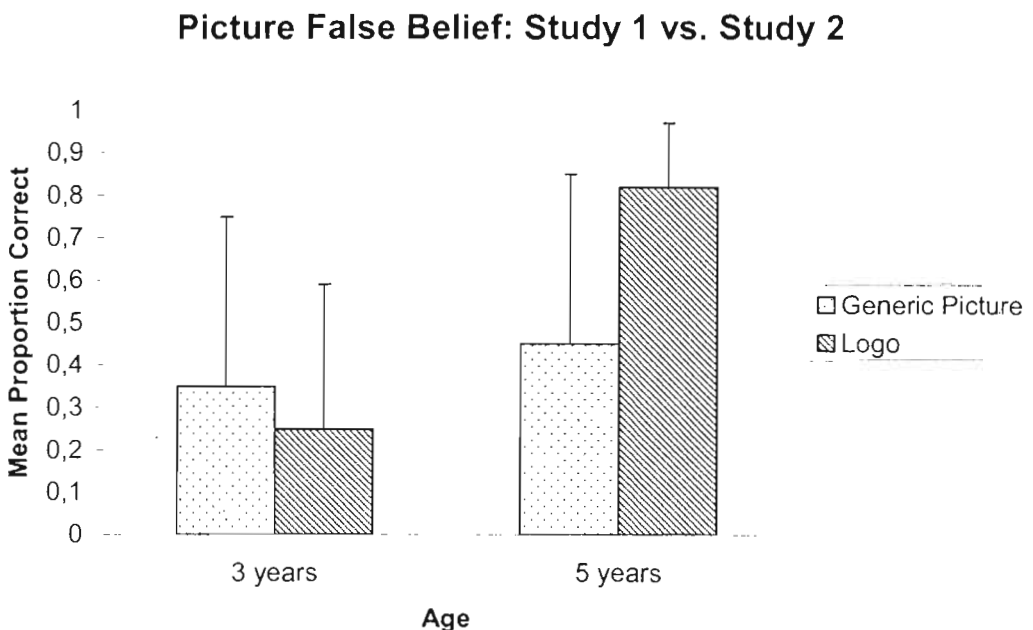
**Figure 9.10** Sample stimuli used in Callaghan et al. (2006) in the picture false belief task with familiar and unfamiliar logos.

Following this, she asked if the child wanted to play a trick on the other experimenter and then switched the pictures on the front of the boxes. The child was then asked to predict where the experimenter would look for his favorite toys when he returned. The level of understanding measured in this task goes beyond that found for the traditional false belief task in that it requires the child to form a representation of another person's representation of a representation (picture) of reality (contents of the box). Children found this additional level of complexity difficult; it was not until 7 years of age that children correctly predicted that the experimenter would look in the box with the picture of his favorite toys (see Figure 9.11). In a follow-up study we found that when we used more familiar logos (e.g., *Shrek* vs. *Lion King*) as labels for the contents of boxes, then 5-year-olds did well on the task.

Taken together, the results of these studies with older children suggest that when implicit knowledge of the picture-referent relation is measured in tasks that expose children to an artist in the process of making and using pictorial symbols, children fare well beginning around 5 years of age (Callaghan, 1997; Callaghan & Anton, under



review; Callaghan & MacFarlane, 1998; Callaghan & Rochat, 2003; Callaghan et al., under review). When explicit knowledge is measured in language-based tasks (Freeman, 1997; Freeman & Sanger, 1993; Parsons, 1987), children's accessible knowledge of the artist-picture relation appears to emerge later in childhood, and becomes more sophisticated by adolescence. There has been relatively little work completed on the forces that are necessary to move children, and indeed most adults, toward the more mature understanding of the artist-referent relation that would allow, for example, for understanding that an artist could hide his felt emotion at the time of the making process and still complete a masterpiece of an imagined world.



*Figure 9.11* Findings from Studies 1 and 2 (Callaghan et al., under review).

## Conclusions

We have reviewed a number of studies that examined what children know about the picture-referent relation in situations where children have to infer this knowledge from an artist using or producing pictorial symbols. What is clear from these studies is that reading intentions from artists' symbolic actions is a process that begins in infancy. Children's knowledge of symbols is manifested differently depending on the stage of development, giving us some insight into the understanding the child has of the picture symbol process at various points in development. Infants act on pictures as they see adults act on pictures, but we have no converging evi-

dence that they have knowledge that pictures have a symbolic function (Callaghan et al., 2004). Three-year-olds can readily use the pictorial symbols of others to find the referent, implying implicit knowledge of the picture-referent link (Callaghan, 1999; Callaghan & Rankin, 2002; DeLoache & Burns, 1994). Their ability to do this can be facilitated by concentrated exposure to an adult producing pictorial symbols (modeling the symbolic act) and highlighting the symbol-referent link (Callaghan & Rankin, 2002), as well as by giving them information about the intention to represent with pictures (Salsa & Peralta de Mendoza, 2007). Three-year-olds can also reproduce the act of making a pictorial symbol, thereby making their own symbols, under conditions where the artist has just explicitly demonstrated that action (Callaghan & Anton, under review). When the inference of a symbolic intention is more difficult to infer from the artist's actions, only older children reproduce the symbolic act. The ability to conceptualize how the artist's concept of a pictorial symbol will influence that artist's belief system also takes some time to develop. However, when familiar pictorial symbols are used as props, even 5-year-olds accomplish this complex cognitive leap (Callaghan et al., under review), revealing that they do have a sophisticated, albeit implicit, understanding of the symbolic function of pictures. Also relatively late to develop is explicit knowledge of the artist-referent relation. When children are interviewed about the link between the referent and artists' skills or mental states they typically do not clearly communicate about this link until late in childhood (Freeman, 1995; Freeman & Sanger, 1993; Parsons, 1987). This may be due to language demands or lack of experience with aesthetic concepts and needs to be further explored, especially given the finding that even 4-year-old children readily make a link between artist and pictorial symbol in matching tasks (Callaghan & Rochat, 2003).

Many of the studies reviewed here have a common goal of understanding how children infer referential function from engaging with others who are using pictorial symbols. The responses of children to adults engaging with them in such symbolic acts are used as a window on what children know about the function of pictorial symbols. That children can build this knowledge through observations of other people is clear from the studies we have reviewed here, and suggests that cultural learning plays a lead role in the development of symbolic functioning with pictures. But is cultural learning necessary? We have recently begun to explore this question in cross-cultural studies of children's picture symbol understanding. These studies are not yet complete, but what the preliminary findings do indicate is that in our field sites (traditional villages in southeastern India and central highlands Peru), where there are very few pictorial symbols in the environments of children and very few interactions between adults and children that center around pictorial symbols, using pictures as symbols or producing pictures are relatively late-developing skills. Thus, the central importance in symbolic development of the ability to understand communicative intentions in others appears to be supported. Ultimately, it is this understanding that children acquire through others that will allow the child to fly on their own, using pictorial symbols intentionally in communicative exchanges that they initiate.

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