

# Get the Picture? The Effects of Iconicity on Toddlers' Reenactment From Picture Books

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What do toddlers learn from everyday picture-book reading interactions? To date, there has been scant research exploring this question. In this study, the authors adapted a standard imitation procedure to examine 18- to 30-month-olds' ability to learn how to reenact a novel action sequence from a picture book. The results provide evidence that toddlers can imitate specific target actions on novel real-world objects on the basis of a picture-book interaction. Children's imitative performance after the reading interaction varied both as a function of age and the level of iconicity of the pictures in the book. These findings are discussed in terms of children's emerging symbolic capacity and the flexibility of the cognitive representation.

*Keywords:* picture books, reenactment, imitation, iconicity, symbols

Picture-book reading plays a prominent role in young children's daily activities. From around 1 year of age, many children in Western cultures spend considerable time engaged in joint picture-book reading with their parents (DeBaryshe, 1993; Gelman, Coley, Rosengren, Hartman, & Pappas, 1998; Karrass, VanDeventer, & Braungart-Rieker, 2003; Payne, Whitehurst, & Angell, 1994). In a recent large-scale survey, parents of preschool children reported that they own dozens of children's picture books and spend around 40 min a day in picture-book interactions with their children (Rideout, Vandewater, & Wartella, 2003).

Most of the existing research on picture-book reading with toddlers has focused on the nature of the interaction and the relative contributions of parents and children to it (Fletcher & Reese, 2005). Parents use picture books as a teaching event: They point to and label pictures (Murphy, 1978; Ninio & Bruner, 1978), ask questions and provide feedback (DeLoache & DeMendoza, 1987; Ninio & Bruner, 1978), emphasize taxonomic category relations (Gelman et al., 1998), and elaborate on story lines (DeLoache & DeMendoza, 1987; Hayden, Reese, & Fivush, 1996). We know little, however, about what young children learn from these interactions and whether they relate the contents of books to the real world.

Although it is widely assumed that toddlers learn a great deal about the world from picture-book interactions, there is reason to

believe that this may be a relatively challenging task for very young children. Understanding that pictures in a book may represent real objects requires some level of pictorial competence—the ability to perceive, interpret, and understand the nature and use of pictures (DeLoache, 2002; DeLoache & Burns, 1994; DeLoache, Pierroutsakos, & Troseth, 1996). The development of full pictorial competence takes place gradually over several years.

Very young infants can discriminate pictures and objects (DeLoache, Strauss, & Maynard, 1979; Slater, Rose, & Morrison, 1984), but they show little evidence of comprehending a picture as a representation of another entity (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998). Nine-month-olds, for example, manually explore pictures in books; they feel, rub, and even grasp at the pictures as though they were real objects (DeLoache et al., 1998). By 19 months, infants instead point at and label pictures, indicating a nascent awareness of how pictures differ from the real entities they represent (DeLoache et al., 1998; Murphy, 1978).

Further evidence of an emerging symbolic capacity has come from Preissler and Carey's (2004) finding that 18- and 24-month-old children extended a novel word that they learned for a depicted novel object to the real object. In the only study we know of examining infants' learning from picture books, Ganea and DeLoache (2005) found that 18-month-olds, and some 15-month-olds, extended a novel label learned for a novel depicted object to the real object. Moreover, from around 24 to 30 months of age, young children can use a photograph to locate a toy hidden in a room (DeLoache, 1991; DeLoache & Burns, 1994; Suddendorf, 2003).

Early on, infants' and toddlers' ability to relate pictures to their referents is relatively tenuous and affected by iconicity, that is, by the degree of similarity between depiction and real object. For example, 9-month-olds engage in more manual exploration of highly iconic pictures (photographs) than less iconic pictures (drawings) (Pierroutsakos & DeLoache, 2003). Moreover, Ganea and DeLoache (2005) found that iconicity affected 15- and 18-month-olds' generalization from depicted to real objects, and Cal-

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laghan (2000) reported that 3-year-olds more often succeeded in matching real objects to color pictures than to line drawings.

This iconicity effect is consistent with Hayne's (2004) representational flexibility hypothesis: Successful performance on a task depends on the extent to which the attributes of the cues available at encoding match the attributes of the cues available at retrieval. For example, toddlers imitate novel target actions when tested with the same objects they saw during the demonstration, but performance is substantially poorer when the test objects differ perceptually (e.g., in color, size, form) from the original ones (Hayne, Barr, & Herbert, 2003; Hayne, MacDonald, & Barr, 1997; Herbert & Hayne, 2000a). Thus, because highly iconic pictures share many attributes with their referents, they may be easier for toddlers to use symbolically than pictures of low fidelity.

### Experiment 1

The primary goals of this research were to examine toddlers' ability to learn new information from picture books and to see if iconicity affected their performance. Specifically, we asked whether 18-, 24-, and 30-month-old children could learn how to perform a novel sequence of actions from a picture-book interaction. To do so, we used a reenactment procedure: The children were asked to use a set of real objects to reenact the novel action sequence presented in the book. In reenactment paradigms, toddlers typically observe a model demonstrate a novel action sequence, and they are then given an opportunity to reproduce it either immediately or after a delay (e.g., Barr, Dowden, & Hayne, 1996; Bauer, 1996; Meltzoff, 1985, 1988b).

A large body of research has established that toddlers readily reproduce action sequences presented to them live by an experimenter (Bauer, 1996; Herbert & Hayne, 2000b; Meltzoff, 1988b; Simcock & Hayne, 2003). They can also imitate action sequences presented on television, although their performance is usually poorer than when imitating a live model (Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003; McCall, Parke, & Kavanaugh, 1977; Meltzoff, 1988a).

To see whether the nature of the book affected the children's reenactment performance, we used illustrations that were either highly iconic (color photographs) or less iconic (color drawings). To ensure that the children's behavior was based on learning from the book, we did not expose a control group to the book but tested the controls in the same way.

### Method

#### Participants

The participants were 36 children at each of three ages: 18 months ( $M = 18.19$ ,  $SD = 0.60$ ), 24 months ( $M = 24.19$ ,  $SD = 0.67$ ), and 30 months ( $M = 30.31$ ,  $SD = 0.82$ ), including 51 girls and 57 boys. All participants were English-speaking children from Brisbane, Queensland, Australia, and were primarily Caucasians of middle socioeconomic status. They were recruited from a database comprising birth announcements from local newspapers. Parents were sent a letter describing the study and were invited to participate. Twelve children at each age were assigned to one of three conditions: photograph, color drawing, or control.

#### Materials

Two picture books were constructed for the experiments. One contained six color photographs, and the other contained colored pencil drawings that were reproductions of the photographs (each 15.0 cm  $\times$  10.0 cm). Each book comprised six laminated pages bound with a cover, with each picture and accompanying text on the right of the binding facing a blank page. Table 1 describes the content of the pictures and shows the accompanying narration about constructing a rattle from three objects.

The stimuli for constructing the rattle (see Barr & Hayne, 1999; Bauer, Hertsgaard, & Wewerka, 1995; Herbert & Hayne, 2000a, 2000b) included a green wooden ball (3.0 cm  $\times$  2.5 cm), a green wooden stick (12.5 cm long) attached to a white plastic lid (9.5 cm diameter), and a clear plastic jar (8.0 cm  $\times$  5.5 cm) with a rubber diaphragm occluding the opening. The top of the jar and bottom of the lid attached together with Velcro.

#### Procedure

*Experimental conditions.* Following a brief warm-up, the children in both experimental conditions participated in a naturalistic picture-book reading session. The experimenter and child sat comfortably on a floor pillow as the experimenter read the book aloud twice in succession. The experimenter drew the child's attention to each picture by pointing to it as she read. At the conclusion of the 1-min interaction, the book was put away.

The child and experimenter sat on the floor for the reenactment test assessing the child's imitation of the target actions from the book. The experimenter placed the rattle components in front of the child, saying, "You can use these things to make a rattle. Show me how you can use these

Table 1  
*Description of the Pictures and Accompanying Text in the Picture Book Sandy Makes a Rattle*

Page	Picture	Text
1	Wide angle of child standing by a table with three objects on it	Sandy has found some toys.
2	Close-up of the three objects	Sandy has found a ball, a jar, and a stick. She can use these things to make a rattle.
3	Close-up of child's upper body and hands in mid-act	Sandy is pushing the ball into the jar. (Target Action 1)
4	Close-up of child's upper body and hands in mid-act	Sandy is picking the stick up and putting it on the jar. (Target Action 2)
5	Close-up of child's upper body and hands in mid-act	Sandy is shaking the stick to make a noise. Shake, shake. (Target Action 3)
6	Wide angle of child holding up the constructed rattle	Wow, Sandy made a rattle. Good job Sandy.

*Note.* The three target actions required to construct the rattle are in parentheses in the Text column.

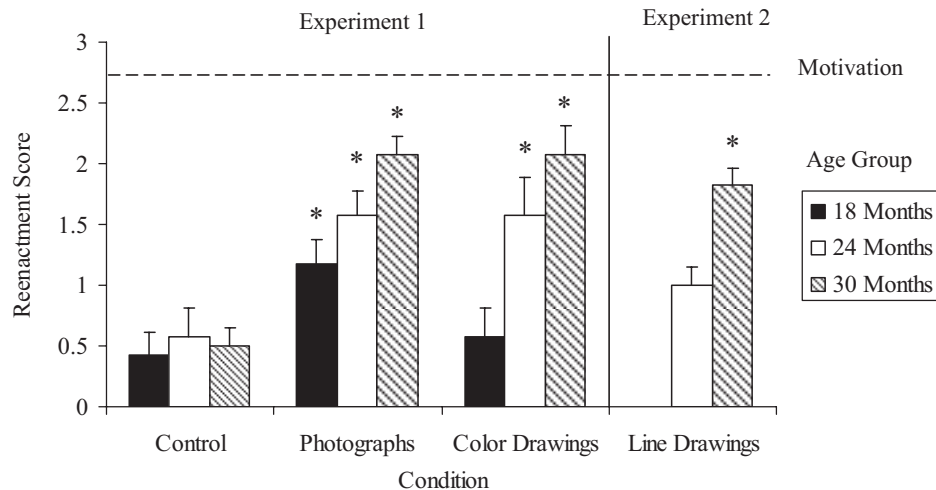


Figure 1. The children's mean reenactment scores (+ 1 SE) in Experiments 1 and 2 as a function of age group and condition. The children's mean motivation scores are collapsed across age and condition and depicted by the dashed line. An asterisk above a bar indicates that the mean score for that condition exceeds that of the age-matched control condition.

things to make a rattle.”<sup>1</sup> The child had 60 s from first touching the stimuli to interact with them. The prompt was repeated after 30 s, and no other instructions were given.

Finally, an immediate imitation procedure was used to ensure that the children were motivated and able to construct the rattle (i.e., that they would imitate following a live demonstration). For this motivation check, the experimenter modeled the three target actions required to make the rattle, accompanied with the relevant narration from the book (see Table 1, book pp. 3–5). The rattle stimuli were then placed in front of the child for the 60-s motivation test. The same prompts as in the reenactment test were used.

**Control condition.** The control condition established baseline levels of spontaneous production of the target actions without exposure to the book. These children never saw the book and participated only in the test. The timing and prompts were identical to those described above.

### Coding

Each child's entire session (test and motivation check) was videotaped and coded for production of the three target actions: (1) Put the ball in the jar, (2) put the lid on the jar, and (3) shake the stick. As in prior imitation studies, the three target actions could occur in any order. A second coder provided interobserver reliability for one third of the sample at 97% (Cohen's  $\kappa = .87$ ).

### Results and Discussion

Two checks ensured that any differences in reenactment could be attributed to the children's experience with the picture book itself. First, all children were very attentive and looked at the book over 85% of the time during the reading session (ranging from 86% for the youngest children to 95% for the oldest). Second, in the motivation check (see below), imitation approached ceiling after the live demonstration (see Figure 1). Thus, all age groups were motivated and able to assemble the rattle.

### Reenactment Scores

The children's reenactment scores (see Figure 1) were subjected to a 3 (age)  $\times$  3 (condition) analysis of variance (ANOVA). The

primary result of the analysis was a significant Age  $\times$  Condition interaction,  $F(4, 33) = 2.99, p < .05, \eta^2 = .11$ . There were also significant main effects for age,  $F(2, 99) = 11.93, p < .001, \eta^2 = .19$ , and for condition,  $F(2, 99) = 23.64, p < .001, \eta^2 = .32$ .

The interaction was explored in one-way ANOVAs across condition at each age with Student Newman-Keuls tests ( $p < .05$ ). The 24- and 30-month-olds outperformed the control group in both picture conditions: 24-month-olds,  $F(2, 33) = 5.80, p < .05, \eta^2 = .26$ ; and 30-month-olds,  $F(2, 33) = 25.79, p < .0001, \eta^2 = .61$ . In contrast, the 18-month-olds produced more target actions in the photograph condition than in the control condition,  $F(2, 33) = 3.51, p < .05, \eta^2 = .18$ , but performance with the drawings did not differ from the photo or control conditions. Thus, the 24- and 30-month-olds imitated some of the target actions regardless of the nature of the illustrations in the book, but the 18-month-olds did so primarily with the highly iconic photographs.

Although the older children's reenactment performance was better than that of the youngest group, relatively few children at any age completed the entire three-step sequence following the reading interaction. The number of children who completed it differed by age: Zero 18-month-olds, four 24-month-olds, and six 30-month-olds did so,  $\chi^2(2, N = 72) = 6.50, p < .05$ .

Reenactment of each target action after the picture-book interaction differed across the three-step sequence (see Table 2), as shown by a 3 (age)  $\times$  3 (target action) ANOVA with repeated measures (Wilks's  $\lambda = .41, p < .0005, \eta^2 = .59$ ). More children performed Target Action 1 than Target Action 2,  $t(71) = 4.62, p < .0001$ , and more produced Target Action 2 than Target Action 3,  $t(71) = 4.87, p < .0001$ . Moreover, there was a significant increase in the number of target actions produced by each successive age group,  $F(2, 66) = 13.57, p < .001, \eta^2 = .29$ . There was no interaction.

<sup>1</sup> The test prompt was used in imitation studies by Bauer et al. (1995) and Hayne and Herbert (2004).

Table 2  
*Mean Proportions and Standard Errors of Children in Experiments 1 and 2 Completing Each Target Action Required to Construct the Rattle as a Function of Age and Condition*

Age group and condition	Target action					
	1		2		3	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
Experiment 1						
18 months						
Photographs	.75	.13	.25	.13	.17	.11
Color drawings	.33	.14	.25	.13	.08	.08
24 months						
Photographs	.92	.08	.58	.15	.08	.08
Color drawings	.83	.11	.50	.15	.25	.13
30 months						
Photographs	1.0	.00	.83	.11	.25	.13
Color drawings	1.0	.00	.75	.13	.33	.14
Experiment 2						
24 months						
Line drawings	.58	.15	.17	.11	.17	.11
30 months						
Line drawings	.92	.18	.50	.15	.42	.14

### Motivation Scores

Consistent with prior studies testing immediate imitation using similar rattle stimuli (Bauer et al., 1995; Herbert & Hayne, 2000b), imitation scores following a live demonstration were near ceiling and did not differ by age (18-month-olds:  $M = 2.60$ ,  $SD = 0.11$ ; 24-month-olds:  $M = 2.63$ ,  $SD = 0.14$ ; 30-month-olds:  $M = 2.89$ ,  $SD = 0.10$ ; see Figure 1, dashed line). The performance of all age groups was higher after the live demonstration than following the picture-book interaction: 18-month-olds,  $t(19) = 8.46$ ,  $p < .001$ ,  $\eta^2 = .80$ ; 24-month-olds,  $t(18) = 5.30$ ,  $p < .001$ ,  $\eta^2 = .62$ ; 30-month-olds,  $t(17) = 4.08$ ,  $p < .001$ ,  $\eta^2 = .51$ . Thus, children of all ages were highly motivated and able to make the rattle after a live demonstration, indicating that the lower reenactment scores with the picture book were not due to inability to imitate the target behaviors.

In sum, most of the young children in this study learned from a short picture-book interaction how to perform some of the target actions required to construct a novel toy. The children's performance on each individual target action varied: Most put the ball in the jar, about half attached the stick to the jar, and only a few shook the rattle. It may be that the children's low production of the shake action can be attributed to the fact that motion and noise are not conveyed well by a static picture.

Consistent with other research with infants and young children (Callaghan, 2000; Pierrousakos & DeLoache, 2003), the iconicity of the pictures in the books influenced the youngest children's reenactment performance: The 18-month-olds showed some ability to relate the realistic color photos to the real-world objects but not the less realistic color drawings. In contrast, the 24- and 30-month-olds performed equally well with both types of pictures. In terms of Hayne's (2004) representational hypothesis, the

younger children required substantial overlap in the attributes present in the target objects and their depictions to transfer what they learned from the book to the objects.

The high motivation scores reported here are consistent with extensive research showing that 18-, 24- and 30-month-olds' imitation from a live model approaches ceiling (Barr & Hayne, 1999; Bauer et al., 1995; Hayne, Barr, & Herbert, 2003; Herbert & Hayne, 2000a, 2000b). The similarity between the present live-imitation scores and those in earlier research occurred even though the previous studies involved three demonstrations of the action sequence, whereas in our study the children experienced two picture-book readings and one demonstration. The results of our study are also consistent with research showing superior imitative performance from a live model in comparison to a televised display (Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003). Thus, a live model is more effective at communicating to very young children than either a televised model or still pictures.

### Experiment 2

Given that age-related differences in reenactment performance emerged with the two versions of the book for the 18-month-olds but not for the older children, we next asked whether iconicity might also affect imitation by the older toddlers. Thus, new groups of 24- and 30-month-olds participated in the same picture-book task but with even less iconic pictures: black-and-white line drawings.

### Method

#### Participants

The participants were twelve 24-month-olds ( $M = 24.58$ ,  $SD = 0.55$ ) and twelve 30-month-olds ( $M = 29.77$ ,  $SD = 0.58$ ), including equal numbers of girls and boys. Data from the 24- and 30-month-olds in the control condition from Experiment 1 were used for comparison.

#### Materials and Procedure

A black-and-white line drawing version of the picture book from Experiment 1 was created by tracing around the color drawings with a black felt pen. Everything else about the materials and procedures was the same as in Experiment 1. Interrater reliability was high at 98% (Cohen's  $\kappa = .88$ ).

### Results and Discussion

As in Experiment 1, both age groups were highly attentive during the picture-book interaction: The 24- and 30-month-olds attended to the book 91% and 97% of the time, respectively. Further, the imitation scores of both groups on the live demonstration motivation check were near ceiling (24-month-olds:  $M = 2.50$ ,  $SD = 0.53$ ; 30-month-olds:  $M = 2.83$ ,  $SD = 0.39$ ).

#### Reenactment Scores

The children's reenactment scores (see Figure 1) were subjected to a 2 (age)  $\times$  2 (condition: line drawing, control) ANOVA. The primary result of the analysis was a significant Age  $\times$  Condition interaction,  $F(1, 44) = 4.34$ ,  $p < .05$ ,  $\eta^2 = .10$ . There was also a significant main effect for condition,  $F(1, 44) = 15.80$ ,  $p < .001$ ,



$\eta^2 = .26$ , but not for age. Post hoc *t* tests to explore the interaction revealed that the 30-month-olds in the line drawing condition performed better than the age-matched controls,  $t(22) = 4.00$ ,  $p = .001$ , whereas there was no difference for the 24-month-olds. Thus, the 30-month-olds exhibited imitation with illustrations of very low iconicity, but the 24-month-olds did not outperform the controls with the simple line drawings.

Only a few of the children in the line-drawing condition completed the entire three-step sequence: None of the 24-month-olds and 4 of the 30-month-olds did so. The proportion of children completing each individual target action is shown in Table 2. A 2 (age)  $\times$  3 (target actions) ANOVA with repeated measures revealed that performance differed across the three-step sequence (Wilks's  $\lambda = .53$ ,  $p < .0001$ ,  $\eta^2 = .47$ ). More children performed Target Action 1 than Target Action 2,  $t(23) = 4.05$ ,  $p < .0005$ , or Target Action 3,  $t(23) = 3.82$ ,  $p < .001$ . Moreover, the 30-month-olds produced more target actions than did the 24-month-olds,  $F(1, 22) = 5.97$ ,  $p < .05$ ,  $\eta^2 = .21$ . There was no interaction.

### Motivation Scores

As in Experiment 1, the children's imitation scores following the live demonstration did not differ as a function of age and were higher than in the reenactment test that was based on the picture-book experience: 24 months,  $t(9) = 5.25$ ,  $p < .001$ ; 30 months,  $t(11) = 3.32$ ,  $p < .05$ .

Thus, the nature of the illustrations in the picture books affected the reenactment performance of the 24-month-old children but made less difference for the 30-month-olds. Experiment 2 supports Experiment 1 in showing a greater effect of iconicity on younger children's imitation of actions presented in a picture-book interaction. The 30-month-olds performed similarly well in both studies. However, relative to controls, the 24-month-olds in Experiment 1 performed quite well with the colored line drawings, but the same age group in Experiment 2 performed relatively poorly with the less iconic black-and-white line drawings.

### General Discussion

In the research reported here, 18- to 30-month-old children who engaged in a naturalistic picture-book reading interaction about how to construct a novel object subsequently applied that information to a set of real objects. Older children performed more of the target actions described and depicted in the book than did the younger children, and performance was better with more iconic than with less iconic pictures. Moreover, the younger children were more sensitive to the iconicity of the pictures than were the older children.

These studies thus demonstrate that toddlers are capable of learning new information from picture-book reading interactions like those frequently engaged in by parents and toddlers. Specifically, very young children can learn to perform novel actions on novel objects from exposure to a series of pictures and accompanying narration. The research constitutes an important extension to the literature on parent-child picture-book interactions (DeLoache & DeMendoza, 1987; Hayden et al., 1996; Murphy, 1978; Ninio & Bruner, 1978) by examining specific effects of those interactions during toddlerhood.

The iconicity effects reported here reveal that the nature of the pictures in children's books can play a crucial role in learning from them. A question for future research concerns the relative contributions—and probable interactions—among the pictures and the accompanying verbal information involved in everyday picture-book interactions.

The positive effects reported here for higher levels of iconicity and for live versus symbolic presentation of information likely involve the interaction of two factors. One is the basic fact that using symbolic objects as a source of information for problem solving is challenging for very young children (Callaghan, 2000; DeLoache, 2002; Troseth & DeLoache, 1998). The younger the child, the more difficult it is to appreciate the representational relation between a symbol—including a picture—and what it stands for. Further, the lower the level of physical similarity between symbol and referent, the more difficult it is for very young children to exploit the relation between them (e.g., Callaghan, 2000; DeLoache, 1991; Ganea & DeLoache, 2005).

A second factor concerns age-related changes in the flexibility of the underlying memory representation (Hayne, 2004). Past research shows that even a slight change in stimulus properties from encoding to testing causes greater disruption of imitative performance by younger than by older toddlers (Hayne et al., 1997; Hayne, Barr, & Herbert, 2003; Herbert & Hayne, 2000a). Thus, the better imitation we found from the live demonstration compared with the picture book—and especially for the low-iconicity pictures—partly reflects differences in the perceptual information available to support reenactment (cf. Schmitt & Anderson, 2002). This fundamental difference between real and depicted objects is an inherent part of the problem that very young children must overcome in achieving the ability to use pictures as a source of information.

In conclusion, the results of this research show that very young children can learn to perform novel actions with novel objects from a brief picture-book reading interaction. Thus, this common form of interaction, with which young children have experience from very early in development, may constitute an important source of information about the world. Further, the results expand our understanding of the development of pictorial competence in the second year of life and point to an interaction between symbolic and general representational capacities in the performance of very young children.

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