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Deborah Kelemen [a], Rebecca Seston [a] & Laure Saint Georges [a]

[a] Boston University

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ARTICLES

The Designing Mind: Children's Reasoning About Intended Function and Artifact Structure

Deborah Kelemen, Rebecca Seston, and Laure Saint Georges
Boston University

There is currently debate about the emergence of children's ability to reason about artifacts by reference to their intended design. We present two studies demonstrating that, while 3-year-olds have emerging insights, 4-year-old children display an explicit, well-rounded, adult-like understanding of the way design constrains an artifact's physical structure. Study 1 examined children's recognition that designers generally create artifacts with structures that are optimally efficient for achieving their intended function. Three- and 4-year-olds explored pairs of objects—one physically optimal and one suboptimal for a given function—and judged which one had been designed for the purpose. Despite both age groups recognizing the relative physical optimality of the objects, only 4-year-olds judged the optimal tool as designed for the function. Study 2 examined children's recognition that designers generally create artifacts with structures that primarily subserve a single intended function rather than other functions. Participants explored pairs of objects that were equally physically optimal for a given purpose; however, one object had additional salient features suggestive of an alternative function. Both 3- and 4-year-olds recognized the equivalent physical optimality of the objects. Both also showed evidence of explicit design understanding, identifying the more physically specific tool as created for the function. Implications for children's broad functional attributions to artifacts and natural phenomena are discussed.

Correspondence should be sent to Deborah Kelemen, Department of Psychology, Boston University, 64 Cummington Street, Boston, MA 02215, USA. E-mail: dkelemen@bu.edu

Children grow up in environments surrounded by human-made objects with significant relevance to their everyday lives. Given this, there has been much recent interest in the development of children's reasoning about these artifacts and their understanding of artifact design (e.g., Diesendruck, Markson, & Bloom, 2003; German & Johnson, 2002; German, Truxaw, & Defeyter, 2007; Kelemen, 1999; Kemler Nelson, Herron, & Morris, 2002; Matan & Carey, 2001; Siegel & Callanan, 2007; see Kelemen & Carey, 2007, for review). The topic is interesting for various reasons: First, artifacts are the physical manifestations of an (absent) historical creator's intentional goals. Children's reasoning about intentional design therefore offers a window into how children marshal their physical knowledge to constrain inferences about the actions and intentions of abstracted agents. In consequence, it also provides insights into the developmental integration of domain-specific core knowledge systems with contents that are, arguably, entirely distinct (e.g., Carey, 2009; Spelke, 2003). Second, as evidenced by many religions, artifact design represents a powerful analogical base that children and adults use to understand the natural world. Insight into the emergence of design understanding therefore has relevance beyond the realm of reasoning about the artifact domain.

Studies exploring children's understanding of design have often adopted the approach of presenting children with explicit information about a designer's versus a subsequent user's intentions regarding the object. Although debate exists (see Kelemen & Carey, 2007), in general, these studies have revealed that 4- to 6-year-old children weigh the designer's intentions when deciding the name or function of a novel artifact (Kelemen, 1999; Matan & Carey, 2001; Siegel & Callanan, 2007; also Gelman & Bloom, 2000; Jaswal, 2006; but see Defeyter & German, 2003; German & Johnson, 2002). Fewer studies have, however, focused on the subtler issue of children's ability to infer the creator's design intentions based on physical structure. Kemler Nelson et al. (2002) studied children's reasoning about physically dysfunctional artifacts. They found that 4-year-olds were more likely to extend a familiar category label (e.g., "cup") to an object with a structure that seemed accidental in origin (e.g., cup with broken side and base) than to an equally typical object with a structure that seemed intentional in origin (e.g., cup-shaped object with metal-rimmed hole in base). This finding has recently been extended to 2-year-old children, despite ambiguous results from 3-year-olds (Kemler Nelson, Holt, & Egan, 2004). In a social learning paradigm, DiYanni and Kelemen (2008) found that 4-year-olds do not imitate an adult who favors use of a suboptimally designed artifact over an optimal one, preferentially using the optimal tool when performing the task for themselves. Finally, Asher and Kemler Nelson (2008; also Kemler Nelson et al., 2002) have shown that when a child asks what an artifact is and an adult responds by stating a function for which many features are superfluous, 3- and 4-year-old children are dissatisfied. They ask significantly more function-based follow-up questions than when shown a function that plausibly accounts for the object's salient features.

Taken together, these studies indicate that preschoolers can see beyond degraded physical evidence to infer the category membership of a familiar artifact, that they expect artifacts to be used in ways that are highly consistent with their physical features (and potentially their intended design), and relatedly, that they have expectations that most artifact features should be explained by their intentional use (or, perhaps, their intended function). However, because the methods employed were indirect indicators of possible design understanding, as the above summary suggests, interpretive ambiguities arise. All of the prior results can be explained by competencies relevant to, but distinct from, an understanding of intentional design. Because prior studies do not unambiguously establish young children's understanding of how designer intention connects to artifact structure, the present research therefore sought to do so via two tasks explicitly measuring 3- and 4-year-old children's grasp of the way a designer's goals typically constrain an artifact's physical features.

Study 1 explored participants' recognition that designers generally create artifacts with structures that are optimally efficient for achieving their intended function (see Dennett, 1990).[1] Participants explored pairs of objects—one physically optimal and one suboptimal for a given function—and judged which one had been designed for that function. In Study 2, we moved away from efficiency cues. We explored children's recognition that designers generally create artifacts with physical features that are primarily directed toward serving a single intended function rather than other functions. Participants explored pairs of objects that were equally physically optimal for achieving a specific purpose; however, one object had additional

[1]One practical consequence of technological progress is that earlier, less physically efficient models of an artifact (e.g., quill pen) can historically coexist with later, more physically efficient versions (e.g., roller ball ink pen). Thus, while competent designers do try to craft artifacts with properties that are optimally efficient for achieving their intended goal, cultural evolutionary processes can mean the optimality assumption is potentially fallible as a heuristic for design reasoning. It may lead earlier prototypes of an artifact category to be inaccurately rejected as members of an artifact kind, especially if judgments are made by individuals who lack perspective on how material culture evolves (e.g., children). Despite this potential for false rejection, optimality is still a powerful basis for making design judgments—one indispensable to a field like archeology, for example, and one likely to be accurate more often than not simply because competent designers do, in fact, tend to create artifacts with features highly efficient for achieving their desired function.

highly salient features suggestive of an alternative function. Once again, participants judged which object had been designed for the task. In both studies, an understanding of the designer's intentions would lead participants to choose the optimal tool.

STUDY 1

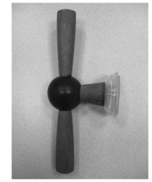
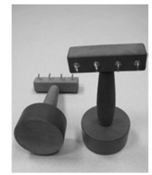
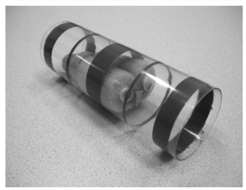
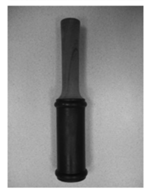
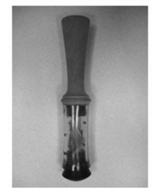
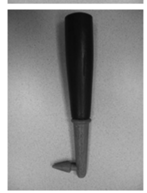
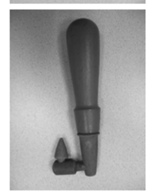
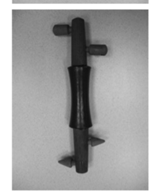
Method

Participants. Participants were thirty-seven 3-year-olds (18 males; $M_{\text{age}} = 3;5$; $SD = 3$ months), thirty-seven 4-year-olds (16 males; $M_{\text{age}} = 4;5$; $SD = 3$ months), and 32 undergraduates (14 males; $M_{\text{age}} = 18;0$; $SD = 9$ months). Participants were tested in a quiet place at day care, our lab, or their home.

Materials. Materials were four pairs of artifacts, each comprised of: 1) an ''optimal'' object with physical features ideally suited to efficient achievement of the specified function (e.g., popcorn crushing) and no parts suggesting an alternative function; and 2) a ''suboptimal'' object with physical features rendering it suboptimal for the specified function but capable of achieving it with extra effort (e.g., ridges in base catch popcorn while crushing). See Table 1 for stimuli. Prior to testing, a separate sample of adults was asked to judge which tool was easier to use and to justify their responses. Their explanations clearly indicated that the suboptimal tool was indeed less efficient (e.g., ''complicated bottom,'' ''inefficient for crushing,'' ''it would get stuck'').

Design and procedure. Children were randomly assigned to one of two conditions. In the ''design'' experimental condition, children sat at a table with an experimenter who brought out a box and announced for each trial, ''My friend Ben made something for X (e.g., crushing popcorn). He gave me these things, but I don't know which one he made—which one he built—for X. Can you help me figure it out?'' The experimenter then demonstrated each object performing the function before handing it to the child to try it out. After children had attempted the function with both objects and the objects had been returned to the box, the experimenter looked into it and announced, ''Now I know which one was made for X.'' Laying the objects in front of the child, she then asked, ''Which one do you think was made for X?'' Twenty-one 4-year-olds, twenty-one 3-year-olds, and 16 adults completed this condition.

TABLE 1
Goal States and Tools for Study 1 (Optimal and Suboptimal) and Study 2 (Optimal and Optimal-Part)

Goal		*Optimal*	*Suboptimal*	*Optimal-part*
Ring the bell in the cage				
Crush the popcorn[a]				
Pop the toy out of the tube				
Hang the rings on the hook to dry				

[a]Popcorn tools are shown in two orientations.

The other half of the participants performed an "ease" control condition that was included to ensure that children's judgments in the design condition were based on assessments of optimality. The ease procedure was identical to the design condition, except that references to design became references to ease of use: "My friend Ben told me there was something that makes it easy for X. He gave me these things, but I don't know which one is the easiest for X"; then later, "Now I know which one is easiest for X. Which one do you think is easiest for X?" This condition served as a manipulation check that the stimuli were designed correctly and that the participants understood optimality. Sixteen participants in each age group completed this condition.

Tool sets were presented in two fixed orders, and the optimal tool was presented first in half of the trials. In addition, pilot work indicated that relative to 4-year-olds, 3-year-olds were less attentive to the experimenter's initial demonstration of each tool. To compensate for this, while the experimenter only did one demonstration with each tool before handing it over to 4-year-old children, she did four brief demonstrations of each tool achieving the goal before handing each over to 3-year-olds. As results indicate, however, 4-year-olds' competence was still evident despite the leaner demonstration.

Results

A 2 (condition) × 3 (age group) analysis of variance (ANOVA) on participants' tendency to select the optimal tool found no difference between conditions but did reveal an effect of age group, $F(2,105) = 16.69$, $p < .001$, partial $\eta^2 = .25$. This occurred because across conditions, 4-year-olds (74%) selected the optimal tool more often than 3-year-olds (60%), with adults selecting it more than both child age groups (89%), Fisher's LSD, all ps $< .005$. *T*-tests indicated that the overall tendency to select the optimal tool was above chance for all age groups, all ps $< .05$. However, as Figure 1 shows, considering the conditions separately, 3-year-olds were above chance in the ease control condition, $t(15) = 2.3$, $p < .05$, but not in the design experimental condition, $t(20) = 1.2$, $p = .23$. Four-year-olds (ease, $t(15) = 4.3$; design, $t(20) = 6.0$) and adults (ease and design, $t(15) = 11.2$) were above chance in both conditions, all ps $< .005$.

Individual subjects analyses (see Table 2) confirmed that although an equivalent number of 3-year-olds (63%) and 4-year-olds (63%) correctly identified the optimal tool as the "easier" tool on 75% or more of trials in the ease condition, $\chi^2(1) = 0.00$, $p = 1.0$, only 43% of 3-year-olds versus 81% of 4-year-olds identified the optimal tool as "made for" the function on 75% or more of trials in the design condition, $\chi^2(1) = 6.69$, $p < .01$.

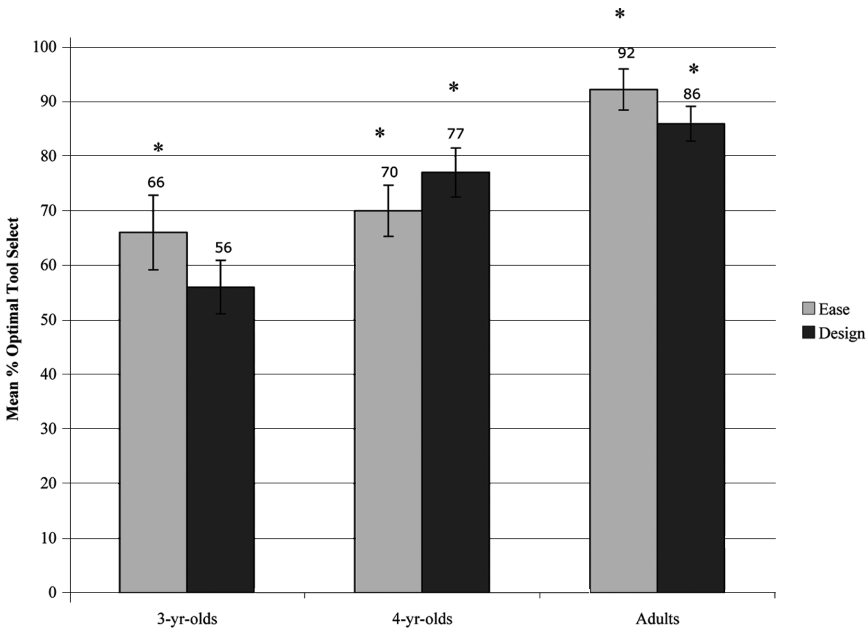


FIGURE 1 Study 1: Mean tendency to select the optimal tool over the suboptimal tool. $^{*}p < .05$, two-tailed, different from chance.

Finally, two coders reviewed the videotaped sessions to explore whether the 3-year-olds' failure to identify optimal tools as design tools occurred because, their judgments in the ease condition aside, 3-year-olds in the design condition had actually experienced the suboptimal tools as physically easier to use. Children's tool manipulations on each trial were coded into

TABLE 2
Study 1: Percentage of Subjects Choosing the Optimal Tool Over the Suboptimal Tool on Four, Three, Two, One, or None of the Trials

	Ease condition			*Design condition*		
# Trials	*3-year-olds*	*4-year-olds*	*Adults*	*3-year-olds*	*4-year-olds*	*Adult*
0 (0%)	6	0	0	0	0	0
1 (25%)	6	0	0	24	5	0
2 (50%)	25	37	6	33	14	0
3 (75%)	44	44	19	38	48	56
4 (100%)	19	19	75	5	33	44
≥75%	63	63	94	43	81	100

three mutually exclusive categories: 1) optimal tool easier to use; 2) other tool easier to use; and 3) tools equally easy to use. A tool was deemed "easier" to use if it required less effort and/or less time to complete the task. Intercoder reliability was substantial (Cohen's Kappa =.64), and disagreements were resolved through discussion. Trials in which tools were equivalently easy were removed from analysis (8% of trials). One-sample *t*-tests against chance (i.e., 50%) confirmed that both 3- and 4-year-olds manipulated the optimal tool with greater ease in both the ease (88%, 3-year-olds; 84%, 4-year-olds) and design conditions (91%, 3-year-olds; 85%, 4-year-olds), all $ps < .001$.

Discussion

Study 1 revealed that participants at all ages were sensitive to the functional affordances of the artifacts and selected optimal objects as easier to use. However, only 4-year-olds and adults recognized that these more physically optimal objects were likely to have been the ones intentionally designed for each task. This pattern of results is consistent with the notion that 4-year-olds have a robust understanding of a basic aspect of intentional design and are more advanced than 3-year-olds in their construction of a "design stance." However, stronger support for the conclusion that 4-year-olds have a thorough understanding of how designer intentions constrain artifact structure requires indications of design sensitivity under conditions other than those involving structural optimality. In Study 2, we therefore moved away from design cues based on optimality of fit between structure and function to, arguably, less transparent cues based on the specificity of fit between structure and function.

While multifunctional objects obviously exist (e.g., Swiss Army knives), most artifacts are designed with specific primary functions in mind, and their features reflect this fact. Thus, despite many of the features of a door key (e.g., pointiness, handle, and thin metal extension) being plausibly explained by uses to which it is frequently and efficiently put (e.g., slitting open taped packages, loosening tin lids), details of its structure (e.g., teeth) suggest that these uses are not its primary intended function. In Study 2, we therefore explored children's sensitivity to these design cues and their recognition that designers generally create specialized objects with features that, considered together, primarily reflect their intended function.

STUDY 2

Method

Participants. Participants were thirty-seven 3-year-olds (18 males; $M_{age} = 3;5$; $SD = 3$ months), thirty-seven 4-year-olds (20 males; $M_{age} = 4;7$;

$SD = 3$ months), and 32 undergraduates (14 males; $M_{age} = 18;0$; $SD = 6$ months). None of these subjects participated in Study 1.

Materials and procedure. Materials were four pairs of artifacts, each comprised of: 1) an "optimal" object—used in Study 1—with physical features ideally suited to efficient achievement of the specified function (e.g., bell ringing) and no parts suggesting an alternative function, and 2) an "optimal-part" object with physical features ideally suited for efficient achievement of the specified function (e.g., bell ringing) but specialized parts (e.g., suction cup) irrelevant to that function and consistent with some other task. The parts of the two tools that were relevant to the specified function were identical, thus making both tools equally efficient for that task—intuitions confirmed by adult pilot testing (e.g., "It did the job but it has a lot of extra designs"; "It seems that the handle of the object was capable of ringing the bell which shows that [this] was probably not the purpose of the object"; see Table 1 for stimuli). Participants were randomly assigned to either the "ease" control condition requesting judgments about ease of use ($N = 16$ in each age group) or the "design" experimental condition requesting judgments about intended function (N =twenty-one 4-year-olds, twenty-one 3-year-olds, 16 adults). The procedure was identical to that in Study 1.

Results

A 2 (condition) $\times$ 3 (age group) ANOVA on participants' tendency to select the optimal tool found an effect of age group, $F(2,105) = 9.53$, $p < .001$, partial $\eta^2 = .16$, and an effect of condition, $F(1,105) = 5.07$, $p < .05$, partial $\eta^2 = .05$, and no interactions. The effect of age occurred because, collapsing across conditions, adults (78%) were more likely to select the optimal tool than 3-year-old (59%) and 4-year-old (57%) children, who did not differ from each other, both Fisher's LSD, $ps < .05$. The effect of condition occurred because participants in the design condition (68%) were more likely to select the optimal tool than those in the ease condition (59%).

Planned post-hoc tests revealed different patterns across adults and children. Specifically, adults selected the optimal tool at above-chance levels in both the design, $t(15) = 6.0$, and ease conditions, $t(15) = 5.5$, both ps $< .001$. By contrast, both 3- and 4-year-olds selected the optimal tool at chance in the ease condition—viewing it as no easier to use than the optimal-part tool—and as the "designed artifact" at above-chance levels in the design condition, ts$(20) = 2.4$, 2.8 (3- and 4-year-olds, respectively), both ps $< .05$ (see Figure 2).

Individual subjects analyses indicated, however, that while 57% of 4-year-olds identified the optimal tool as "made for the function" on 75%

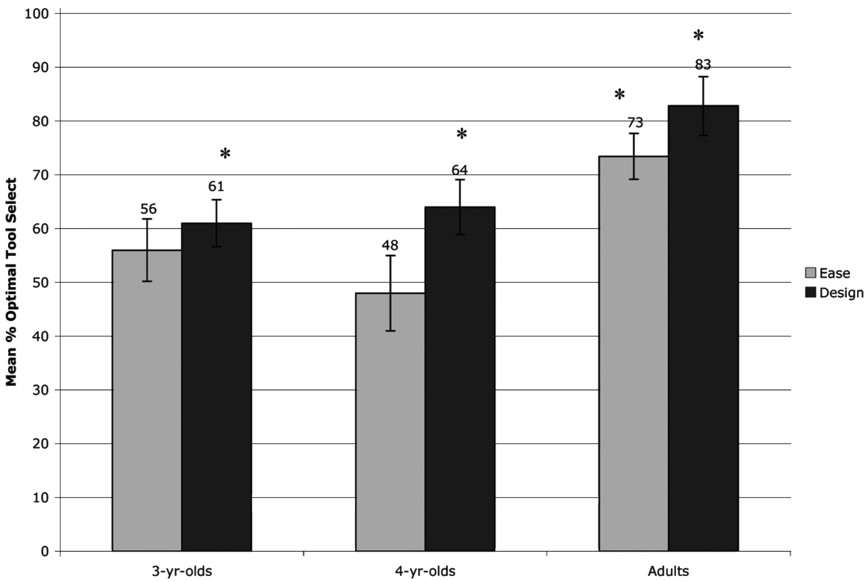


FIGURE 2 Study 2: Mean tendency to select the optimal tool over the optimal-part tool. $^{*}p < .05$, two-tailed, different from chance.

or more of trials in the design condition, only 43% of 3-year-olds did so (see Table 3), although this age difference did not reach statistical significance, $\chi^2(1) = 0.86$, $p = .35$.

Participants judged the optimal and optimal-part tools as equally easy to use in the ease condition. Despite this, we were interested to examine

TABLE 3
Study 2: Percentage of Subjects Choosing the Optimal Tool Over the Optimal-Part Tool on Four, Three, Two, One, or None of the Trials

	Ease condition			*Design condition*		
# Trials	*3-year-olds*	*4-year-olds*	*Adults*	*3-year-olds*	*4-year-olds*	*Adult*
0 (0%)	0	6	0	0	0	0
1 (25%)	19	31	0	10	14	0
2 (50%)	50	38	25	48	29	25
3 (75%)	19	13	56	33	43	19
4 (100%)	12	13	19	10	14	56
≥75%	31	26	75	43	57	75

whether 3- and 4-year-olds' tendencies to select optimal tools as the "designed objects" in the design condition might have arisen because children's judgments had been governed by finding them physically easier to use in that condition. Using videotapes, children's tool manipulations on each trial were coded into the three mutually exclusive categories already described in Study 1. Intercoder reliability with a second coder was substantial (Cohen's Kappa = .66), and disagreements were resolved through discussion. Trials in which tools were handled with equivalent ease were removed from analysis (16% of trials). One-sample *t*-tests against chance (i.e., 50%) on the remaining trials confirmed that neither 3- nor 4-year-olds found the optimal tool easier to use in either the ease (40%, 3-year-olds; 41%, 4-year-olds) or design conditions (51%, 3-year-olds; 50%, 4-year-olds), all $ps > .10$. On trials where participants found one tool easier, no significant associations were found between motor experiences and tool judgment for any age group (all Kappas $< .20$, $ps > .20$). In short, children's design judgments were not being guided by their own experience of the optimal tools as easier to manipulate than the optimal-part tools.

Discussion

In Study 2, 3- and 4-year-old children judged the optimal tool and the optimal-part tool as equivalently easy for a task but actively identified the more physically specified optimal tool as designed for that function. In contrast to Study 1, 3-year-olds, like 4-year-olds, demonstrated insight into the way intentional design constrains physical structure. Furthermore, children's judgments were not simply based upon personal ease of use. On average, children physically experienced the optimal tool as the easier tool to use in only 42% of the cases where they went on to select it as the designed artifact. In consequence, preschoolers' intuitions seem based upon an understanding of the relationship between physical structure and intended function that is abstracted away from their own personal experience.

In contrast to children, adults in Study 2 selected the optimal tool not only as the designed artifact in the design condition but also as the one that was easier to use in the ease condition. Adults' informal post-hoc comments on the task provided an explanation for this pattern: Apparently, their intuitions about specificity in design were often so sufficiently strong that they intruded upon judgments about ease of use. For example, when asked about their choices, adults in the ease condition made statements like, "(The optimal tool was easier because the optimal-part tool) looks like it was made for something else," and "(The optimal tool was easier) because it looks like it was made for (bell ringing)."

GENERAL DISCUSSION

In the ease control conditions of both studies reported here, 3- and 4-year-olds demonstrated similar intuitions about artifacts' relative physical affordances and their ease of use for a particular function. Despite this, subtle developmental differences emerged in their judgments about which artifacts were likely to have been intentionally designed for a task. In Study 1, 4-year-olds, but not 3-year-olds, used the optimality of tools' physical features to inform their judgments about which tool was likely to have been intended for a function. By contrast, in Study 2, both 3- and 4-year-olds used specificity as a design cue, judging the structurally more specific optimal tool as being more likely to have been intentionally made for a particular purpose.

Taken together, these findings suggest that an explicit grasp of design emerges around 3 years of age and becomes a robust, multifaceted understanding of how the intentions of an abstract agent constrain functional structure by 4 years of age. Such results therefore strongly contradict suggestions that children do not possess a sophisticated understanding of design until the second half of their first decade of life (e.g., Defeyter & German, 2003; German & Johnson, 2002; Matan & Carey, 2001). They also extend and elucidate earlier findings indicating that 3- and 4-year-olds expect an artifact's intentional use to plausibly account for most of its structural features (e.g., Asher & Kemler Nelson, 2008): Findings from current research not only show that preschoolers possess this expectation but that they explicitly rationalize such structure–function relations in terms of a historical designer's intended function, displaying rather nuanced design intuitions even by 3 years of age. Specifically, in Study 2, both 3- and 4-year-olds managed to select optimal tools as the designed objects, despite the fact that the optimal-part foils also possessed a very tight fit between structure and function—a tighter fit than in previous studies in which foil objects tended to have a greater number of functionally irrelevant features (e.g., Asher & Kemler Nelson, 2008). Study 2 data therefore strongly suggest that by 3 years of age, the integration of children's physical and intentional knowledge is sufficient to produce substantial sensitivity to the subtleties of intentional design for a specific function. Moreover, the finding that children's Study 2 design judgments were not dependent upon their personal motor experience indicates that in both age groups, children's "design stance" goes beyond experiential knowledge and represents an abstract explanatory structure.

Questions remain regarding the reasons for differences between 3- and 4-year-olds' understanding of intentional design. Why is it that 3-year-olds develop a sensitivity to specificity (Study 2) before a sensitivity to optimality in design (Study 1)? The developmental pattern is interesting because as noted earlier, optimality is a powerful—and for adults, straightforward—basis for design inference even if the gradual refinement of an artifact's design over time (e.g., from film cameras to digital cameras) might create openings for false negatives (see Footnote 1). So, why did 3-year-olds show less competence in Study 1 than in Study 2? The possibility that they did not recognize the differential physical affordances of the Study 1 artifacts can be ruled out by their control condition performance. This raises an alternative motivational possibility: Despite recognizing the differential efficiency of tools, perhaps 3-year-olds are themselves so personally unmotivated to act efficiently that they do not weigh optimality as something that might concern a designer.

Such an alternative seems viable, especially given results from prior social learning research suggesting that 2- and 3-year-olds are tolerant of inefficient artifacts (DiYanni & Kelemen, 2008). Specifically, this earlier work found that in contrast to 4-year-olds, younger children were willing to imitate an adult who favored a suboptimal tool over an optimal tool for a task as long as the tool possessed reasonable capacity to get the job done. Future research is required to explore this motivational account further. For example, it is an open question whether 3-year-olds might have displayed design sensitivity in Study 1 if the benefits of efficiency had been made salient to them by telling them that they had only a limited amount of time to try out and render judgments on the tools.

It is also interesting to consider the 3- to 4-year-old developmental trends in design understanding documented in the current study in relation to developmental trends in children's function-based reasoning more generally. Recent research has revealed that young children display a broad teleo-functional tendency to ascribe functions not only to artifacts, but to all kinds of natural phenomena. For example, among 4- and 5-year-olds, lions are "for going in the zoo" and mountains are "for climbing" (Kelemen, 1999). Among older children, such promiscuous teleological endorsements have been found to correlate with intuitions about intentional agency in nature (Kelemen & DiYanni, 2005; see also Diesendruck & Haber, 2009). However, one question concerning children's tendency to broadly construe all kinds of objects in terms of a function is whether it only emerges in the later preschool years, once—as the current research suggests—children develop a more complete understanding of design that might foster construal of nature as a grand artifact. Several recently completed studies suggest that the tentative answer to this question is "yes" (Kelemen, 2012). For example, prior work has found that 2- and 3-year-olds need only brief exposure to an adult using an artifact for a purpose to rapidly and enduringly categorize that tool as existing for that function. Across 2 days of testing, they repeatedly return to it to perform the task, despite the availability of an equally good alternative tool (Casler & Kelemen, 2005, 2007; Phillips, Seston, & Kelemen, 2012). Despite this strong tendency with artifacts, results suggest, however, that it is not until around 4 or 5 years old—after children have developed a more robust and thorough understanding of artifact design—that children display similar rapid functional construal tendencies when the objects demonstrated are natural entities rather than tools (Kelemen, 2012; Kelemen, Phillips, & Seston, 2012).

Current research is following up on these findings to more fully elaborate relationships between children's functional intuitions about nature, their developing artifact knowledge, and ideas about design. Such research is fruitful not only because it will elucidate children's emerging understanding of artifacts—a domain that has been central to human ecological success—but because it will answer questions about human cognition more broadly.

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