Research Report

What Do Children Want to Know About Animals and Artifacts?

Domain-Specific Requests for Information

Marissa L. Greif,[1] Deborah G. Kemler Nelson,[2] Frank C. Keil,[1] and Franky Gutierrez[1]

[1]Yale University and [2]Swarthmore College

ABSTRACT—*Children's questions may reveal a great deal about the characteristics of objects they consider to be conceptually important. Thirty-two preschool children were given opportunities to ask questions about unfamiliar artifacts and animals. The children asked ambiguous questions such as "What is it?" about artifacts and animals alike. However, they were more likely to ask about the functions of artifacts, but about category membership, food choices, and typical locations of animals. They never asked questions about either artifacts or animals that would be considered inappropriate by adults. The results indicate that children hold different expectations about the types of information important for categorizing living and artifact kinds. Young children conceive of artifacts in terms of functions, but conceive of animals in terms of biologically appropriate characteristics. Such results speak to debates about the role of function in children's biological reasoning and to accounts of children's artifact concepts.*

For adults, a core property that determines an artifact's identity is the purpose for which it was originally designed, an intuition derived from what many researchers have referred to as the *design stance* (Bloom, 1996; Dennett, 1987; German & Johnson, 2002; Keil, 1989). The centrality of functional design is said to be exclusive to artifact kinds and perhaps to animal parts, and for adults it does not tend to extend to whole animals (Keil, 1995). Controversies arise, however, about the role of function and design in young children's concepts of living and human-made kinds. Do young children also see function as central to understanding artifacts, and, more significantly, do they adopt a different stance toward animals?

Address correspondence to Marissa Greif, Department of Psychological and Brain Sciences, Duke University, 9 Flowers Dr., Durham, NC 27708-0086, e-mail: marissa.greif@duke.edu.

The current study brings new evidence to bear on both developmental issues. Following Kemler Nelson, Egan, and Holt (2004), we examine the questions that children ask about objects. Kemler Nelson et al. investigated the intent of children's ambiguous questions about novel artifacts, such as "What is it?" Such questions could be requests for names or, alternatively, requests for information about object kinds. The results suggested that the inquiries were intended to elicit kind information. In particular, when ambiguous questions elicited names, 3- and 4-year-olds frequently followed up with questions about the objects' functions. Ambiguous questions eliciting information about function were never followed up with requests for names.

If children's questions about novel artifacts are intended to elicit information about conceptual kinds, then one can adapt the questioning procedure to address a new issue. By exploring non-ambiguous questions children ask about artificial and living kinds, one can gain insight into the kinds of properties children consider fundamental to conceptual categorization in each domain.

Children as young as 3 years old have intuitions about essential properties of living kinds and can distinguish them from artifacts (Gelman, 2003). Extending the name of an animal permits extension of other essential properties of the category, such as manner of breathing (Gelman, 1988), aspects of growth (Inagaki & Hatano, 1996; Inagaki & Sugiyama, 1988; Rosengren, Gelman, Kalish, & McCormick, 1991), and inheritance (Springer & Keil, 1989, 1991). Three-year-olds also understand that traits of biological entities serve the purpose of enhancing survival, and traits of artifacts serve the social purposes of benefiting people (Keil, 1992, 1994).

Still, there is debate concerning the pervasiveness of functional design in children's concepts of living kinds. One proposal is that young children "promiscuously" overextend attributions of function, purpose, and design to all types of objects. Such a tendency is said to stem from an earlier proclivity to understand the world in terms of intentions, or via a naive

psychology. According to this account, it is natural for children to ask "What is it for?" for all objects, and children do appear to judge statements of purpose and function as reasonable for a wide array of objects (Kelemen, 1999a). To make inductive inferences and provide explanations for the existence and emergence of properties, children might treat living natural kinds as "quasi-artifacts" (Kelemen, 1999b) and engage the same teleological mode of construal they use for human-made objects. Alternatively, children may have an autonomous biological mode of thought and limit teleological reasoning to features of living entities that have adaptive value (Keil, 1992, 1994). According to this discriminative-teleology account, even young children restrict purpose-based thinking to artifacts and adaptive parts of animals.

If function and design are prominent elements of children's thinking about animals, as the promiscuous-teleology proposal suggests, then one would expect children to be curious and ask questions about animals' purposes and functions, just as they do for artifacts (Kemler Nelson et al., 2004). Accordingly, the goal of the current research was to compare children's requests for kind information about novel artifacts and animals. We expected this comparison to shed light on whether or not children privilege different types of information for living and artificial things.

METHOD

Participants

The participants were 32 preschool children (mean age = 4.62 years, range: 3.38–5.28 years), 12 girls and 20 boys. Data from 6 additional children were discounted because of shyness, speech delays, or unwillingness to complete the protocol. Participants were recruited from local preschools and a participant database at Yale University.

Materials

Photographs

Pictures of eight unfamiliar animals and eight novel artifacts were selected from the Internet and from Kemler Nelson's previous studies (e.g., Kemler Nelson et al., 2004). Their unfamiliarity was confirmed by a group of adults. Each object was removed from its original context (habitat or support) using Adobe Photoshop and presented on a plain background, as shown in Figure 1.

Game Presentation

A game display was created in PowerPoint and presented on a laptop computer. The initial display was a screen containing a

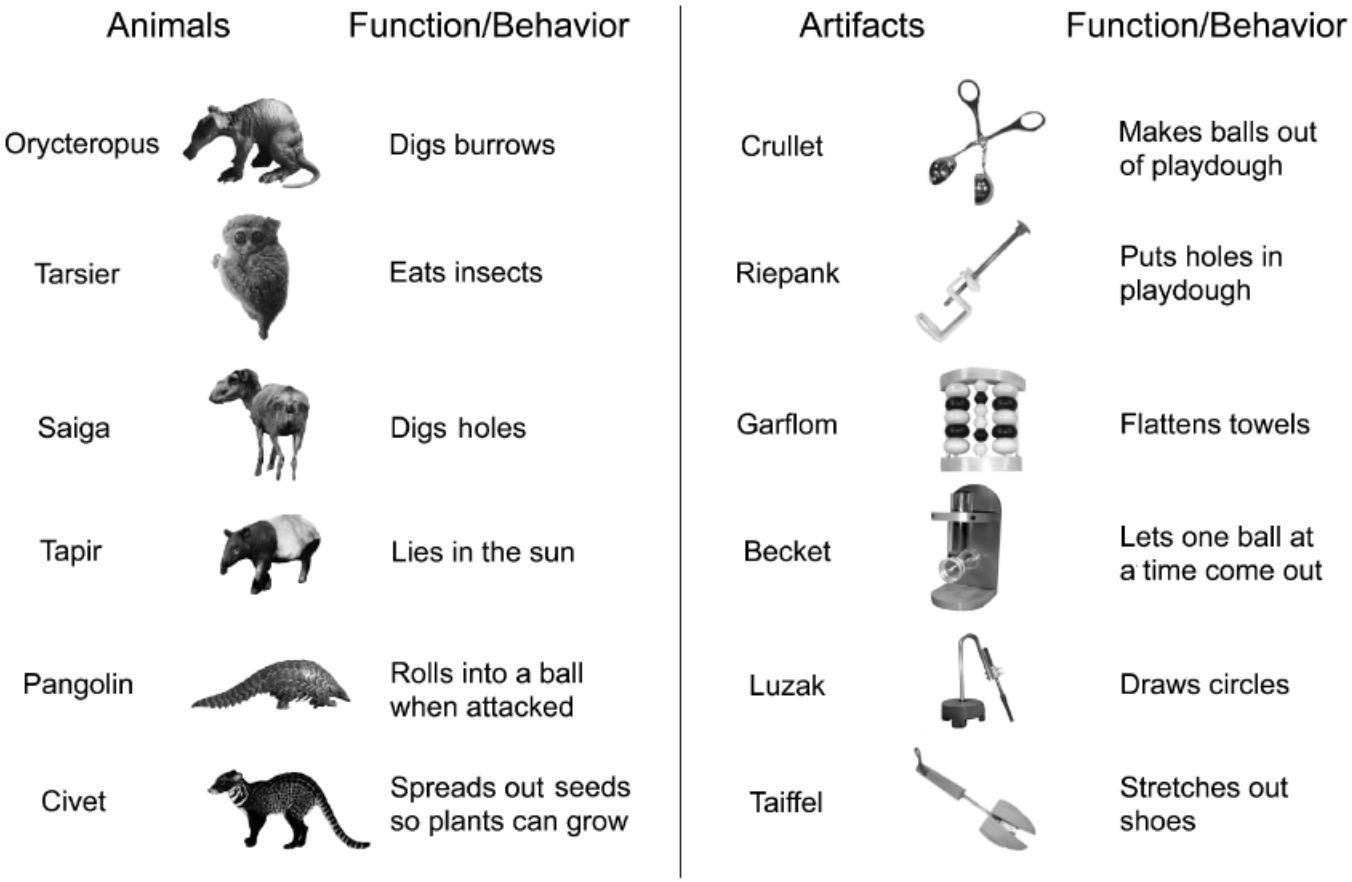

Fig. 1. Pictures and descriptions of the stimuli.

3×4 matrix of boxes with question marks. Clicking a question mark prompted a new screen with a picture of an animal or artifact. The stimulus set included six animals and six artifacts. Clicking on a location that said "Play Again" brought back the initial game screen, but without the options that had already been selected for view.

A similar training game included an initial screen containing only a 2×2 arrangement of two animals and two artifacts.

Procedure

The children were told that they would be seeing pictures of new things, and that they could ask questions about them. To elicit curiosity about the display and make the children comfortable, we used a humanlike puppet to demonstrate the game. With the training screen in view, the puppet chose a box and looked at the screen inquisitively while the experimenter clicked on the corresponding question mark. When the picture was revealed, the experimenter encouraged a question, saying "Wow, look at that! What do you want to know about that thing?" The puppet and experimenter inaudibly whispered questions and answers about the picture to each other three times to show it was acceptable to ask multiple questions about each object. Questions and answers were not spoken aloud, to prevent training on particular types of questions.

When the experimenter indicated it was the child's turn, the child chose a box, which then revealed a picture. The experimenter exclaimed, "Wow! That's cool. What do you want to know about that thing?" If the child did not respond, the experimenter asked if there was anything the child wanted to know about the picture. As a last resort, the experimenter said that asking questions would help the puppet learn about the object.

The experimenter always answered the children's questions. Ambiguous questions (e.g., "What is it?") always elicited the entity's name. All other questions were answered with appropriate information. After answering the first question, the experimenter asked if the child had additional questions. The trial continued until the child indicated he or she did not have more questions or asked to move on. Then the initial screen was brought up, and the child chose another box. The procedure was repeated for the remaining two training boxes.

After training, the experimenter brought up the game screen and told the child that he or she would see new items even more interesting than the earlier ones. Then the procedure was repeated, just as in the training phase.

The children were randomly assigned to one of two picture arrangements. The second arrangement was a mirror image of the first along the diagonal. The children were allowed to choose the boxes in any order they desired. All children saw all 12 pictures in the display.

RESULTS

Overall, 834 questions were asked, an average of 26.1 per child. Seven hundred eight questions concerned whole objects (321 initial questions and 387 follow-ups), and 126 concerned parts (24 initial questions and 102 follow-ups). Questions about whole objects were coded into several categories; by adult standards, some of these types of questions are appropriate for inquiring about both animals and artifacts, whereas others are appropriate for only animals or artifacts.

Questions Appropriate for Both Animals and Artifacts

The top panel of Table 1 lists the types of questions appropriate for both kinds of objects. These include ambiguous requests for names or information about kinds (e.g., "What is it?"), requests for names (e.g., "What is it called?"), questions about nonspecific functions or behaviors (e.g., "What does it do?") and guesses about such actions (e.g., "Does it turn?" or "Does it swim?"), guesses about category membership (e.g., "Is it a bear?" or "Is it scissors?"), and questions about niche or location (e.g., "Where does it live?" or "Where do you find it?"). For each type of question, the table shows the number of initial and follow-up queries, listed separately for animals and artifacts.

The total number of initial or follow-up questions did not differ reliably between animals and artifacts. Moreover, at a finer level of analysis, the number of ambiguous questions and name requests did not differ between the two kinds. However, despite being appropriate to ask of both kinds, some question types occurred at different rates for animals and artifacts. Questions and guesses about functions and behaviors, taken together, were more common for artifacts than animals, $F(1, 31) = 16.55$, $p_{rep} = .96$, $\eta^2 = .35$, for initial questions and $F(1, 31) = 18.58$, $p_{rep} = .96$, $\eta^2 = .38$, for follow-ups. By contrast, more animals than artifacts elicited category guesses, $F(1, 31) = 5.39$, $p_{rep} = .91$, $\eta^2 = .15$, for initial questions and $F(1, 31) = 6.86$, $p_{rep} = .93$, $\eta^2 = .18$, for follow-ups. Additionally, more animals than artifacts prompted follow-ups about niche or location, $F(1, 31) = 4.31$, $p_{rep} = .89$, $\eta^2 = .12$.

It is useful to partition guesses about functions and behaviors according to whether they concerned actions that can be sensibly predicated (by adults) of either kind (e.g., turning) or actions that can be sensibly predicated of only one kind or the other (e.g., climbing trees or cutting). The frequencies of these types of guesses are shown in the bottom panel of Table 1. Note that children never guessed about one kind a predicate that was solely applicable to the other kind. For example, types of behaviors expected of artifacts were not guessed for animals. Kind-specific guesses accounted for virtually all the children's guesses for animals. Although the same was not true for artifacts, fewer actions associated with artifacts are kind-specific in general.

Questions Appropriate for Artifacts

The second panel of Table 1 lists types of questions that, by adult standards, are appropriate to ask only about whole objects that are artifacts. These include questions about intended function (e.g., "What is this for?"), guesses about intended function (e.g., "Is this for X-ing?"), and questions about typical use ("How does this work?"). Although these types of questions were not asked

TABLE 1
Frequencies of Question Types, by Type of Object

Question type	Animal			Artifact		
	Initial question	Follow-up question	Total	Initial question	Follow-up question	Total
Questions relevant to both kinds						
Ambiguous	78	36	114	82	33	115
Name	6	6	12	6	4	10
Function or behavior	6	39	45	26	95	121
Guesses about function or behavior	1	20	21	13	27	40
Category guess	46	43	89	30	14	44
Niche or location	3	12	15	0	1	1
Questions relevant to artifacts						
Intended function	0	0	0	5	2	7
Guesses about intended function	0	0	0	5	3	8
Typical function	0	0	0	0	6	6
Questions relevant to animals						
Eating behavior	13	43	56	0	0	0
Reproduction	1	3	4	0	0	0
Guesses about functions and behaviors						
Animal-specific	1	19	20	0	0	0
Artifact-specific	0	0	0	5	10	15
Ambiguous	0	1	1	8	17	25

Note. Only questions about whole objects are included in this table.

frequently, no such questions were ever asked about animals, whereas they sometimes occurred in reference to artifacts.

Questions Appropriate for Animals

The third panel of Table 1 shows the frequency of questions that, by adult standards, apply appropriately only to animals: questions about eating behavior and reproduction. Questions about eating behavior were asked with moderate frequency for animals, but questions of both types never occurred for artifacts.

Questions About Parts

We also inspected children's questions about parts. Overall, both the number of initial questions and the number of follow-up questions about parts were similar for animals and artifacts. Of specific interest is whether children asked questions about purposes and functions of animal parts more frequently than they inquired about functions and behaviors of whole animals. For all children who asked questions about animal parts, we computed the proportion of their part questions that were about functions, and we compared these proportions with the proportions of questions about whole animals that were about functions and behaviors. Children asked proportionally more function questions about animal parts ($M = .55$, $SD = .45$) than wholes ($M = .12$, $SD = .17$), $t(16) = 3.77$, $p_{rep} = .98$, $\eta^2 = .47$. In contrast, there was no difference in the proportion of function questions asked about artifact parts ($M = .66$, $SD = .369$) and wholes ($M = .51, SD = .206$), $t(10) = 1.20, p_{rep} = .67, \eta^2 = .13$.

DISCUSSION

Our central finding concerns the distinction between animals and artifacts in preschool children's lines of questioning about novel objects, and the relevance of this distinction to disagreements about the role of teleological reasoning in children's thinking about biological concepts. We found that preschool children seek out different information about animals and artifacts. As Kemler et al. (2004) found, preschoolers frequently asked about the functions of artifacts. However, they did not indiscriminately impute design and function to biological kinds. Accordingly, the current findings support the discriminative-teleology proposal (Keil, 1992, 1994), rather than the promiscuous-teleology proposal (Kelemen, 1999a, 1999b).

Children appear to understand that different kinds of abstract relations are essential to the domains of artifacts and animals, and their questions reveal a deep-seated conceptual contrast between animals and artifacts. Children's questions reveal what they themselves consider important in creating a new conceptual category. Children were more likely to ask questions about functions and potential behaviors of artifacts than to ask questions about functions and potential behaviors of animals. Questions sensible to ask of either kind, such as "What does it do?" occurred more often for artifacts than animals, an indication that children consider function to be more central to concepts of artifacts than to concepts of animals. Function questions were more frequent for animal parts than for whole animals. Additionally, children occasionally asked what artifacts were

designed for or how they worked, but never made such inquiries about animals. In contrast, children were more likely to ask where animals typically were found than where artifacts typically were found. This question, although certainly sensible to ask about artifacts, does not strike children as conceptually important to learning about novel artifacts. Children also asked about properties that could pertain only to animals, such as eating habits and reproduction, and focused these queries appropriately and exclusively toward animals in the stimulus set.

Preschool children may not be able to verbalize the abstract differences between causal patterns associated with living kinds and with artifacts, but this inability should not be confused with problems in understanding such differences or with an interpretive system that applies in the same way to these two kinds. Instead, as evidenced in their questions, preschoolers show a rich and sharply contrasting pattern of differences in their expectations about the kinds of information important for learning about these two kinds. Further, the questions cluster together in ways that suggest coherent sets of expectations about the two kinds. Thus, at a young age, children have a clear sense of how explanatory systems differ for these very broad and abstract categories that represent one of the most important contrasts in the world.

Acknowledgments—The authors thank Stacy Brock for assistance with coding. This research was supported by funds from Swarthmore College to D.G.K.N. and National Institutes of Health Grant R37HD023922 to F.C.K.

REFERENCES

Bloom, P. (1996). Intention, history, and artifact concepts. *Cognition*, *60*, 1–29.

Dennett, D. (1987). *The intentional stance*. Cambridge, MA: MIT Press.

Gelman, S.A. (1988). The development of induction within natural kind and artifact categories. *Cognitive Psychology*, *20*, 65–95.

Gelman, S.A. (2003). *The essential child: Origins of essentialism in everyday thought*. London: Oxford University Press.

German, T.P., & Johnson, S. (2002). Function and the origins of the design stance. *Journal of Cognition & Development*, *3*, 279–300.

Inagaki, K., & Hatano, G. (1996). Young children's recognition of commonalities between animals and plants. *Child Development*, *67*, 2823–2840.

Inagaki, K., & Sugiyama, K. (1988). Attributing human characteristics: Developmental changes in over- and under-attribution. *Cognitive Development*, *3*, 55–70.

Keil, F. (1989). *Concepts, kinds, and cognitive development*. Cambridge, MA: MIT Press.

Keil, F.C. (1992). The origins of an autonomous biology. In M.R. Gunnar & M. Maratsos (Eds.), *The Minnesota symposia on child psychology: Vol. 25. Modularity and constraints in language and cognition* (pp. 103–137). Hillsdale, NJ: Erlbaum.

Keil, F.C. (1994). The birth and nurturance of concepts by domains: The origins of concepts of living things. In L.A. Hirschfeld & S.A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 234–254). New York: Cambridge University Press.

Keil, F.C. (1995). The growth of causal understandings of natural kinds. In D. Sperber & D. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (Symposia of the Fyssen Foundation, pp. 234–267). New York: Clarendon Press.

Kelemen, D. (1999a). The scope of teleological thinking in preschool children. *Cognition*, *70*, 241–272.

Kelemen, D. (1999b). Why are rocks pointy? Children's preference for teleological explanations of the natural world. *Developmental Psychology*, *35*, 1440–1452.

Kemler Nelson, D.G., Egan, L.C., & Holt, M.B. (2004). When children ask, "What is it?" what do they want to know about artifacts? *Psychological Science*, *15*, 384–389.

Rosengren, K., Gelman, S., Kalish, C., & McCormick, M. (1991). As time goes by: Children's early understanding of growth in animals. *Child Development*, *62*, 1302–1320.

Springer, K., & Keil, F.C. (1989). On the development of biologically specific beliefs: The case of inheritance. *Child Development*, *60*, 637–648.

Springer, K., & Keil, F.C. (1991). Early differentiation of causal mechanisms appropriate to biological and non-biological kinds. *Child Development*, *62*, 767–781.

(RECEIVED 6/13/05; REVISION ACCEPTED 10/28/05; FINAL MATERIALS RECEIVED 12/12/05)