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Remembering kinds: New evidence that categories are privileged in children's thinking

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ABSTRACT

What are the representations and learning mechanisms that underlie conceptual development? The present research provides evidence in favor of the claim that this process is guided by an early-emerging predisposition to think and learn about abstract kinds. Specifically, three studies ($N = 192$) demonstrated that 4- to 7-year-old children have better recall for novel information about *kinds* (e.g., that dogs catch a bug called “fep”) than for similar information about *individuals* (e.g., that a particular dog catches a bug called “fep”). By showing that children are particularly likely to retain information about kinds, this work not only provides a first empirical demonstration of a phenomenon that may be key to conceptual development but also makes it apparent that young children's thinking is suffused with abstractions rather than being perceptually-based and concrete.

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1. Introduction

A central goal of developmental research is to provide an account of how children construct a conceptual system capable of generating the full spectrum of predictions, inferences, and explanations that characterize adult cognition. In this paper, we focus on a feature of children's cognition that is essential to the construction of a mature conceptual system, and whose existence is supported by a growing body of work: Put simply, children may be predisposed to think and learn about *kinds*—classes of entities that are equivalent by virtue of being tokens of the same abstract type. On this proposal, even very young children (1) assume that there exist such equivalence classes in the world, and (2)

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possess the cognitive machinery needed to gather and process information about them. Within the context of this overarching proposal about the privileged status of kind representations in early cognitive life, the specific goal of the present research is to formulate and test a new prediction: that children would exhibit superior memory for novel facts about kinds than for novel facts about individuals.

In the next two sections, we summarize some of the existing evidence for the claim that kinds are a fundamental component of young children's thinking. We first discuss children's early-emerging ontological assumption that objects in the world can be grouped into kinds, followed by a description of the means that young children have at their disposal to learn about these entities. We then lay out the prediction of superior memory for kind information and motivate the current studies.

1.1. Children's ontological assumption about kinds

From a young age, children seem to assume that their world is populated with kinds and, in addition, that the members of these kinds are alike on a number of dimensions, many of which may not be immediately obvious (e.g., Booth & Waxman, 2002; Dewar & Xu, 2007; Dewar & Xu, 2009; Gelman & Markman, 1986, 1987; Graham & Diesendruck, 2010; Keates & Graham, 2008; Mandler & McDonough, 1996; Markman, 1989; but see, e.g., French, Mareschal, Mermillod, & Quinn, 2004; Quinn & Johnson, 2000; Samuelson & Perone, 2010; Sloutsky, 2010; Sloutsky, Kloos, & Fisher, 2007). Evidence for this dual assumption can be found even in infants. For example, when two novel objects were given the same kind label (e.g., "There's a zav"), 10-month-olds expected these objects to share a non-obvious property such as the sound they made when shaken, regardless of whether the two objects looked alike or not (Dewar & Xu, 2009; see also Baldwin, Markman, & Melartin, 1993; Graham, Kilbreath, & Welder, 2004). The most likely explanation for infants' behavior was that the shared count noun label signaled shared membership in a kind (e.g., Keates & Graham, 2008; Markman & Hutchinson, 1984; Waxman & Braun, 2005; Waxman & Markow, 1995; but see, e.g., Sloutsky & Robinson, 2008), which in turn led to the expectation that the two objects would be similar even on unforeseen dimensions such as the sound they make when shaken. For our purposes, though, it is important to point out that the shared labels could only have signaled shared kind membership if infants already assumed that objects in the world can be grouped into kinds, the ontological assumption discussed here.

Important clues concerning children's early-emerging assumptions about kinds can also be found in their language production. Languages across the globe provide the means to refer explicitly to kinds via what are known as *generic noun phrases* (e.g., "Birds fly"; e.g., Behrens, 2005; Carlson, 1977; Carlson & Pelletier, 1995); much evidence suggests that these noun phrases denote kinds *per se* rather than merely plural sets of individuals (e.g., "Many birds fly"; Brandone, Cimpian, Leslie, & Gelman, *in press*; Cimpian, Brandone, & Gelman, 2010; Cimpian, Gelman, & Brandone, 2010; Leslie, 2008). Consistent with the proposal that kinds are fundamental to early cognition, recent studies of parent-child conversations revealed that children start referring explicitly to kinds in their speech almost as soon as they become able to produce multiword utterances (Gelman, Goetz, Sarnecka, & Flukes, 2008; Gelman, Taylor, & Nguyen, 2004; Pappas & Gelman, 1998; see also Gelman, 2010). Moreover, young children *initiate* talk about kinds. For example, the majority of the generic noun phrases produced by 2-year-olds in everyday conversations occur in contexts where the children themselves bring up kinds as a topic of discussion (e.g., asking, "Why *babies* can't play with children?", in a conversation which up to that point had been about a particular baby; Gelman *et al.*, 2008). Thus, it is unlikely that young children's talk about kinds simply mimics their parents'; rather, these utterances reflect children's own assumptions about the structure of the world. Remarkably, even young deaf children who are growing up without exposure to sign language, and thus without much linguistic input at all, produce sequences of signs that seem to express generic meaning (Goldin-Meadow, Gelman, & Mylander, 2005). This finding underscores that children's propensity to communicate about kinds cannot be the product of modeling by adults. More broadly, these findings also suggest that children may not need explicit linguistic input about kinds in order to realize that such entities are a potential object of thought.

In fact, the causal arrow might well go in the opposite direction, such that children's prior assumptions about the existence of kinds may help them understand utterances about kinds (rather than the other way around). This conclusion is suggested by the striking contrast between the speed with

which children develop the ability to identify kind-referring generic utterances in the input and the unique challenges involved in doing so. These challenges are as follows. First, kind reference is not straightforwardly marked in English or any language that has been studied so far (e.g., Dahl, 1995; Gelman & Tardif, 1998; Mannheim, Gelman, Escalante, Huayhua, & Puma, 2011). There is no generic quantifier or any other grammatical particle that indicates whether a sentence expresses a fact about a kind. Second, as a result, the mapping between surface linguistic form (e.g., plurality, tense, determiners) and generic meaning is complex and non-deterministic, and extralinguistic factors such as the context of the conversation or one's background knowledge often play a crucial part in the final interpretation (e.g., Carlson & Pelletier, 1995; Cimpian & Markman, 2008; Gelman & Raman, 2003). Third, the entities denoted by generic noun phrases (that is, kinds) are not perceptually accessible in the referential context. Kinds are unbounded sets of tokens—actual and potential, real and imaginary, present and past; as such, they do not lend themselves to perceptual inspection. In this respect, the distinction between kind and specific reference is unlike most of the linguistic distinctions that children acquire during the early course of language learning. For example, a child's understanding of the singular/plural distinction in English may be spurred by detecting the association between the suffix *-s* on count nouns and the presence of multiple exemplars in the referential context. No association exists that might analogously spur children's understanding of the generic/non-generic distinction, since kinds can never be physically present in the contexts where generic statements are produced.

Yet, despite the obvious complexity of this learning problem, children as young as 2 and 3 years of age can already distinguish between generic and non-generic statements in a variety of circumstances (Cimpian & Markman, 2008; Cimpian, Meltzer, & Markman, 2011; Gelman & Raman, 2003; Graham, Nayer, & Gelman, 2011; Hollander, Gelman, & Star, 2002; for a review, see Gelman, 2010). This early competence is all the more impressive given that, even a few years later, children still have trouble with some linguistic inferences for which there is plenty of associative evidence. For example, 4-year-olds cannot reliably use the *-s* inflection on a present tense verb to infer that its subject noun phrase is singular (e.g., that a sentence such as "The elephant spills the paint" is about one, not multiple, elephants; Johnson, de Villiers, & Seymour, 2005), despite the fact that this number agreement suffix is obligatory in mainstream English, leading to strong statistical links between singular subjects and the final *-s* on the verbs. How, then, do children acquire such rapid proficiency with the distinction between generic and specific reference, which is so much more abstract from a conceptual standpoint and opaque in terms of its marking in the language?

As already alluded to, the key to this puzzle may lie in the assumption under consideration here: If children assume that kinds exist and that they are potential referents of others' expressions, the absence of linguistic markers of generic reference and the perceptual unavailability of kinds become less problematic (Gelman, 2003, 2004, 2010; Gelman et al., 2008). As Susan Gelman and her collaborators have argued, children could instead be on the lookout for markers of specific reference (e.g., "my dog," "this chair," "two apples"), which are not only plentiful but also more readily recognizable. If no such cues to specificity are present, then the utterance becomes a candidate for generic meaning. Crucially, though, this inferential leap¹ from *non-specific* to *generic* would not be possible unless children already assumed that the world can be carved up into kinds—as proposed here—and that these kinds are a potential topic of conversation.

In sum, several pieces of evidence support the idea that conceptual development is jump-started by an assumption that objects that are physically distinct, and even perceptually dissimilar, can nevertheless be equivalent at some deeper level by virtue of their shared membership in the same *kind*. In the next section, we provide evidence for the claim that children's assumption about the existence of kinds is supplemented by powerful cognitive biases dedicated to the task of acquiring and processing information about kinds. Just as above, our argument will draw in part on the generics literature. Because generic noun phrases refer explicitly to kinds, they provide one of the most direct ways of investigating how people *reason about* kinds. In other words, probing children's interpretation of kind generalizations expressed in language is informative not just about their linguistic competence but

¹ We should emphasize that this inference is indeed nontrivial, as non-specific reference is not by necessity generic. For example, the noun phrase "a cat" in "I want a cat" is also non-specific (i.e., there is no particular cat that I have in mind), yet it is not kind-referring.

also about the deeper cognitive structures by virtue of which children understand these linguistic expressions. Generic language relies on kind representations, and thus children's interpretation and use of generics can provide unique insights into their thinking about kinds (e.g., Brandone & Gelman, 2009; Gelman, 2010).

1.2. Cognitive biases that facilitate learning about kinds

As previously mentioned, only particular samples of a kind are amenable to visual inspection—never the kind as a whole. As a result, the information children acquire through direct observation of the world must necessarily be at the level of the perceived samples rather than at the level of kinds *per se*. Observation can only lead to kind-level knowledge if it is supplemented by inductive generalizations that translate the information obtained by inspecting samples (e.g., the birds seen so far have had wings) into a conclusion about the kind as a whole (e.g., *having wings* is a feature of the kind *bird*). Of course, the ability to generalize from experience, broadly construed, is present even in young infants (e.g., Baldwin et al., 1993; Quinn & Johnson, 2000). However, the type of generalization required here is of a special sort, in large part because the conditions under which it is legitimate to make a generalization about a *kind* are not straightforwardly predictable on the basis of the statistical evidence (e.g., Carlson, 1977; Leslie, 2007, 2008). In fact, these legitimacy conditions have resisted many attempts at description and formalization over the last few decades (see Carlson & Pelletier, 1995; Lawler, 1973; Leslie, 2008). To take an example, although less than half of all ducks lay eggs (only the mature females), people agree that *ducks lay eggs* is a legitimate kind-level generalization about ducks (e.g., Khemlani, Leslie, Glucksberg, & Rubio-Fernandez, 2007). In contrast, the generalization *ducks are female* is not valid, even though there are at least as many ducks that are female as there are ducks that lay eggs. One can find even more extreme examples, such as that the kind-level generalization *mosquitoes carry the West Nile virus* is acceptable despite the fact that fewer than 1% of mosquitoes are carriers.

In principle, one might expect that the ability to reason about kind generalizations of this sort—with their loose, non-linear relationship to the evidence—requires a degree of cognitive sophistication that is beyond young children's grasp. Thus, one might expect young children to start out with generalizations that are more regular and rule-bound, such as those expressed in language by the quantifiers *all* or *some* (e.g., *some ducks lay eggs*). The conditions under which quantified generalizations are legitimate are constant, predictable, and specified by relatively simple rules—arguably a good fit to young children's limited cognitive resources.

It turns out, however, that the actual developmental sequence is exactly the opposite of the one just sketched: Children first display adult-like competence in their reasoning about kind generalizations and only later become competent with quantified generalizations, despite their seemingly more tractable semantics (Brandone et al., *in press*; Hollander et al., 2002; Leslie & Gelman, 2011; Mannheim et al., 2011; Tardif, Gelman, Fu, & Zhu, 2011). In Hollander et al. (2002), for example, 3- and 4-year-olds' reasoning about questions involving kind-level generalizations (e.g., "Do clothes have zippers?") was almost indistinguishable from that of adults. In contrast, the questions involving quantified generalizations (e.g., "Do some/all clothes have zippers?") posed considerable difficulties for the preschoolers. The idea that kind generalizations are more accessible from a cognitive standpoint is also supported by adults' tendency to fall back on these generalizations when they have to remember (Leslie & Gelman, 2011) or judge the truth value of (Leslie, Khemlani, & Glucksberg, 2011; Meyer, Gelman, & Stilwell, 2011) certain quantified generalizations.

Taken together, these findings point to the existence of a somewhat paradoxical bias in humans' ability to formulate and evaluate generalizations, such that generalizations about kinds are privileged over generalizations that, at least in terms of formal complexity, seem much more tractable (e.g., Gelman, 2010; Leslie, 2008). To be precise, kind generalizations are privileged in the sense of being particularly easy to think about or process, which may explain both why these generalizations come online early during the course of development and why adults occasionally "default" to them while contemplating quantified generalizations. In sum, the presence of this processing advantage for generic generalizations supports our claim that children's learning about kinds is guided by early-emerging cognitive biases.

According to a recent hypothesis, another potent means of learning about kinds comes in the form of an early sensitivity to “pedagogical” cues (e.g., Csibra & Gergely, 2006, 2009; Gergely, Egyed, & Kiraly, 2007; Yoon, Johnson, & Csibra, 2008). That is, children are biased to interpret certain communicative, often non-verbal, cues as signaling that their interaction partner is about to teach them generic, category-wide facts. For example, when an adult makes eye contact before demonstrating a non-obvious property of a novel object, children typically make a strong inference that this property is characteristic of the novel object’s kind rather than idiosyncratic to the object it was demonstrated on (Butler & Markman, *in press*). In contrast, when the adult does *not* make eye contact before providing evidence for the property, children more commonly assume that the property is idiosyncratic. Children’s sensitivity to these pedagogical cues as signposts for generalizable information provides a powerful means of capitalizing on the accumulated knowledge of those around them.

To conclude, the evidence reviewed in this section suggests that children’s ability to gather information about kinds is guided by powerful inferential and communicative biases that appear to be dedicated to this task. More broadly, this evidence reinforces the argument that thinking and learning about kinds is a natural inclination of our species.

1.3. The present studies

In the present research, we tested a key prediction of this argument. If kind representations are a fundamental, even privileged, component of how children reason about the world, then it is possible that children’s memory for information about kinds would be particularly robust. This prediction follows from well-established principles that govern memory encoding and storage. For example, information that is privileged by the cognitive system may be processed more deeply, leading to robust retention (e.g., Craik & Lockhart, 1972; Craik & Tulving, 1975; Geis & Hall, 1976). Moreover, the value one implicitly attaches to a fact often determines whether it is selectively attended to and encoded (e.g., Benjamin, 2008; Weiner, 1966). In short, the privileged status of kinds in young children’s thinking should leave its mark on their ability to remember this information, leading to a generic advantage. Such an advantage would play an important functional role as well because it would make kind generalizations readily available in the long term to the conceptual system and thus able to support its many operations (e.g., generating predictions, enabling linguistic communication).

Our prediction here is not absolute—there will of course be many exceptions. For example, specific information that is salient (e.g., the name of a new teacher, the color of a new favorite toy) may very well be encoded more quickly and robustly than any generic information learned around the same time. Similarly, children’s memory for specific information to which they receive extensive exposure will most likely be faithful as well (see discussion of Gelman, Ware, & Kleinberg, 2010, in Section 1.3.1 below). In other words, there is no doubt that the magnitude of hypothesized generic advantage in children’s memory will be sensitive to factors such as the content and salience of the information to be remembered, the amount of exposure to it, and so on. Nevertheless, all things being equal, the present account predicts that if a piece of information applies to an entire kind, it will be particularly memorable when compared to similar, but more specific, information.

To test the prediction of superior memory for information about kinds, we compared 4- to 7-year-old children’s ability to recall such information with their ability to recall information that, although identical in content, was about a particular individual. This comparison provides a stringent test of our hypothesis. For example, there is abundant evidence that even infants in the first few months of life can keep track of information about individuals over time (e.g., Buresh & Woodward, 2007; Hamlin, Wynn, & Bloom, 2007; Luo & Baillargeon, 2005). Strikingly, 5- and 7-year-olds’ incidental memory for individuals is so accurate that they even outperform adults, at least in some circumstances (Fisher & Sloutsky, 2005; Sloutsky & Fisher, 2004a, 2004b; but see Wilburn & Feeney, 2008). In sum, it appears that children can easily retain information about individuals. As a result, it is conservative to use 4- to 7-year-olds’ recall for this type of information as a baseline against which to compare their recall for generic information.

1.3.1. Previous evidence

In apparent contrast to our prediction, two recent studies did not find differences in children’s ability to remember facts about kinds vs. individuals (Gelman & Raman, 2007; Gelman et al., 2010).

However, since neither study had it as its primary goal to test the prediction of superior memory for kinds, their methodology was not tailored for this comparison. For example, the 4- and 5-year-olds in Gelman, Ware, and Kleinberg's (2010) study received extensive exposure to the generic and specific facts on which they were later tested, having heard each of them approximately 10 times. Moreover, the retrieval cues used in this study were often so detailed as to make accurate recall relatively trivial. For example, for a fact such as "Zarpies are/This zarpie is scared of ladybugs," the retrieval cue was a picture of a zarpie (a novel animal) recoiling away from a ladybug with a frightened expression on its face (p. 277). Consistent with these observations, children's recall scores were routinely high in Gelman et al.'s study.

With regard to Gelman and Raman (2007), its design may have prompted children to construe the individual animals they were told about as *representatives of their kinds* rather than as *distinct individuals* with their own idiosyncratic features, which may have led to the inference that the individual-level facts were in fact broadly applicable to the relevant kinds.² Several considerations motivate this claim. First, each non-generic trial was about a member of a different category ("This snail breathes through its feet," "This bee has five eyes," "This spider sheds its skin," and so on). This one-fact-per-category structure may promote the interpretation that each individual animal is illustrative of its kind. Contributing to this interpretation is the fact that it is relatively unusual for particular members of the categories used in this study (e.g., snails, bees, spiders) to be singled out and talked about as individuals; intuitively, this type of differentiation is much more common for members of kinds that children have extensive contact with in daily life (people, cats, dogs). Finally, many of the properties used in Gelman and Raman's study were biological in nature (e.g., method of breathing, number of eyes) and thus unlikely to vary within a kind (e.g., Cimpian & Markman, 2008; Gelman, 1988; see also the work on over-hypotheses, starting with Goodman, 1965; Dewar & Xu, 2010; Macario, Shipley, & Billman, 1990; Shipley, 1993). In sum, if children were on the lookout for information about kinds, as we propose they are, then Gelman and Raman's design may have provided sufficient evidence to make kind generalizations from individual-level information, which in turn may explain the null effect on the memory measure.

1.3.2. Overview of experiments

We report three studies that tested the prediction of superior memory for kind information. In Experiments 1 and 2, we tested 4- to 7-year-old children's memory for facts about kinds vs. individuals using a task designed to avoid some of the pitfalls identified in previous work. For example, we provided sparse retrieval cues and tried to make sure that the kind- and individual-level information to be remembered was in fact understood as being about kinds and individuals, respectively (i.e., that broader generalizations from the individual-level information were blocked). The results of these two studies supported our prediction. Experiment 3 was a control study in which we added back some of the task features that may have led to null results in previous work (e.g., using a different category on each trial); as predicted, these changes eliminated the generic memory advantage.

2. Experiment 1

In this study, children were provided with novel facts that were either about boys or girls in general (the Kind condition) or about particular boys or girls (the Individual condition). All facts referred to preferences (e.g., liking a fruit called *mod*) or abilities (e.g., being really good at playing an instrument called *zid*) and were accompanied by pictures of the novel objects mentioned (e.g., an exotic fruit, an unusual instrument). After a delay, children were asked to recall these facts, the prediction being that

² The fact that Gelman and Raman's participants recalled the non-generic facts predominantly in non-generic form does not necessarily contradict this claim. Children who generalized a non-generic fact to the relevant kind might still retain enough of the surface form of the original utterance to produce a *non-generic* statement at recall. As long as the relevant memory traces are available, such verbatim retrieval is common in tasks where the retrieval cues provide an exact match to the original experience (as the pictures cues did in this case; see Brainerd & Reyna, 2001, 2004). In addition, the psycholinguistics literature on syntactic priming suggests that being exposed to certain linguistic structures (e.g., demonstrative noun phrases) is likely to bias subsequent language production towards the same structures, which would also boost correct production of the non-generic form (see Branigan, McLean, & Jones, 2005; Cleland & Pickering, 2003).

children's memory for the content of the facts would be more accurate in the Kind than in the Individual condition.

Several features of this task were meant to ensure that the individuals talked about were not seen simply as standard representatives of their categories (cf. Gelman & Raman, 2007): First, the facts in the Individual condition were about four different boys and four different girls; this within-category contrast should highlight the distinctiveness of the individual boys and girls involved. Since distinctiveness facilitates memory (e.g., Baddeley & Dale, 1966; Hunt & Mitchell, 1982; Schmidt, 1985), this is actually a conservative feature of our design, in that it may favor the Individual condition. Second, we used two categories (boys and girls) whose members children should not have any difficulties conceiving of as distinct individuals. Third, we used abilities and preferences, rather than biological features, as our facts because they are dimensions on which there could easily be individual variability within a kind (e.g., some boys/girls like apples and others do not). Finally, we should also note that the pictures shown to children, and later used as retrieval cues, depicted just the objects mentioned in the novel facts and were thus rather sparse (cf. Gelman et al., 2010).

2.1. Method

2.1.1. Participants

Sixty-four children participated in this study: half were 4 and 5 years old (16 boys and 16 girls; $M = 4.94$ years; $SD = 0.52$) and half were 6 and 7 years old (16 boys and 16 girls; $M = 7.04$ years; $SD = 0.65$). The children were recruited in a small city in the Midwestern US, either from local preschools and elementary schools or from a database of families interested in participating in developmental studies. Although demographic information was not collected formally, the participants were mostly European American and represented a range of socioeconomic backgrounds.

2.1.2. Materials and design

Children were randomly assigned either to the Kind condition ($n = 32$), in which the novel information was framed as being about boys or girls in general, or to the Individual condition ($n = 32$), in which the novel information was framed as being about different boys or girls. Equal numbers of 4–5-year-olds and 6–7-year-olds were assigned to each condition.

We used eight novel facts (see Table 1), presented in counterbalanced order. Half of the facts were about abilities, and half were about preferences. Also, half were positive in valence (e.g., about what boys/girls like) and half were negative in valence (e.g., about what boys/girls do not like). Each fact was accompanied by a color picture of an object mentioned in the fact (e.g., an unfamiliar fruit); the same pictures were used in the Kind and Individual conditions. These pictures were presented alongside the facts in the study phase (when the facts were first introduced), and they also served as retrieval cues in

Table 1

The items used in Experiment 1.

Kind condition ^a	Individual condition ^b
Boys/girls like a <u>fruit</u> called mod	He/she likes a <u>fruit</u> called mod
Boys/girls like a <u>vegetable</u> called fep	He/she likes a <u>vegetable</u> called fep
Boys/girls don't like a <u>snack</u> called voom	He/she doesn't like a <u>snack</u> called voom
Boys/girls don't like a <u>drink</u> called pim	He/she doesn't like a <u>drink</u> called pim
Boys/girls are really good at making a <u>puzzle</u> called wug	He/she is really good at making a <u>puzzle</u> called wug
Boys/girls are really good at playing an <u>instrument</u> called zid	He/she is really good at playing an <u>instrument</u> called zid
Boys/girls aren't really good at making a <u>shape</u> called dax	He/she isn't really good at making a <u>shape</u> called dax
Boys/girls aren't really good at playing a <u>game</u> called neem	He/she isn't really good at playing a <u>game</u> called neem

Note: The underlined words refer to the objects depicted in the photographs we used as retrieval cues.

^a The facts in the Kind condition were prefaced with, "I wanna tell you something interesting about boys/girls".

^b The facts in the Individual condition were prefaced with, "I wanna tell you something interesting about a [different] boy/girl". (The modifier "different" was used after the first two trials.)

the recall phase. A stuffed hedgehog (“Mr. Hedgehog”) was used to keep children interested and motivate them throughout the experimental session.

Each participating child was provided with four facts about boys and four facts about girls. The boy and girl facts alternated, and the gender of the first fact was counterbalanced across children. Each fact was presented as being about boys (or a boy) for half of the children, and as being about girls (or a girl) for the other half.

2.1.3. Procedure

Children were tested individually in a quiet room in the lab or in their school. The experimenter wrote down children’s responses during the recall phase, but the sessions were also videotaped and transcribed for later coding.

The experimenter first introduced children to Mr. Hedgehog and explained that they would be asked to tell him about the things they would hear in the game. The main part of the study was divided into three phases: a study phase, a distractor task, and a recall phase.

2.1.3.1. The study phase. In this phase, the experimenter presented children with the eight facts to be remembered. Each fact was prefaced either with, “I wanna tell you something interesting about boys/girls” (Kind condition) or with, “I wanna tell you something interesting about a boy/girl”³ (Individual condition). The experimenter then provided the actual fact (e.g., “Boys/girls like a fruit called *mod*” or “He/she likes a fruit called *mod*”), repeating it once.

To ensure that children were paying attention, the experimenter asked them to repeat each fact, ostensibly for the sake of the stuffed hedgehog. If children did not repeat as requested, the experimenter reiterated the relevant fact and prompted them to try again. After children repeated a fact, the experimenter stated it two more times before moving on to the next one. Because this procedure introduced some variability in the number of times each fact was presented, we used the transcripts of the sessions to verify that children in the Kind and Individual conditions received equal exposure to the information to be remembered. Indeed, the average number of times the experimenter stated each fact was identical for the Kind ($M = 4.01$ repetitions per fact) and Individual ($M = 4.04$) conditions, Mann–Whitney $Z = 0.35$, $p = .782$.

2.1.3.2. The distractor task. After hearing all eight facts, children were asked to do some coloring. This task lasted 4 min, a delay that was sufficient to ensure that subsequent recall would rely on long-term memory traces (e.g., Peterson & Peterson, 1959; see also Gelman & Raman, 2007).

2.1.3.3. The recall phase. At the beginning of this phase, children were told that they would be asked to remind Mr. Hedgehog, with the help of some clues, about some of the things they heard before they did the coloring. For each fact, children were shown the picture that had accompanied it in the study phase and told, “Here’s the clue. Think about it for a little bit. Can you remind Mr. Hedgehog what we said?” If children had trouble remembering the information, the experimenter prompted them at most two more times (e.g., “This is a pretty tricky question, huh? You know, *anything* you remember is good”) before moving on to the next item. The items were presented in the same order as in the study phase.

2.1.4. Coding

Children’s responses during the recall phase were coded for accuracy on six different dimensions: generic/specific, gender, verb content, verb valence, object noun, and novel word (for more detail about these coding categories, see Table 2). Each of these six dimensions was coded using a binary correct/incorrect (1/0) scale, although several of the dimensions did allow partial credit (0.5; see Table 2). To illustrate, if children produced recall statements that were about *girls* or *boys*, they received a

³ After the first two facts in the Individual condition, the experimenter switched to prefacing the facts with, “I wanna tell you something interesting about a *different* boy/girl.” This contrast was added to emphasize that the boys and girls talked about in this condition were distinct individuals.

Table 2
The coding scheme used in Experiment 1.

Coding category	Criterion	Possible scores	Hypothetical coding examples, assuming that the fact to be remembered is “Girls like a fruit called <u>mod</u> ”
(1) Generic/specific	Did the child remember the fact in the correct generic/specific format?	0 or 1	“Boys like ...” or “Girls like ...” would be coded as 1 “He likes ...” or “She likes ...” would be coded as 0
(2) Gender	Did the child remember the gender associated with the fact?	0 or 1	“Girls like ...” or “She likes ...” would be coded as 1 “Boys like ...” or “He likes ...” would be coded as 0
(3) Verb content	Did the child remember the content of the verb (e.g., “like”)?	0, 0.5, or 1	“Girls <u>like</u> ...” or “Girls don’t <u>like</u> ...” would be coded as 1 “Girls <u>eat mod all the time</u> ” would be coded as 0.5 ^a “Girls <u>are good at</u> ...” would be coded as 0
(4) Verb valence	Did the child remember the valence of the verb (positive vs. negative)?	0 or 1	“Girls <u>like</u> ...” or “Girls <u>are good at</u> ...” would be coded as 1 “Girls <u>don’t like</u> ...” or “Girls <u>aren’t good at</u> ...” would be coded as 0
(5) Object noun	Did the child remember the direct object of the sentence conveying the fact (e.g., “fruit”)?	0, 0.5, or 1	“... like a <u>fruit</u> called...” would be coded as 1 “... like an <u>apple</u> called ...” would be coded as 0.5 ^a “... like a <u>toy</u> called ...” would be coded as 0
(6) Novel word	Did the child remember the novel word included in the fact (e.g., “mod”)?	0, 0.5, or 1	“... a fruit called <u>mod</u> ” would be coded as 1 “... a fruit called <u>yod</u> ” would be coded as 0.5 ^a “... a fruit called <u>veep</u> ” would be coded as 0

^a The coding scheme was relatively liberal in assigning partial credit. For example, for the Novel Word category, children were given partial credit for producing any word that shared at least one phoneme with the original word.

Generic/Specific score of 1 (correct) in the Kind condition and a score of 0 (incorrect) in the Individual condition.

These accuracy scores were averaged across the six coding categories to create a recall score ranging between 0 and 1 for each fact. To assess reliability, a second researcher coded 59 of the 64 transcripts. Cohen’s kappas for the six coding categories ranged from 0.79 to 0.99, indicating excellent agreement. Disagreements were resolved by discussion.

Because the accuracy of children’s repetition responses during the study phase may provide a valuable index of their linguistic ability and overall engagement in the task, we coded these responses as well and included them as a covariate in the analysis reported below. Reliability for this measure was calculated over all 64 transcripts and ranged from 0.75 to 0.99 for the six coding categories.

2.1.5. Data analysis

The main dependent measure was the average score across the eight facts in the recall phase (possible range = 0–1). Since this variable was neither normally distributed within the Kind and Individual conditions (Shapiro–Wilk test, $ps < .001$) nor homoscedastic across them (Levene’s test, $p < .001$), it violated the main assumptions of parametric statistical procedures such as analysis of variance (ANOVA). As a result, we analyzed children’s recall responses with ordinal logistic regressions (OLRs), which were computed through the Generalized Linear Models procedure in SPSS 19 (for similar analyses, see Cimpian & Cadena, 2010; Cimpian & Markman, 2009, 2011). As a measure of effect size for pairwise comparisons, we report Cohen’s d (Cohen, 1988).

2.2. Results and discussion

Our main prediction was that children would display superior memory for information about kinds than for analogous information about individuals. To test this prediction, we performed an OLR with

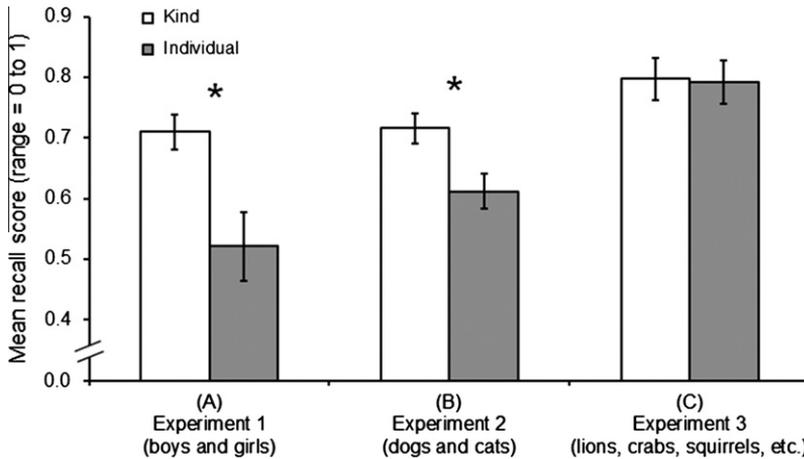


Fig. 1. The mean recall scores for the Kind and Individual conditions in Experiments 1–3. The error bars represent ± 1 SE. * $p < .05$.

children's recall scores as the dependent variable and with Condition (Kind vs. Individual), Age Group (4–5-year-olds vs. 6–7-year-olds), and Gender of the participants (boys vs. girls), along with all their interactions, as dichotomous predictors. Children's repetition scores were also entered into the model as a covariate. The means reported below, however, are the observed means, not adjusted for the repetition covariate.

As predicted, children's memory for the novel facts about kinds ($M = .71$) was more accurate than their memory for the novel facts about individuals ($M = .52$), Wald $\chi^2 = 4.01$, $df = 1$, $p = .045$, $d = 0.74$ (see Fig. 1A).⁴ The magnitude of the generic advantage did not differ significantly between the younger ($M_{Kind} = .64$ vs. $M_{Individual} = .40$) and the older ($M_{Kind} = .78$ vs. $M_{Individual} = .64$) children, as indicated by the absence of a Condition \times Age Group interaction, Wald $\chi^2 = 0.18$, $df = 1$, $p = .675$.

The only other significant result revealed by this OLR was a main effect of Age Group, Wald $\chi^2 = 9.48$, $df = 1$, $p = .002$, $d = 0.73$. Unsurprisingly, 6–7-year-olds' memory ($M = .71$) was better than 4–5-year-olds' ($M = .52$).

2.2.1. Results by coding category

Fig. 2A illustrates the results broken down by coding category. The generic advantage in memory held up across all six categories (binomial $p = .016$) but was relatively small for the novel word category—most likely because children only very rarely remembered this information.

Although these disaggregated results support our prediction, the accuracy difference on the Generic/Specific dimension could be of some concern: We designed our task so that the information in the Individual condition would appear idiosyncratic rather than generalizable (cf. Gelman & Raman, 2007). Do the lower Generic/Specific scores in the Individual condition signal that, contrary to our expectations, children in this condition *did* generalize and thus produced many generic statements (which would be scored as incorrect on the Generic/Specific dimension)? To explore this question, we tallied the number of trials on which children in the Individual condition used a bare plural noun phrase in their recall response (e.g., recalling something about *boys* when the original fact had been about a particular boy); these are the clearest examples of specific-to-generic errors, since the bare plural is the prototypical form of expressing generic meaning in English (e.g., Gelman, Coley, Rosengren, Hartman, & Pappas, 1998; Gelman et al., 2008). Strikingly, only 0.4% of the recall utterances in the Individual condition were in bare plural form, which accounted for only 1.2% of all the

⁴ This key main effect was also significant when the repetition score covariate was not included in the model, and when the data were analyzed with an ANOVA (either with or without the repetition covariate).

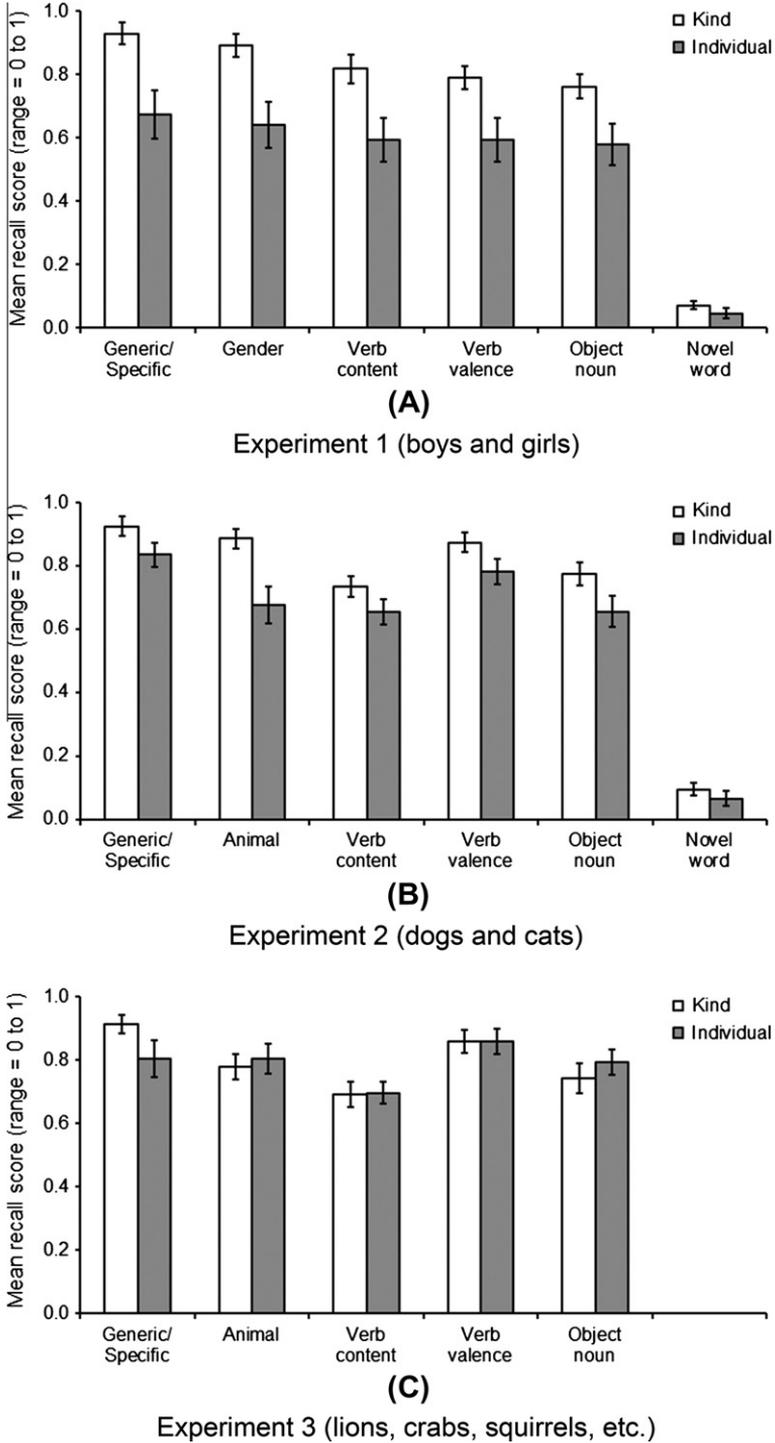


Fig. 2. The mean recall scores, by coding category, for the Kind and Individual conditions in Experiments 1–3. The error bars represent ± 1 SE.

errors on the Generic/Specific dimension in this condition. Instead, by far the most common type of mistake was one of *omission*: 98.8% of Generic/Specific errors in the Individual condition occurred because children simply did not produce a codable subject noun phrase—often because they could not remember anything about the facts they were asked to recall. Thus, the lower Generic/Specific scores in the Individual condition were not driven by the presence of generic statements. Rather, the Kind vs. Individual difference on this coding dimension was most likely due to the phenomenon under investigation, namely that children do not remember information about individuals as well as they remember information about kinds.

2.2.2. Addressing an alternative explanation

In order to produce a correct response during the recall phase, children in the Individual condition needed to refer to an absent, anonymous person. This may be a challenging task for young children because many of the common linguistic means of referring to individuals (e.g., “this girl”) are not entirely felicitous in this context. As a result, children may fail to say anything, which could be mistaken for a failure to remember. Thus, there are two potential explanations for why children in the Individual condition performed more poorly: (1) because they were unable to retain the information across the retention interval (our original interpretation), or (2) because they were unable to express the remembered information in this referential context.

One way of distinguishing between these possibilities would be to reduce the retention interval while keeping the referential context the same. If the effect identified in Experiment 1 is truly due to children’s differential ability to retain information about kinds and individuals over time, then reducing the delay should lead to a corresponding reduction in the Kind vs. Individual difference. On the other hand, if the effect is due to children’s inadequate knowledge of referring expressions, then reducing the delay should have little effect on the Kind vs. Individual difference.

This is the strategy we adopted in a small follow-up study ($n = 12$ children aged 4 and 5; $M = 5.08$ years) whose goal was to disentangle these possibilities. On each trial, the experimenter presented a novel fact, counted out loud to five, and then asked children to “remind Mr. Hedgehog what we said,” just as in the recall phase of the main study. In this modified task context, children’s memory for the content of the facts was identical on the Individual ($M = .60$) and the Kind ($M = .60$) trials. Importantly, children did not simply *repeat* the experimenter’s exact phrasing, which would bypass the need to actually generate a referential expression: Only on 12.5% of the Individual trials did children use the pronouns “he” and “she” in the subject position, as in the original facts. Instead, children frequently came up with their own ways of referring to the relevant boys or girls (e.g., “There was a little girl that . . .” or “I know a boy that . . .”). To conclude, these follow-up data are consistent with our original interpretation of the results from Experiment 1: that the empirical difference between the Kind and Individual conditions is truly due to a difference in children’s ability to *remember* these types of information, which in turn supports the proposal that kinds are privileged in young children’s cognition.

3. Experiment 2

Experiment 2 addressed another potential alternative explanation for the generic advantage in Experiment 1: Perhaps children were more likely to remember the generic information about boys and girls because it was also *self-relevant*, whereas the non-generic information was not (e.g., Bower & Gilligan, 1979; Rogers, Kuiper, & Kirker, 1977). Young children are notoriously eager to learn about, and conform to, the features stereotypically associated with their gender category (e.g., Bradbard & Endsley, 1983; Martin, Eisenbud, & Rose, 1995; Rhodes & Brickman, 2008), and the Kind condition in Experiment 1 may have provided them with an opportunity to do exactly that. Although self-relevance contributes to the perceived importance of a fact, and perceived importance may be part of the reason why generic facts are remembered more faithfully (see Section 5.2.1 for additional discussion), we would nevertheless expect the generic advantage in children’s memory to extend to kinds that are not quite so directly relevant to children’s self-concept.

To explore this prediction, in Experiment 2 we provided children with novel generic facts about two *natural kinds*, namely dogs and cats. We chose these kinds because most children have had

experience with their members as distinct individuals, which may help block unwanted kind generalizations in the Individual condition. Our prediction was that, despite this change in the stimuli, we would replicate the finding that children are better able to remember facts about entire categories. However, if immediate self-relevance was the sole reason why children had better memory for the generic facts in Experiment 1, then in Experiment 2 we should find no difference between children's memory for information about kinds and individuals.

3.1. Method

3.1.1. Participants

Sixty-four children participated in this study: half were 4 and 5 years old (16 boys and 16 girls; $M = 4.91$ years; $SD = 0.50$) and half were 6 and 7 years old (16 boys and 16 girls; $M = 7.03$ years; $SD = 0.53$). The participants were demographically similar to those in Experiment 1. None had participated in Experiment 1. One additional 4-year-old was tested but excluded from the sample because she did not want to take part in the recall phase.

3.1.2. Materials

We used eight new facts (see Table 3) and eight new color pictures of objects mentioned in these facts. Four of the facts were about preferences, and four were about habitual actions. As in Experiment 1, four were positive in valence (e.g., about what dogs/cats like and do), and four were negative in valence (e.g., about what dogs/cats do not like or do).

3.1.3. Procedure

The procedure was identical to that of Experiment 1, with one minor exception: To better set up the main part of the study, at the beginning of each session the experimenter told children they would hear “some things about dogs and cats” (Kind condition) or “some things about some dogs and cats in my neighborhood” (Individual condition).

A tally of the number of times children heard each fact in the study phase showed, again, that participants in the Kind and Individual conditions received equal exposure to the information to be remembered, $M_{Kind} = 4.05$ vs. $M_{Individual} = 4.06$ repetitions per fact, Mann–Whitney $Z = 0.04$, $p = .949$.

3.1.4. Coding

The coding scheme was identical to that used in Experiment 1, except instead of coding whether children remembered the correct gender associated with each fact, we coded whether they remembered the correct *animal*. Inter-coder agreement for children's repetition and recall responses was high, with kappas ranging from .78 to .97 across the six categories.

Table 3

The items used in Experiment 2.

Kind condition ^a	Individual condition ^b
They like to chase an <u>animal</u> called dax	She likes to chase an <u>animal</u> called dax
They like to smell a <u>flower</u> called pim	He likes to smell a <u>flower</u> called pim
They don't like to sit under a <u>tree</u> called mod	She doesn't like to sit under a <u>tree</u> called mod
They don't like the sound of a <u>machine</u> called zid	He doesn't like the sound of a <u>machine</u> called zid
They catch a <u>bug</u> called fep	He catches a <u>bug</u> called fep
They bury their food under a <u>bush</u> called neem	He buries his food under a <u>bush</u> called neem
They don't eat a <u>treat</u> called voom	She doesn't eat a <u>treat</u> called voom
They don't sleep on a <u>grass</u> called wug	She doesn't sleep on a <u>grass</u> called wug

Note: The underlined words refer to the objects depicted in the photographs we used as retrieval cues.

^a The facts in the Kind condition were prefaced with, “I wanna tell you something interesting about cats/dogs”.

^b The facts in the Individual condition were prefaced with, “I wanna tell you something interesting about a [different] cat/dog”. (The modifier “different” was used after the first two trials.)

3.2. Results and discussion

Our prediction was that children's recall would be more accurate in the Kind than in the Individual condition. To test this prediction, we performed an OLR with Condition, Age Group, and Gender (along with their interactions) as predictors, and with children's repetition scores as a covariate.

The results were almost identical to those of Experiment 1: In line with our hypothesis, children were significantly more accurate in their recall for information about kinds ($M = .72$) than for information about individuals ($M = .61$), Wald $\chi^2 = 4.71$, $df = 1$, $p = .030$, $d = 0.68$ (see Fig. 1B).⁵ As before, the magnitude of this generic advantage was not significantly different across the younger ($M_{Kind} = .67$ vs. $M_{Individual} = .54$) and the older ($M_{Kind} = .76$ vs. $M_{Individual} = .69$) age groups, Wald $\chi^2 = 0.10$, $df = 1$, $p = .749$. The only other significant effect was that of Age Group, Wald $\chi^2 = 6.65$, $df = 1$, $p = .010$, $d = 0.79$, with older children ($M = .72$) recalling significantly more than younger children ($M = .60$).

3.2.1. Results by coding category

Fig. 2B illustrates the results broken down by coding category. As in Experiment 1, recall in the Kind condition was superior to recall in the Individual condition across all six categories (binomial $p = .016$). Also similar to Experiment 1 was the low prevalence of bare plurals in the recall of children in the Individual condition (3.1%, which accounted for only 19.0% of all Generic/Specific errors in this condition); these data indicate that in this experiment as well children were unlikely to draw broader inferences from the individual-level information.

3.2.2. Conclusion

In this study, children were better able to remember facts about natural kinds (dogs, cats) than facts about individuals belonging to those kinds. Thus, kind information is privileged in children's memory even when it is not directly self-relevant.

4. Experiment 3

Earlier we speculated that, in contexts where an adult provides information about a series of individual animals from different categories, children may actually construe these individuals as representatives of their categories. As a result, children may conclude that the facts they heard are broadly applicable within the categories to which those animals belong. In Experiment 3, we provided a formal test of these ideas by using eight kinds (e.g., lions, pigs, crabs) instead of two, such that children in the Individual condition heard one fact about one member of each of these eight kinds. Our prediction was that these changes should result in a null effect of the Kind vs. Individual manipulation.

An additional goal of this study was to provide a control for the first two. If simply changing the items as described above—while leaving everything else about the method intact—eliminates the difference between the Kind and the Individual conditions, then the generic advantage identified in Experiments 1 and 2 cannot be an artifact of some unanticipated problem with our task. In other words, a null effect would speak against the possibility that the procedure itself (e.g., asking children to repeat the facts, allowing variability in the number of exposures to each fact) was somehow biased in favor of the Kind condition, since such a bias should operate regardless of whether the items are about two kinds or eight.

4.1. Method

4.1.1. Participants

Sixty-four children participated in this study: half were 4 and 5 years old (16 boys and 16 girls; $M = 5.09$ years; $SD = 0.62$) and half were 6 and 7 years old (16 boys and 16 girls; $M = 7.04$ years;

⁵ As in Experiment 1, this key result was significant regardless of how the data were analyzed (with or without the repetition covariate; with an OLR or an ANOVA).

$SD = 0.55$). The participants were demographically similar to those in Experiments 1 and 2. None had participated in these prior studies.

4.1.2. Materials

We used eight novel facts, each of which was about a different kind (Kind condition) or about a member of a different kind (Individual condition; see Table 4). Aside from the one-fact-per-category aspect, the items were quite similar to those used in Experiment 2: Half were about preferences, and half about habitual activities. Also, half of them were positive in valence, and half were negative.

One additional change to the items was that we no longer included novel words in them (see Table 4). We were concerned that, if we left the novel words in, the amount of information to be remembered may just be overwhelming for the younger children, since they would have to remember eight different categories as well. A null effect due to floor performance would not be informative, so we dropped the novel words. Also, since children's memory for the novel words showed the weakest Kind vs. Individual differences in the first two studies, eliminating them should make it less likely that we would find the predicted null effect.

4.1.3. Procedure

The three-part procedure was identical to that of Experiments 1 and 2. As in the first two studies, children received equal exposure to the facts to be remembered, $M_{Kind} = 4.15$ vs. $M_{Individual} = 4.08$ repetitions during the study phase, Mann–Whitney $Z = 0.92$, $p = .365$.

4.1.4. Coding

The coding scheme was identical to that in Experiment 2, with two exceptions. First, because we omitted the novel words, there were only five coding categories instead of six. Second, partial credit was now allowed for the Animal coding category. Children received a score of 0.5 whenever they remembered a fact as being about an animal that was similar, but not identical, to that in the original fact (e.g., a tiger instead of a lion). Inter-coder reliability for children's repetition and recall responses was again high, with kappas ranging from .79 to .97 across the five coding categories.

4.2. Results and discussion

We predicted that we would find no memory advantage for generic facts in this experiment because the one-fact-per-category structure of the items may lead children in the Individual condition to assume that the information they hear is broadly generalizable as well.

An OLR with Condition, Age Group, and Gender (along with their interactions) as predictors, and with children's repetition scores as a covariate,⁶ confirmed this prediction. The average recall scores for information in the Kind ($M = .80$) and in the Individual ($M = .79$) conditions were almost identical, Wald $\chi^2 = 2.14$, $df = 1$, $p = .143$, $d = 0.03$ (see Fig. 1C). Neither the younger nor the older children showed a generic advantage (younger: $M_{Kind} = .72$ vs. $M_{Individual} = .72$; older: $M_{Kind} = .87$ vs. $M_{Individual} = .86$); accordingly, the Condition \times Age Group interaction was not significant, Wald $\chi^2 = 1.28$, $df = 1$, $p = .257$.

As in the first two studies, 6- and 7-year-olds' recall ($M = .86$) was better than 4- and 5-year-olds' ($M = .72$), Wald $\chi^2 = 5.62$, $df = 1$, $p = .018$, $d = 0.76$.

4.2.1. Results by coding category

We hypothesized that children in the Individual condition would often be led by the modified structure of our task to generalize the information to which they are exposed. As a result, there should be little difference in how much children retain of this generalized information compared to

⁶ Four children's repetition scores were missing because videotapes of their sessions were not available ($n = 3$) or because their voices were not audible on tape ($n = 1$). (These children's recall scores were not missing, however, because recall responses were always written down during the session.) These missing repetition scores were replaced with values imputed, or predicted, on the basis of children's age, gender, condition, and recall score. Note that the results remained the same if the four children with missing scores were excluded from the analysis, or if the analysis was performed without the repetition covariate on all 64 children's recall data.

Table 4

The items used in Experiment 3.

Animal	Kind condition ^a	Individual condition ^b
Lion	They really like to sleep on this kind of <u>grass</u>	She really likes to sleep on this kind of <u>grass</u>
Pig	They really like to smell this kind of <u>flower</u>	He really likes to smell this kind of <u>flower</u>
Horse	They don't like to eat this kind of <u>vegetable</u>	He doesn't like to eat this kind of <u>vegetable</u>
Cow	They don't like to sit under this kind of <u>tree</u>	She doesn't like to sit under this kind of <u>tree</u>
Rabbit	They chew on this kind of <u>bark</u> to sharpen their teeth	He chews on this kind of <u>bark</u> to sharpen his teeth
Snake	They build their nests behind this kind of <u>bush</u>	She builds her nest behind this kind of <u>bush</u>
Crab	They don't lay their eggs under this kind of <u>rock</u>	She doesn't lay her eggs under this kind of <u>rock</u>
Squirrel	They don't bury their food under this kind of <u>root</u>	He doesn't bury his food under this kind of <u>root</u>

Note: The underlined words refer to the objects depicted in the photographs we used as retrieval cues.

^a The facts in the Kind condition were prefaced with, "I wanna tell you something interesting about lions/pigs/etc."

^b The facts in the Individual condition were prefaced with, "I wanna tell you something interesting about a lion/pig/etc."

information that was heard in generic format in the first place. The results by coding category (see Fig. 2C) were compatible with this prediction. The means for the Kind and Individual conditions were closely matched across the board, with only one coding category showing an advantage for the Kind condition. The stark contrast with Experiments 1 and 2 (for which all six categories showed a generic advantage), provides further evidence that, in this modified task, children's recall for facts learned in the Kind and the Individual conditions was equivalent.

Interestingly, the only coding category for which there was a hint of a difference between the Kind ($M = .91$) and the Individual ($M = .80$) conditions was Generic/Specific. This aspect of the data is also consistent with our argument: If children in the Individual condition generalize the information provided to them, we would in fact expect them to occasionally misremember these facts as generic, which would lead to lower scores on the Generic/Specific dimension. Although children in the Individual conditions of Experiments 1 and 2 also scored lower on this dimension, they did so mostly because they did not produce a codable subject noun phrase or because they forgot the whole fact (errors of omission). In contrast, the Kind vs. Individual difference in Experiment 3 should be driven to a greater extent by children's mistaken recall of individual-level facts as generic (errors of commission). In line with this argument, bare plural errors (e.g., recalling "Lions like to sleep on this grass" when the original fact had been about a particular lion) accounted for a full 50.0% of the Generic/Specific errors in the Individual condition of Experiment 3, as compared to only 1.2% and 19.0% of the analogous errors in Experiments 1 and 2, respectively.⁷ Although children's specific-to-generic errors provide only a rough measure of their actual interpretation, this informal comparison nevertheless supports the idea that children were more likely to generalize the individual-level information in Experiment 3 than in the other two.

However, if the hypothesized generalizations were so common, why were there so few Generic/Specific errors overall? Why were children in the Individual condition able to accurately produce specific utterances 80% of the time (see Fig. 2C)? There are several factors that may have converged to facilitate good performance on this dimension. For instance, our design was between subjects, such that children in the Individual condition only heard facts about individuals. Thus, if children noticed this rather obvious pattern and remembered it, they would have had all the information they needed to perform perfectly on the Generic/Specific dimension during the recall phase. (None of the other coding dimensions were amenable to such strategies.) Moreover, as long as children could still access what was actually said during the study phase (which is a definite possibility; Reyna & Kiernan, 1994), our retrieval cues (i.e., the pictures) may have promoted verbatim recall because they matched the surface aspects of the original experience at encoding (Brainerd & Reyna, 2004). The memory prompt

⁷ By comparison, the percentage of errors of commission in the Kind condition (e.g., recalling "Him no eat lemonade" when the original fact had been about boys) was equally low across experiments: 5.6%, 5.3%, and 4.5% of all Generic/Specific errors in Experiments 1, 2, and 3, respectively.

itself may have done the same, in that children were asked to recall “what we said” rather than, e.g., “what you learned.” Finally, children heard and produced the same types of noun phrases (e.g., “a lion/crab/etc.,” “he/she”) several times for each of the eight items in the study phase. The repeated activation of these linguistic structures may have increased the probability of their use in the subsequent recall phase (for reviews, see Branigan, 2007; Pickering & Ferreira, 2008), adding to children’s ability to produce sentences in the correct generic/specific format.

4.2.2. Comparing the Individual conditions in Experiment 3 vs. Experiments 1 and 2

If children in the present experiment were particularly likely to assume that the individual-level information generalizes to kinds, then one might also expect their recall to be more accurate than that of children in the Individual conditions of the first two experiments. Although such comparisons should be treated with caution because the three studies varied on a number of dimensions other than property generalizability (e.g., there were more category names to remember in Experiment 3 than in Experiments 1 and 2), our data were in fact consistent with this possibility. For purposes of this comparison, we averaged children’s recall scores across all coding categories except Novel Word, which is not applicable to Experiment 3, and Generic/Specific, on which we do not expect Experiment 3 to be different from the others (as discussed above). These average scores were submitted to an OLR with Experiment 3 vs. Experiments 1 and 2 as a dichotomous between-subjects factor; Age Group and Gender were also factors, and the repetition score was a covariate. As expected, recall in the Individual condition was better in Experiment 3 ($M = .79$) than in Experiments 1 and 2 ($M = .65$), Wald $\chi^2 = 3.22$, $df = 1$, $p = .073$, $d = 0.52$.

As a side note, the combination between this difference and the absence of a parallel difference for the Kind condition ($M_{\text{Expt. 3}} = .77$ vs. $M_{\text{Expts. 1 and 2}} = .82$; Wald $\chi^2 = 0.002$, $df = 1$, $p = .963$, $d = 0.25$) rules out another potential alternative explanation for the generic memory advantage in Experiments 1 and 2. In those studies, children in the Individual condition had to remember eight facts about eight entities (four boys and four girls; four dogs and four cats), whereas children in the Kind condition had to remember eight facts about only two entities (the kinds *boy* and *girl*; the kinds *dog* and *cat*). Although we previously argued that this difference should have made the facts in the Individual condition more distinctive (and thus more memorable), it is also possible that it increased the memory load in this condition, leading to poorer recall. The present cross-experiment comparisons render this claim implausible: (1) the Kind condition of Experiment 3 (where there were eight kinds) was no different in accuracy from the Kind conditions of the first two studies (where there were only two kinds), and yet (2) the Individual condition of Experiment 3 was more accurate than the Individual conditions of the first two studies, even though the facts in all of these conditions were about eight individuals. Thus, it appears that recall in this paradigm is independent of the number of entities involved; rather, the main factor driving children’s memory is whether the facts are (or can be assumed to be) about a kind vs. an individual.

4.2.3. Conclusion

When information about individuals was presented in a way that allowed children to infer it generalizes more broadly, the clear generic advantage seen in the first two studies disappeared. The findings of Experiment 3 also suggest that there is no inherent bias in our procedure that favors the Kind condition: Simply changing the items to a one-fact-per-category structure led to a predicted null effect. More generally, the results of this study may also speak to children’s eagerness to learn about kinds: Even in a context in which the experimenter explicitly talked about individuals, children seemed motivated to trace the implications of this information for the relevant *kinds*. There was no evidence of a converse tendency to particularize information about kinds.

5. General discussion

Much work in cognitive development points to the conclusion that reasoning about kinds comes naturally to our species. First, children make the substantive assumption that the unique objects that comprise their world are also instantiations, or tokens, of abstract types; in other words, children

understand that objects that are spatiotemporally and perceptually distinct can nevertheless be *the same* at a deeper level due to their shared membership in a kind. Thus, kind membership is a non-obvious dimension that structures children's reasoning about the world from an early age. Second, children display a precocious ability to gather and process information about kinds, thanks in large part to powerful cognitive biases that guide children's generalizations from first-hand evidence and that sensitize them to the social cues signaling the transmission of generic knowledge. In this paper, we provide a new type of evidence in support of the claim that humans are predisposed to learn about kinds: Children remember kind-wide information better than information that is about particular individuals but is otherwise identical in content. To our knowledge, this is the first demonstration of this important phenomenon.

Arguably, the memory advantage documented here is somewhat counterintuitive: Facts about kinds (which are unbounded sets comprising the tokens of an abstract type) are formally more complex than facts about a single individual,⁸ and yet children's memory for the kind-level facts was better than their memory for the simpler individual-level facts. This paradoxical yet predicted cognitive strength seems particularly revealing of children's hypothesized predisposition to learn about kinds—at least to the extent that confirming a counterintuitive prediction is particularly revealing about the hypothesis that motivated it.

The present results also demonstrate that the probability that children will remember a piece of information depends on their nuanced, context-sensitive *interpretation* of this information rather than being dictated by its surface form (i.e., by whether it is explicitly about an individual or about a kind). For example, certain contexts may lead children to infer that information that is explicitly about an individual can implicitly be assumed to characterize the category to which the individual belongs (see Experiment 3). The memory system then operates on this broader interpretation, treating the original information as if it were generic. This conclusion is consistent with a number of recent studies suggesting that (1) facts initially provided in non-generic format are often implicitly converted to generic format in certain contexts (e.g., when they are quantified with *most* or *all*; when they denote deep rather than superficial properties), and (2) it is the resulting generic beliefs that are used in subsequent reasoning (e.g., Cimpian & Erickson, 2011; Leslie & Gelman, 2011; Leslie et al., 2011; Meyer, Gelman, & Stilwell, 2011; Rhodes & Gelman, 2008).⁹ Note that these conversions are almost always unidirectional, from specific to generic. This striking asymmetry, which is seen in adults and children alike, constitutes additional evidence for the claim that kinds are central to human reasoning.

5.1. Implications for the perceptual vs. conceptual debate

By demonstrating that kinds are privileged in children's memory, this research advances an ongoing debate about the nature of the mental representations that underlie cognitive development (e.g., Booth & Waxman, 2002; Cimpian & Markman, 2005; Markson, Diesendruck, & Bloom, 2008; Rakison & Lupyan, 2008; Sloutsky, 2010; Smith & Samuelson, 2006; Waxman & Gelman, 2009).

5.1.1. "Perceptual beginnings" views

On some accounts, the early stages of human cognition are concrete and perceptual (e.g., Colunga & Smith, 2005; Madole & Oakes, 1999; Rakison & Lupyan, 2008; Sloutsky, 2010). Much of young children's thinking is assumed to consist of general-purpose computations (e.g., co-occurrence tracking, similarity detection, memory storage and retrieval) performed over the perceptual characteristics of specific objects (e.g., shape, texture, solidity) and of the contexts in which these objects are embedded (e.g., the words spoken at the time when the objects are perceived). Gradually, this initial set of item-specific, perceptually-based representations is transformed—exclusively via the operation

⁸ To clarify, our claim here is simply that kind-level facts may be more complex than individual-level facts from an information-theory standpoint. However, kind-level facts may not necessarily be more complex from a *cognitive* standpoint. On our account, human minds are structured such that kind reasoning is relatively effortless.

⁹ Extrapolating from these results, it is possible that information introduced via broad-scope quantified statements (e.g., "Most/All girls like a fruit called *mod*") would also be remembered better than information about individuals because these broad-scope statements may lead to kind generalizations.

of domain-general learning mechanisms—into the rich conceptual frameworks that guide the reasoning of adult humans (e.g., Murphy, 2004).

Consistent with this view, recent evidence has shown that even modest amounts of input are sufficient for children to derive abstract, rule-like expectations about their environments, such as that solid objects that co-occur with the same name tend to be similar in shape¹⁰ (e.g., Colunga & Smith, 2005; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002). However, despite these signs of early abstraction, children's mental representations are hypothesized to remain relatively concrete until late in development. According to Sloutsky, Fisher, and their colleagues, for example, the transition from item-specific to kind-based representations in children's thinking is only finalized after the age of 7, perhaps when children “learn at school . . . that there are kinds that consist of similar entities” (Fisher & Sloutsky, 2005, p. 594). It is not until this late age that children fully become able to view the objects around them as instantiations of abstract types and, as a result, to conceive of these objects via kind-based representations.

We now describe the evidence for this striking claim, which stands in direct contrast with the claims we made in the present paper; we will return to this conflict in Section 5.1.3 below. Briefly, Sloutsky and Fisher (2004a,b; Fisher & Sloutsky, 2005) asked their participants (adults and children aged 5, 7, and 11) to perform an inductive inference task in which they had to decide whether a non-obvious property of a particular cat (having *beta* cells inside its body) applied to other animals as well (individual cats, birds, and bears). Participants were then administered a surprise memory test assessing their ability to recognize the individual animals from the induction task. Remarkably, 5- and 7-year-olds had better recognition memory for these individuals than the adults did, despite similar responses on the induction task. Sloutsky and Fisher interpreted this result as suggesting that the 5- and 7-year-olds had performed the inductive inference task on the basis of perceptual similarity (e.g., similar-looking things have beta cells) rather than kind membership (e.g., cats have beta cells). The focus on perceptual similarity led children to attend closely to the appearance of the pictures and ultimately resulted in superior performance on the surprise recognition test. These studies were used to buttress the claim that young children's thinking does not spontaneously invoke kind representations, as well as the broader argument that children are concrete and perceptual thinkers until well into the school years.

5.1.2. “Conceptual beginnings” views

An alternative to the argument above is that an important subset of abstract concepts do not emerge out of experience but rather are inherent features of the human mind. These conceptual structures guide learning from its earliest stages by directing children's attention to certain information and by making available certain interpretations of their sensory experiences (e.g., Baillargeon, 2004; Carey, 2009; Csibra & Gergely, 2009; Gelman, 1990; Spelke & Kinzler, 2007). To take one example, there is considerable evidence that infants' reasoning about the physical world is guided by a set of skeletal assumptions regarding the nature of objects (e.g., that objects persist even when hidden from sight; that objects cannot pass through one another; e.g., Baillargeon, 1987; Spelke, Breinlinger, Macomber, & Jacobson, 1992). These early-emerging assumptions are *abstract*, in the sense that they can be deployed to interpret any event rather than being tied to specific objects or contexts, and they are also *conceptual*, at least insofar as their output cannot be derived from the appearance of the objects involved (e.g., nothing about the appearance of an object is directly informative about its behavior when hidden from sight). Similar arguments have been proposed to account for children's reasoning about space, number, and psychological agents (for a brief review, see Spelke & Kinzler, 2007), as well as famously for how they acquire syntax (e.g., Chomsky, 1959).

The present proposal is compatible with this “conceptual beginnings” argument, in that we attribute to children a *predisposition* to think and learn about kinds—a feature of their mental apparatus that may not be the result of experience or instruction. The evidence reviewed in the Introduction

¹⁰ Researchers who endorse the view that children's early thinking is abstract and conceptual take these results to suggest that children expect objects that have the same label to belong to the same kind; on this alternative view, shape similarity is only a proxy for kind membership (e.g., Booth, Waxman, & Huang, 2005; Booth & Waxman, 2002; Cimpian & Markman, 2005; Markson et al., 2008; Waxman & Markow, 1995).

suggests that even young children think and talk as if they believed that there exist such things as kinds, although none of them could possibly have seen, or otherwise perceived, a kind. Moreover, although the formal conditions under which it is legitimate to say that a property is true of a kind have puzzled generations of linguists and philosophers, 3-year-olds seem to have no trouble drawing these inferences—in stark contrast to the apparent ineptitude children display when it comes to generalizations that are formally trivial, such as those expressed by the universal quantifier “all” (e.g., [Hollander et al., 2002](#)). To us, such unlikely peaks in children’s cognitive profile are suggestive of preexisting mental structures that facilitate kind-based reasoning, structures that we collectively described as a “predisposition.”

5.1.3. *Relating the present results to the perceptual vs. conceptual debate*

By providing evidence for a predisposition to think and learn about kinds, the present findings also provide evidence for the general argument that children’s thinking is abstract and conceptual from early on. This conclusion aligns well not only with the research described in the Introduction but also with a number of other findings—particularly from the literature on word learning and inductive inference—that highlight children’s early propensity to reason about the world in terms of kinds (e.g., [Booth & Waxman, 2002](#); [Diesendruck & Bloom, 2003](#); [Gelman & Markman, 1986](#); [Graham & Diesendruck, 2010](#); [Graham et al., 2004](#); [Jaswal, 2004](#); [Mandler & McDonough, 1996](#)).

On the other hand, these findings are broadly inconsistent with “perceptual beginnings” theories about the development of children’s concepts, and in particular with the subclass of these theories according to which the transition from item- to kind-based representations occurs after the age of 7 as a result of explicit instruction in school (e.g., [Fisher & Sloutsky, 2005](#)). If children younger than 7 habitually encode their experiences in terms of the individual entities involved, without invoking kinds, there is little reason to expect that they will remember information about kinds better than information about individuals, which is at children’s preferred level of representation on this view.

However, if our proposal is correct and children do invoke kind-based representations much earlier in development than predicted by these theories, then it is unclear how to explain [Sloutsky and Fisher’s \(2004a,b; Fisher & Sloutsky, 2005\)](#) findings: Why did children as old as 5 and 7 seem to perform inductive inferences simply on the basis of the perceptual appearance of the stimuli (hence the superior recognition memory performance), without consideration of their kind membership? The answer may lie in a plausible alternative interpretation of [Sloutsky and Fisher’s](#) data. It may be that children did in fact rely on kind membership to make their inferences but took longer to answer (e.g., due to greater uncertainty or more inefficient task approaches), which would have given them *more exposure* to the pictures. Although [Sloutsky and Fisher](#) did not report how long children and adults spent on the inductive inference task, follow-up studies indicated that children are indeed slower ([Hayes, McKinnon, & Sweller, 2008](#); [Wilburn & Feeney, 2008](#)). Furthermore, these subsequent studies showed that, when children’s and adults’ exposure to the pictures is equated, the age differences in recognition memory disappear as well. In light of this alternative explanation, [Sloutsky and Fisher’s \(2004a,b; Fisher & Sloutsky, 2005\)](#) findings no longer present a challenge to the argument that young children spontaneously conceive of the world via kind-based representations.

5.2. *The source of the generic advantage in children’s memory*

What is the origin of the memory bias for generic information? As already mentioned in the Introduction, it is possible that this bias can be explained in terms of the interaction between basic memory processes and children’s early-emerging propensity to think about kinds. We discuss several possibilities next.

5.2.1. *Generic facts are better remembered because they are considered more important*

First, memory is influenced by the extent to which the information to be remembered is considered important and of value, or by the extent to which people are otherwise motivated to acquire this information (e.g., [Castel, Benjamin, Craik, & Watkins, 2002](#); [Heyer & O’Kelly, 1949](#); [Weiner & Walker, 1966](#); for reviews, see [Benjamin, 2008](#); [Weiner, 1966](#)). With respect to our argument, there is considerable evidence that children treat the information learned from statements about kinds as being more

important than the information learned from statements about individuals (e.g., Cimpian & Cadena, 2010; Cimpian & Markman, 2009, 2011; Gelman, Raman, & Gentner, 2009; Hollander, Gelman, & Raman, 2009). For example, when exposed to a novel generic fact (e.g., that dolphins have a lot of fat under their skin), preschool-age children often infer that the relevant property must be present in order to enable some survival-relevant biological functions (e.g., the fat helps them swim; Cimpian & Markman, 2009). In contrast, when told that a particular individual displays the same property, children are more likely to see it as an inconsequential, accidental feature (e.g., the dolphin overate). It is possible that these differences in the presumed importance of facts about kinds vs. individuals would lead to differential motivations to retain these facts, which would provide an explanation for the generic advantage found in our results.

In light of these considerations, we should reiterate that our claim of a generic advantage in children's memory is a qualified one. We do not dispute that there are many circumstances in which information about individuals would also be considered important, perhaps especially when the individuals in question are prominent in children's lives (e.g., their parents). In turn, the importance assigned to such personally-relevant information would boost children's motivation to retain it and thus their memory for it. One could also make the opposite argument with respect to some generic facts: Perhaps information about kinds that are *not* relevant to children's lives (e.g., prehistoric life forms) would not be considered important and would therefore not be remembered well. This prediction, however, is contradicted by our results. As illustrated in Figs. 2A and C, children's memory for information about crabs, lions, and other such animals was roughly equivalent to their memory for information about boys and girls, despite the fact that knowing about boys and girls is undoubtedly more personally relevant to children this age than knowing about crabs and lions. This result is incompatible with the argument that children's memory for facts about kinds is influenced by the relevance of these kinds to children's lives (though the possibility remains that their memory for facts *about individuals* is sensitive to this dimension). Therefore, it seems doubtful that self-relevance is responsible for the generic memory advantage under investigation here. More likely, children's superior memory for generic facts may be due to their tendency to view these facts as important in the deeper, more abstract sense that they contain clues about how the world works.

5.2.2. *Generic facts are better remembered because they are processed more deeply*

Memory is also influenced by the quality of one's engagement with the material to be remembered (Craig & Lockhart, 1972; Craik & Tulving, 1975). "Deeper" processing of a piece of information (e.g., connecting it to other known facts, explaining it to oneself) leads to superior memory for it. Relevant to this phenomenon, some recent work suggests that the regularities expressed by kind-referring generic statements are particularly likely to spark children's curiosity, perhaps leading them to search for explanations and, as a result, to encode these facts at a relatively deep level (Cimpian & Petro, 2011). In these studies, 4- and 5-year-olds were first told that they would be playing with a special box meant to hold things that made them wonder, "Why is that?" Next, children were provided with pairs of novel facts—one about an individual animal (e.g., "*This one cheeba* never eats apples") and one about an entire category (e.g., "*Sapers* really like the color yellow")—and asked to choose one fact from each of these pairs to put into the "why box." In other words, children had to decide which of the two facts made them more curious. Children chose the category-wide regularities more often than expected by chance, suggesting that these types of facts may indeed trigger a search for explanations, which would lead to deeper encoding and may thus provide another explanation for the generic advantage in children's memory.

5.2.3. *Generic facts are better remembered because they are added to a richer base of prior knowledge*

Finally, memory for a fact is influenced by the amount of prior knowledge relevant to it (e.g., Chi, 1978; Chi & Koeske, 1983; for reviews, see Bjorklund, 1987; Ornstein & Naus, 1985). The richer the knowledge base to which a new fact is added, the more connections can be established between the new information and facts already stored in semantic memory; this tighter integration typically leads to more reliable storage and easier access for subsequent retrieval. When children learn new generic facts, they often possess some prior knowledge about the relevant kinds. For example, if told that dogs catch a bug called *fep*, children might relate this fact to their knowledge of other creatures

that dogs (attempt to) catch: cats, squirrels, rabbits, etc. Typically, less is known about *individuals* from a kind. Even in the case of very familiar kinds, one cannot know with certainty whether any particular member will display the usual array of category-typical features (e.g., does Sparky actually like to chase cats?). Sparser relevant knowledge could in turn lead to poorer retention of new information. Thus, children's superior memory for facts about kinds may also be explained by differences in their prior knowledge about kinds vs. individuals.

This argument leads to the following prediction: If greater prior knowledge is responsible for the generic memory advantage, then children's memory for information about kinds should correlate with the familiarity of these kinds—the more familiar a kind is (and thus the more prior knowledge one has about it), the better one's memory for information about it should be. Our present results, however, do not support this prediction. Facts about boys and girls (Experiment 1) were not remembered any better than facts about kinds with which children are arguably much less familiar (e.g., crabs, pigs; Experiment 3). This pattern speaks against the possibility that differences in the amount of prior knowledge were responsible for the differences we observed in children's memory for kinds and individuals, suggesting that perhaps the two other mechanisms outlined above play a more central role in the emergence of this phenomenon.

To conclude, these speculations illustrate some of the possible ways in which an early-developing attention to kind-relevant information could interact with well-known memory mechanisms to result in a bias for this type of information.

5.3. Conclusions

The present studies suggest that information about kinds is privileged in young children's memory. Given the power of kind generalizations to inform predictions, explanations, and behavior across a wide range of circumstances, it seems quite adaptive for the memory system to privilege this information. In fact, this bias towards generic information may be a critical ingredient in the process of constructing a mature conceptual system. Finally, by highlighting children's propensity to retain information about entire kinds, these findings contribute to our understanding of early cognition as conceptual and abstract rather than perceptual and concrete.

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