

# Children Show Heightened Knew-It-All-Along Errors When Learning New Facts About Kinds: Evidence for the Power of Kind Representations in Children's Thinking

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Several proposals in the literature on conceptual development converge on the claim that information about *kinds of things* in the world has a privileged status in children's cognition, insofar as it is acquired, manipulated, and stored with surprising ease. Our goal in the present studies ( $N = 440$ ) was to test a prediction of this claim. Specifically, if the early cognitive system privileges kind (or generic) information in the proposed ways, then learning new facts about kinds should be so seamless that it is often accompanied by an impression that *these facts were known all along*. To test this prediction, we presented 4- to 7-year-old children with novel kind-wide and individual-specific facts, and we then asked children whether they had prior knowledge of these facts. As predicted, children were under the impression that they had known the kind-wide facts more often than the individual-specific facts, even though in reality they had just learned both (Experiments 1, 2, 3, and 5). Importantly, learning facts about (nongeneric) plural sets of individuals was not similarly accompanied by heightened knew-it-all-along errors (Experiment 4), highlighting the privileged status of kind information per se. Finally, we found that young children were able to correctly recognize their previous ignorance of newly learned generic facts when this ignorance was made salient before the learning event (Experiment 6), suggesting that children's frequent knew-it-all-along impressions about such facts truly stem from metacognitive difficulties rather than being a methodological artifact. In sum, these 6 studies indicate that learning information about kinds is accompanied by heightened knew-it-all-along errors. More broadly, this evidence supports the view that early cognition privileges kind representations.

*Keywords:* conceptual development, kind representations, generic knowledge, metacognition

The ability to conceive of unique entities (e.g., Rover and Sparky) as equivalent tokens of the same abstract type or kind (e.g., dogs) makes human learning efficient and powerful (e.g., Gelman, 2003; Markman, 1989; Murphy, 2002; Smith & Medin, 1981). Reasoning about kinds, however, also poses significant computational challenges. For instance, our senses only have access to *tokens* of kinds—not the kinds themselves. As a result, one cannot learn about kinds by direct observation of the world (e.g., Gelman, 2004; Waxman, 1999). Instead, knowledge about kinds

must necessarily be derived through *inferences* that take observations made about particular tokens and generalize them to the kind as a whole. Further, because there is no fixed amount of evidence that suffices for a kind generalization, determining when it is appropriate to draw such an inference is far from straightforward. For instance, although the majority of books are paperbacks, the claim that books (as a kind) are paperbacks is false (e.g., Carlson, 1977; Leslie, 2008; see also Goodman, 1965). In contrast, although fewer than 1% of mosquitoes carry the West Nile virus, the claim that mosquitoes (as a kind) carry this virus is generally accepted.

Given the degree of complexity involved in kind-based reasoning, one might expect it to emerge relatively late in development. Although some have indeed argued for this possibility (e.g., Samuelson & Perone, 2010; Sloutsky, 2010), research has also uncovered surprising signs of early competence. For instance, even children who have just begun to produce multiword utterances are able to talk about kinds, and do so spontaneously (e.g., Gelman, Goetz, Sarnecka, & Flukes, 2008; Gelman, Taylor, & Nguyen, 2004; Pappas & Gelman, 1998). Moreover, children's ability to evaluate kind generalizations reaches adult-like levels by the age of 3, far outstripping their ability to process information about quantified sets (e.g., most dogs; Brandone, Cimpian, Leslie, & Gelman, 2012; Hollander, Gelman, & Star, 2002; Mannheim, Gelman, Escalante, Huayhua, & Puma, 2010; Tardif, Gelman, Fu, & Zhu, 2012). To consider another example, young children's memory for information about kinds is also particularly robust

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(Cimpian & Erickson, 2012; Leslie & Gelman, 2012; Riggs, Kailish, & Alibali, 2014), as is their motivation to acquire it (Cimpian & Park, 2014). Children's tendency to seek out generic knowledge (i.e., knowledge about kinds) suggests that they may attach special importance to it, a possibility that is also reflected in their expectation that this sort of knowledge is familiar to most of the people around them (Cimpian & Scott, 2012).

To explain these striking findings, several researchers have postulated the existence of special-purpose cognitive structures that privilege the acquisition of kind information, facilitate its processing, and ensure reliable memory storage (Cimpian & Erickson, 2012; Csibra & Gergely, 2009; Gelman, 2010; Leslie, 2008). Our goal in the present studies was to formulate and test a counterintuitive prediction of this proposal—namely, that learning information about kinds is so seamless and efficient that it often leads children to the false impression that they have always known this generic information. In other words, we predict that children should fail to notice that they have learned a new fact about a kind more frequently than they fail to notice that they have learned a new fact about a nonkind (e.g., an individual). Evidence that children make this predicted *knew-it-all-along* error would provide strong support for the idea that representations of kinds have a powerful influence on, and are privileged in, young children's thinking.

### Why Would Learning Generic Facts Lead to More Knew-It-All-Along Errors?

To begin, we should clarify that "I've always known it"-type errors are not as rare as they may at first seem. After learning a new fact, it is not uncommon for people (and children in particular) to have trouble recalling exactly what they used to think *before* they learned the fact, which then makes it difficult to distinguish new knowledge from old (e.g., Begg, Robertson, Gruppuso, Anas, & Needham, 1996; Birch & Bernstein, 2007; Fischhoff, 1975, 1977; Gopnik & Astington, 1988; Hawkins & Hastie, 1990; Hoch & Loewenstein, 1989; Pohl, Bayen, & Martin, 2010; Taylor, Esbensen, & Bennett, 1994; Wood, 1978). This phenomenon is known as the *knew-it-all-along effect* or the *hindsight bias*, and it is typically explained as a benign side effect of normal, adaptive learning processes: As new information is assimilated into one's existing knowledge, the information that used to be in its place becomes more difficult to access, as does one's prior state of ignorance regarding the new information. As a result, one may occasionally come under the impression that the new fact was known all along (e.g., Begg et al., 1996; Fischhoff, 1975, 1977; Hawkins & Hastie, 1990; Pohl et al., 2010).

Importantly, the likelihood of knew-it-all-along impressions depends on the characteristics of the information being learned. Most relevant to our purposes here, research has suggested that new information that is easy to process and understand (e.g., Hoch & Loewenstein, 1989), easy to remember (e.g., Hell, Gigerenzer, Gaugel, Mall, & Müller, 1988), and consequential (e.g., Walster, 1967) is also particularly likely to be accompanied by knew-it-all-along errors. As may already be apparent, these are precisely the characteristics that information about kinds should possess if kind representations were privileged in children's thinking. If, as claimed by proponents of this view, generic information is easy for children to process and remember (e.g., Cimpian & Erickson, 2012; Hollander et al., 2002) and is viewed as important to know

(Cimpian & Park, 2014), then such information may be integrated into children's existing knowledge particularly efficiently. This seamless integration might then make the newly acquired generic knowledge difficult to distinguish from previous knowledge. As a result, children may be particularly likely to think that they have always known generic information that they just learned, displaying what we call a *generic knew-it-all-along effect*.

Also relevant to this prediction is another claim made by proponents of the view that kinds are privileged: Namely, the claim that children believe generic information to be widely known (Cimpian & Scott, 2012). This claim is relevant because general beliefs are often used to fill in or reconstruct memories that cannot be retrieved from the available traces (e.g., Bartlett, 1932; Bransford & Johnson, 1972; Loftus, 1975; Nisbett & Wilson, 1977). Thus, if children indeed believe that generic knowledge is the sort of knowledge that everyone possesses, and if they rely on this belief whenever they cannot retrieve their previous knowledge states, then they may end up mistakenly judging that they have always possessed the generic knowledge that they in fact just acquired.

In summary, the proposal that kind representations are privileged in young children's thinking leads to the prediction that newly learned facts about kinds should be accompanied by knew-it-all-along impressions more often than similar nongeneric facts.

### Evidence From Prior Research

Indirect evidence for a generic knew-it-all-along effect can be found in some of the studies that documented children's difficulties in identifying the sources of their knowledge (Esbensen, Taylor, & Stoess, 1997; Taylor et al., 1994). In these studies, 4- and 5-year-olds were provided with a series of new facts and then asked to remember how and when they had learned them; notably, many of these facts were *about kinds*. Roughly 60% to 70% of the children who learned such facts, both about familiar kinds (e.g., tigers) and about unfamiliar kinds (e.g., grambees), were later under the impression that they had known these facts all along. Also consistent with the present prediction, one of the few circumstances in which children were clearly able to avoid this error involved learning the name of an individual puppet (Barnaby Bear)—an item that was included in Experiment 4 of Taylor, Esbensen, and Bennett (1994) in order to control for the possibility that children simply didn't understand the task. Only 25% of the children thought they had previously known this individual-specific information (i.e., the puppet's name).

Thus, children's responses across existing studies provide hints of support for the novel prediction that facts about kinds are particularly likely to be accompanied by knew-it-all-along impressions. Nevertheless, the conclusions that can be drawn from Taylor and colleagues' (1994) data are limited because their stimuli were not designed, and are insufficient, to test for a generic knew-it-all-along effect. One important issue is that the generic information about the features of animals and the specific information about the name of a puppet differ in more than just whether they are about a kind. Such extraneous differences in content introduce the possibility of confounds. For instance, as Taylor et al. (1994) themselves point out, it is possible that many children realized they had just learned Barnaby's name simply because the social script for meeting new people highlights the act of *learning* new names (for evidence on the facilitative effect of scripts on children's

autobiographical memory, see Brubacher, Roberts, & Powell, 2012). In the present research, we eliminated such extraneous differences in content, thereby enabling a clean test of whether generic facts induce more knew-it-all-along impressions.

### Overview of the Experiments

The experiments reported here used novel facts that could alternate between generic and specific format (see Tables 1 and 6 for stimuli). By presenting each fact as generic to half of the children and as specific to the other half, we were able to ensure that, across participants, the content of the generic and specific facts was perfectly matched.

The experimental strategy was straightforward: We provided children with a series of facts and asked them, after introducing each fact, whether they had prior knowledge of it. Consistent with the view that kinds are privileged in children's thinking, the results uncovered a generic knew-it-all-along effect: Children were significantly more likely to believe that they had already known the generic (vs. the specific) facts, even though they had just learned them. This effect emerged across a number of experimental manipulations and with categories from a variety of domains (e.g., animal species, human groups, artifact categories; Experiments 1, 2, 3, and 5). Further, this effect was robust against controls for a number of alternative explanations (see Table 2). Importantly, we found that heightened knew-it-all-along impressions did not accompany the learning of facts about nongeneric plural sets (Experiment 4), which suggests that such heightened impressions may be unique to facts about kinds. Finally, we found that these knew-it-all-along impressions disappeared in a context in which children's ignorance of a generic fact was highlighted before they actually learned it (Experiment 6), as would be expected if these impressions were truly indicative of metacognitive difficulties in realizing when generic information was learned. In sum, the six studies reported here provide evidence for a generic knew-it-all-along effect in children's learning and, more generally, for a privileged status for information about kinds in conceptual development.

### Experiment 1

#### Method

**Participants.** Forty-eight children participated ( $M = 5.96$  years,  $SD = 1.19$ , range = 4.01 to 7.80; 24 boys and 24 girls).

Table 1

*The Kind and Individual Novel Facts Used as Stimuli in Experiments 1–3*

Kind (Expts. 1–3)	Individual (Expts. 1 and 2)	Individual (Expt. 3)
Birds feed their babies <i>regurgitated</i> food.	Last night, this bird fed her babies <i>regurgitated</i> food.	This bird feeds her babies <i>regurgitated</i> food.
Chimps crack open <i>kernels</i> .	Last night, this chimp cracked open a <i>kernel</i> .	This chimp cracks open <i>kernels</i> .
Dogs get sick after eating <i>carbammates</i> .	Last night, this dog got sick after eating <i>carbammates</i> .	This dog gets sick after eating <i>carbammates</i> .
Hedgehogs eat <i>hexapods</i> .	Last night, this hedgehog ate a <i>hexapod</i> .	This hedgehog eats <i>hexapods</i> .
Opossums make their homes in <i>foliage</i> .	Last night, this opossum made his home in <i>foliage</i> .	This opossum makes his home in <i>foliage</i> .
Seals sleep on their <i>dorsal</i> side.	Last night, this seal slept on his <i>dorsal</i> side.	This seal sleeps on his <i>dorsal</i> side.
Snakes steal <i>embryos</i> from other animals.	Last night, this snake stole <i>embryos</i> from other animals.	This snake steals <i>embryos</i> from other animals.
Tigers catch lots of <i>ruminants</i> .	Last night, this tiger caught lots of <i>ruminants</i> .	This tiger catches lots of <i>ruminants</i> .

*Note.* The low-frequency words included in each fact are italicized. In Experiment 4, we compared facts about habitual characteristics of individuals (e.g., "This bird feeds her babies regurgitated food;" see the rightmost column above) with facts about habitual characteristics of sets of individuals (e.g., "Some birds feed their babies regurgitated food").

Across most of our studies, we included children ranging in age from 4 to 7; the wide age span enabled us to explore developmental trends in the hypothesized generic knew-it-all-along effect. Children were recruited from a small U.S. city and were socioeconomically diverse. Most were European American.

**Items.** We used eight novel facts (see Table 1 for full list; see also Cimpian & Scott, 2012), presented in one of three random orders. All facts contained a low-frequency word (e.g., "carbammates"), which was included to ensure that the information would be unfamiliar to children. A separate norming study ( $N = 22$ ) confirmed that children aged 4 to 7 do not know these words. Children said they knew what the words meant only 6.3% of the time; moreover, even when children claimed they knew a word, their open-ended definitions were far from correct.

Each of the eight facts had a generic form (e.g., "Dogs get sick after eating carbammates;" see Table 1) and a specific form, which described an event involving an individual (e.g., "Last night, this dog got sick after eating carbammates"). Only one of these forms was presented to a child; across children, however, each fact appeared equally often in its Kind and Individual forms. Each child heard four Kind facts and four Individual facts, separated into two blocks whose order was counterbalanced. The eight facts were presented in a book, each on a separate page. On each page, the fact was printed along the bottom and a single animal (e.g., a dog) was depicted above the fact. Pictures of a single animal accompanied both the Kind and the Individual facts.

**Procedure.** Children were tested individually in a quiet room. The experimenter went through the book with the children, reading each fact twice and then asking whether they had known this fact prior to hearing it from her (e.g., "Did you know about this before we read it just now? Did you know that dogs get sick after eating carbammates?").

Importantly, the procedure was also designed to make children feel comfortable admitting prior ignorance of the facts they learned from the experimenter. To achieve this goal, we structured the script so as to suggest that the experimenter herself was ignorant of the facts she was reading: If an *adult* doesn't know these facts, children should feel comfortable revealing their ignorance as well, as long as they are aware of it. This feature of the procedure is important not only because it lessens the overall pressure to claim knowledge (thereby allowing children to give truthful responses), but also because it lessens the plausibility of artifactual explanations for the predicted effect. One might argue, for example, that

**Table 2**  
*Summary of the Design and Results of Experiments 1–5*

	Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt. 5
Fact type 1	<b>kind</b> (bare plural NP)	<b>kind</b> (bare plural NP)	<b>kind</b> (bare plural NP)	<b>non-kind plural</b> (indefinite plural NP)	<b>kind</b> (indefinite singular NP)
Fact type 2	<b>individual</b> (event, demonstrative NP)	<b>individual</b> (event, demonstrative NP)	<b>individual</b> (habitual, demonstrative NP)	<b>individual</b> (habitual, demonstrative NP)	<b>individual</b> (event, indefinite singular NP)
Experimenter is said to be ignorant?	yes	yes	yes	yes	yes
Check for belief that experimenter is ignorant?	no	no	yes	yes	yes
Check for guessing of the low-frequency word?	no	yes	yes	yes	no
Facts presented in a book?	yes	yes	no	no	no
Familiar filler facts provided?	no	no	yes	yes	yes
Significant difference found in knew-it-all-along responses?	yes	yes	yes	no	yes

*Note.* NP = noun phrase.

children would be particularly likely to feel they are expected to know the facts about *kinds* (e.g., maybe because they believe these facts are more important to know; Cimpian & Park, 2014); as a result, children might be particularly likely to claim to have known these facts without actually believing that they did. However, in a context where the experimenter herself is ignorant of the facts she is reading, children arguably do not have to worry about such expectations. Thus, children's knew-it-all-along responses are more likely to stem from a genuine feeling of having previous knowledge of the relevant information.

Several aspects of the procedure highlighted the experimenter's ignorance. First, at the beginning of the session, the experimenter said that someone had just given her a book and that, although she had not read it yet, she would like to read it together with the child. Second, as the experimenter went over the book with the child, she introduced each fact with "it says here that . . ." so as to make it clear she was simply reading the fact from the book rather than retrieving it from memory. To further emphasize that she was previously unaware of this information, the experimenter acted as if she were surprised (e.g., exclaiming "Huh!" or "Oh! That's interesting!") after reading each fact and right before asking children if they had known it.

**Data analysis.** Our main dependent variable was dichotomous: children's "yes"/"no" answers to questions about their prior knowledge of a fact. As a result, the data were analyzed with a multilevel mixed-effects logistic regression computed with the *xtmelogit* command in Stata 12 (StataCorp, 2011; see Cimpian & Petro, 2014, for a similar analysis). As predictors, we included the generic versus specific format of the fact presented on each trial (a dichotomous variable), children's exact age in years (a continuous variable), and the interaction between these two variables. This analysis also allowed the intercept of the relationship between the predictors and the dependent variable to vary randomly across subjects and items rather than assuming this parameter to be constant. These two random effects (for subjects and items) were crossed rather than nested because each subject saw each item and each item was presented to each subject (see Baayen, Davidson, & Bates, 2008). All predictor variables were mean-centered. Confidence intervals (95%) and significance levels for the regression coefficients were calculated via bootstrapping (1,000 replications). Finally, we report odds ratios (*OR*) as a measure of effect size.

## Results and Discussion

As predicted, children showed a generic knew-it-all-along effect: They thought they had known all along the Kind facts more often than the Individual facts ( $M_s = 49.5\%$  and  $34.9\%$  knew-it-all-along responses, respectively; see Table 3),  $b = 0.55$  [0.28, 0.98],  $p = .002$ ,  $OR = 1.73$ . This analysis thus indicates that the odds of a knew-it-all-along error (vs. a correct response) for a Kind fact were 1.73 times the odds of a knew-it-all-along error for an Individual fact. This difference also held up at the level of individual participants. That is, the percentage of children who gave more knew-it-all-along responses for the Kind facts than for the Individuals facts (45.8% of all children) was more than four times the percentage of children who showed the opposite pattern (more knew-it-all-along responses for the Individual facts than for the Kind facts; 10.4% of all children),  $p = .002$  by a sign test.

**Table 3**  
**Average Percentage of Trials on Which Children Thought They Had Known All Along the Kind and Individual Facts in Experiments 1, 2, 3, and 5 (Standard Deviations in Parentheses)**

Age group	Fact form	Expt. 1 (all)	Expt. 2 (all)	Expt. 2 (didn't know novel word) <sup>a</sup>	Expt. 3 (all)	Expt. 3 (expt. ignorant) <sup>b</sup>	Expt. 3 (hard to guess novel word) <sup>a</sup>	Expt. 5 (all)	Expt. 5 (expt. ignorant) <sup>b</sup>
Overall	Kind	49.5 (50.1)	50.0 (50.1)	37.9 (48.7)	43.2 (49.7)	40.0 (49.2)	33.6 (47.4)	44.8 (49.8)	39.4 (48.9)
	Individual	34.9 (47.8)	42.2 (49.5)	27.4 (44.8)	33.3 (47.3)	27.1 (44.6)	20.0 (40.2)	37.6 (48.5)	30.6 (46.1)
4- and 5-year-olds	Kind	57.3 (49.7)	67.7 (47.0)	51.6 (50.4)	42.7 (49.7)	36.1 (48.4)	35.7 (48.3)	49.7 (50.0)	40.6 (49.2)
	Individual	46.9 (50.2)	60.4 (49.2)	43.6 (50.1)	39.6 (49.2)	31.9 (47.0)	26.1 (44.2)	44.0 (49.7)	36.7 (48.3)
6- and 7-year-olds	Kind	41.7 (49.6)	32.3 (47.0)	27.2 (44.8)	43.8 (49.9)	44.1 (50.0)	31.0 (46.7)	39.8 (49.0)	37.9 (48.6)
	Individual	22.9 (42.3)	24.0 (42.9)	16.3 (37.1)	27.1 (44.7)	22.1 (41.8)	13.1 (34.0)	31.3 (46.4)	25.0 (43.4)

*Note.* Given that the multilevel logistic regressions were computed over the trial-level data (i.e., individual “yes”/“no” responses), the standard deviations were likewise calculated over individual trials rather than at the participant or item level.

<sup>a</sup> These averages include only responses for which, in Part 2, children said they did not know what the low-frequency word meant (Experiment 2) or thought it would be hard to guess what this word meant (Experiment 3). <sup>b</sup> These averages include only children who believed the experimenter to be ignorant.

Returning to the results of the main analysis, age was inversely related to knew-it-all-along responses, such that younger children were more likely to feel as though they had previously known facts that they just learned,  $b = -0.62$  [ $-1.36, -0.12$ ],  $p = .020$ ,  $OR = 0.54$ . (The 0.54 odds ratio indicates that the odds of a knew-it-all-along response [vs. a correct response] for children of a particular age were 0.54 times the odds of a knew-it-all-along response for children who were a year younger.) This difference is consistent with prior evidence of age-related improvements in children's ability to realize when they have learned something new (e.g., Gopnik & Astington, 1988; Taylor et al., 1994). Importantly, however, there was no Fact Format  $\times$  Age interaction,  $b = 0.10$  [ $-0.23, 0.57$ ],  $p = .490$ ,  $OR = 1.10$ , suggesting that the magnitude of the generic knew-it-all-along effect did not vary significantly with children's age (see Table 3 for separate means for the 4- and 5-year-olds vs. the 6- and 7-year-olds in our sample).

In sum, this study suggests that learning generic facts is indeed accompanied by a heightened sense of having known these facts all along. This result was predicted a priori by, and provides support for, the view that information about kinds holds a privileged status in children's thinking.

## Experiment 2

In the second experiment, we explored a possible alternative explanation for the greater number of knew-it-all-along responses for the generic facts: Perhaps the facts about kinds gave children a better sense of the meaning of the low-frequency words embedded in them, and that is why these facts seemed more familiar to children. For example, hearing that dogs, as a kind, get sick after eating *carbarnates* may narrow down the potential referents of this word more than hearing about an individual dog, who could have gotten sick after eating carbarnates for any number of idiosyncratic reasons (e.g., allergies, overeating). A heightened feeling of understanding the low-frequency words when they are embedded in generic facts (e.g., carbarnates must be some sort of toxic substance) might induce a feeling of greater familiarity with the facts themselves, leading to more knew-it-all-along responses.

To explore this possibility (which we term the “meaning through generics” alternative), we expanded our procedure to add an extra part in which children heard the facts a second time and were asked if they knew what the low-frequency words meant. The “meaning through generics” alternative makes two predictions: First, children should feel that they know the meaning of the low-frequency words more often when they are embedded in Kind, as compared with Individual, facts. Second, the facts for which children cannot guess the meaning of the low-frequency words should seem equally unfamiliar to children, regardless of whether they are about kinds or individuals. That is, if the previous Kind versus Individual differences in knew-it-all-along impressions occurred because the Kind facts gave children a sense of knowing the low-frequency words, then the difference between Kind and Individual facts should disappear when we exclude from the analysis the facts for which children thought they knew the low-frequency words.

## Method

**Participants.** Forty-eight children participated ( $M = 5.83$  years,  $SD = 1.29$ , range = 4.01 to 7.97; 24 boys and 24 girls). Children were demographically similar to those in Experiment 1.

**Items and procedure.** The procedure was divided into two parts. Part 1 was identical to Experiment 1, with an ostensibly ignorant experimenter asking children if they had prior knowledge of the facts that she read from a book. In Part 2, the experimenter read the book again, except this time she asked children if they thought they knew what the low-frequency words meant (e.g., “Do you know what carbamates are?”).

## Results and Discussion

Before testing the two predictions laid out above, we analyzed children’s responses in Part 1 alone. These results replicated the generic knew-it-all-along effect: Children thought that they had already known the facts about kinds ( $M = 50.0\%$  knew-it-all-along responses) more often than the facts about individuals ( $M = 42.2\%$ ),  $b = 0.30$  [0.07, 0.65],  $p = .008$ ,  $OR = 1.34$ . Individual children’s response patterns were also consistent with our prediction. That is, there were significantly more children who had stronger knew-it-all-along impressions for the Kind facts (vs. the Individual facts) than there were children who had stronger knew-it-all-along impressions for the Individual facts (vs. the Kind facts), 39.6% and 14.6%, respectively,  $p = .029$  by a sign test. As in the previous study, we found that knew-it-all-along responses decreased in frequency with age,  $b = -0.92$  [-1.59, -0.55],  $p < .001$ ,  $OR = 0.40$ , and that age did not interact with the format of the facts in predicting knew-it-all-along responses,  $b = -0.04$  [-0.22, 0.12],  $p = .482$ ,  $OR = 0.96$  (see Table 3).

We now go on to test the two predictions of the “meaning through generics” alternative. The first prediction was that the generic facts should be more likely than the specific facts to give children a sense of familiarity with the low-frequency words. Children’s responses in Part 2, where they were asked if they knew the meaning of the low-frequency words, revealed no evidence for this prediction. In fact, the percentage of affirmative answers was numerically, but not significantly, greater for the Individual facts ( $M = 29.7\%$  “yes” responses) than for the Kind facts ( $M = 24.5\%$ ),  $b = -0.24$  [-0.68, 0.10],  $p = .174$ ,  $OR = 0.78$ . This finding suggests that children did not feel more familiar with the novel words when they were embedded in facts about a kind as opposed to facts about an individual. Thus, it is unlikely that children’s greater sense of prior knowledge for facts about kinds is due to a greater sense of familiarity with the novel words embedded in these facts.

The second prediction of the “meaning through generics” alternative was that the difference in knew-it-all-along responses between Kind and Individual facts should disappear if we exclude from the analysis any facts for which children thought they knew the low-frequency words. Rather than showing no difference between the Kind and the Individual facts, this subset of knew-it-all-along responses replicated yet again the difference predicted by the view that information about kinds is privileged in children’s thinking,  $M_{Kind} = 37.9\%$  versus  $M_{Individual} = 27.4\%$  knew-it-all-along-responses,  $b = 0.35$  [0.17, 0.76],  $p < .001$ ,  $OR = 1.42$ .

In summary, these results speak against the “meaning through generics” alternative. That is, they appear to rule out the possibility

that the generic knew-it-all-along effect documented in Experiments 1 and 2 emerged simply because the facts about kinds afforded stronger inferences about the meaning of the low-frequency words.

## Experiment 3

Experiment 3 addressed two additional alternative explanations for the generic knew-it-all-along effect. First, we considered the possibility that the facts about kinds evoked more knew-it-all-along impressions in Experiments 1 and 2 simply because we compared them with facts about *temporally bounded events* (“Last night . . .”), which may have set the benchmark too low. Perhaps it is particularly *easy* for children to recognize their prior ignorance about what an animal had done the night before, rather than it being particularly *difficult* for them to recognize their prior ignorance of a generic fact about an animal kind (the generic knew-it-all-along effect). To test this possibility, in Experiment 3 we compared facts about kinds with facts about the *habitual characteristics* of individuals (e.g., what typically makes a specific dog sick). If it is particularly easy to detect one’s prior ignorance about brief one-time events, and it is this ease that explains why we found more knew-it-all-along impressions for Kind than for Individual facts (as this alternative suggests), then there should be no differences when comparing facts about kinds to facts that describe habitual characteristics of individuals. In contrast, the view that kind representations are central in young children’s cognition predicts that the generic knew-it-all-along effect would replicate in this context as well.

The second alternative we considered was as follows: Even though the procedure in Experiments 1 and 2 strongly suggested that the experimenter was ignorant of the facts she read, it is nevertheless possible that children still believed she knew the facts and was simply pretending to be ignorant in order to test children’s own knowledge of these facts. Because children assume that adults are generally knowledgeable (e.g., Jaswal & Neely, 2006; Taylor, Cartwright, & Bowden, 1991), it is not beyond the realm of possibility that our participants discounted the experimenter’s claims to be ignorant. If so, children may still have felt pressured to (falsely) claim that they knew the facts, and perhaps especially the important-sounding generic facts. This potential tendency to falsely claim knowledge may have also been exacerbated by the fact that *all* of the facts that children were asked about in Experiments 1 and 2 were novel. Thus, perhaps to avoid having to repeatedly admit their ignorance to an experimenter whom they suspected to be knowledgeable, children may have opted instead to claim they knew some of the (seemingly important) generic facts. To address this possibility, we made three changes to the procedure. First, we no longer presented the facts in a book, because book reading is often a context in which knowledgeable adults test children by asking questions (e.g., Gelman et al., 1998). Instead, the experimenter and the child looked over loose photographs of animals that had supposedly been given to her by a friend, who was also said to have handwritten some facts “that we might not know about” on the back of the photographs. Moreover, as before, the experimenter provided multiple signals that she was ignorant of these facts as she read them. Second, we added eight filler facts chosen to be familiar to children (e.g., “Winnie the Pooh likes honey;” see Table 4). The fillers were designed to enable children

Table 4  
*The Eight Filler Facts Used in Experiments 3 and 4*

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Oscar the Grouch lives in a garbage can.
Dora the Explorer wears a backpack.
Nemo has stripes.
SpongeBob has square pants.
Cinderella has blond hair.
Peter Pan can fly.
Lightning McQueen is a race car.
Winnie the Pooh likes honey.

---

*Note.* In Experiment 5, the filler questions were similar except they simply asked whether children recognized the characters in the pictures (e.g., “Do you know who this is? Do you know Oscar the Grouch?”).

to display their knowledge to the experimenter by (legitimately) claiming that they had known these facts all along. By allowing children to display their knowledge of the filler facts, we further lessened any pressure they may have felt to claim knowledge of the target generic facts. Third, rather than simply assuming that children believed the experimenter to be ignorant, we now added a question to check whether they actually did. We were thus able to conduct a separate analysis on just the children who believed the experimenter to be ignorant. If our previous results were simply due to a task-induced pressure to claim knowledge of the generic facts, then the generic-versus-specific difference should disappear in this subset of children. In contrast, our prediction is that the generic knew-it-all-along effect would replicate in this subsample as well.

A final goal of Experiment 3 was to provide a more sensitive test of the “meaning through generics” alternative. Rather than asking children whether they *knew* the meaning of the low-frequency words (as we did in Experiment 2), in this experiment we asked children whether it would be easy or hard to *guess* the meaning of the low-frequency words. Because the facts about kinds may simply impose more constraints on the meaning of these words rather than truly revealing it, we reasoned that asking children about how easy it would be to guess this meaning is a more sensitive measure than asking them if they know what the words mean (which may be too high a standard). If children feel they can more easily guess the meaning of the low-frequency words when they are embedded in generic facts, and if this feeling in turn gives children a sense of familiarity with the generic facts themselves, then perhaps that is why children make more knew-it-all-along errors for generic than for specific facts. In contrast to this alternative, we predict that the generic-versus-specific difference would hold even when we limit our comparison to only the generic and specific facts for which the children feel it would be hard to guess the meaning of the novel word (that is, even when we eliminate the potential “meaning through generics” confound).

## Method

**Participants.** Forty-eight children participated ( $M = 6.01$  years,  $SD = 1.14$ , range = 4.01 to 7.95; 24 boys and 24 girls). Children were demographically similar to those in previous studies. One additional child was excluded because he refused to complete the task.

**Items and procedure.** As in Experiment 2, the procedure was divided into two parts. Part 1 was identical to that of Experiment

2 (in that children heard four Kind and four Individual facts grouped into two blocks whose order was counterbalanced), with four exceptions.

First, the Individual facts described habitual characteristics (e.g., “This dog gets sick after eating carbamates”) rather than specific events or behaviors (e.g., “Last night, this dog got sick after eating carbamates”), as in Experiments 1 and 2.

Second, the facts were not presented in a book. Instead, the experimenter told children that a friend who “has a lot of animals” had given her some pictures that morning, and that the friend wrote things on the back that both the child and the experimenter might not know about. (The pictures were the same as those used in the books created for Experiments 1 and 2. They all depicted a single animal for both fact forms.) To ensure that children would feel comfortable admitting their ignorance, the experimenter stressed that she had not yet looked at the pictures or what was written on the back. In addition, the experimenter followed her introduction of each fact (“Oh, it’s my friend’s [dog, bird, etc.]. And she wrote on the back that . . .”) with an exclamation of surprise (e.g., “Oh, that’s cool!”), which served to remind children that these facts were novel to her.

Third, we added eight filler facts, chosen to be familiar to children (e.g., “Winnie the Pooh likes honey” and “SpongeBob has square pants;” see Table 4 for full list and Table 2 for a summary of the procedural changes). These filler facts allowed children to demonstrate their knowledge to the experimenter, thereby potentially making it easier for them to acknowledge their ignorance of the novel facts. The filler facts were introduced in the context of pictures that illustrated the facts (e.g., SpongeBob wearing his square pants). Because these pictures and facts did not fit within the storyline of the friend who owns a lot of animals, the experimenter claimed the filler pictures as her own. Two filler pictures/facts were presented at the beginning of Part 1 (“Okay, so let’s start with a couple of my pictures”), four were presented between the blocks of Kind and Individual facts, and the remaining two were presented at the end of the second block (“Okay, so I just have two more of my pictures left”). As expected, children said they had known the vast majority of these filler facts ( $M = 94.8\%$  knew-it-all-along responses).

Fourth, at the very end of Part 1 we asked children whether they believed that the experimenter had been ignorant of the novel generic and specific facts (“Do you think I knew about these things written on the back here before we read them together, or do you think I didn’t know them before?”). Most of the children ( $N = 35$ ;  $M_{age} = 6.00$ ) answered that the experimenter had not known the facts previously. Responses to this question did not vary with age: Of the 35 children who answered that the experimenter was ignorant, 18 were 4- or 5-year-olds and 17 were 6- or 7-year-olds.

Part 2 was similar to that of Experiment 2, except that the experimenter asked children whether it would be easy or hard to guess the meaning of the low-frequency words (e.g., “If you had to guess what carbamates are, do you think it would be an easy guess or a hard guess?”).

## Results and Discussion

The data from Part 1 replicated yet again the generic knew-it-all-along effect, even though the facts about kinds ( $M = 43.2\%$  knew-it-all-along responses) were now compared with facts about

the habitual characteristics of individuals ( $M = 33.3\%$ ),  $b = 0.39$  [0.10, 0.81],  $p = .012$ ,  $OR = 1.47$ . The effect also held at the level of individual participants: 39.6% of children gave more knew-it-all-along responses for the Kind facts than for the Individual facts, while only 12.5% of children did the opposite,  $p = .015$  by a sign test. Moreover, the generic knew-it-all-along effect persisted even when we restricted the dataset to include only the children who thought that the experimenter was ignorant of the facts,  $M_{Kind} = 40.0\%$  versus  $M_{Individual} = 27.1\%$  knew-it-all-along responses,  $b = 0.48$  [0.11, 1.05],  $p = .022$ ,  $OR = 1.62$ . The same was true when we included only the facts for which children felt that it would be hard to guess the meaning of the low-frequency word,  $M_{Kind} = 33.6\%$  versus  $M_{Individual} = 20.0\%$  knew-it-all-along responses,  $b = 0.42$  [0.04, 0.94],  $p = .028$ ,  $OR = 1.53$ . (There was no difference between the Kind and the Individual facts in the percentage of low-frequency words children thought it would be easy to guess the meaning of,  $M_s = 33.3\%$  and  $32.3\%$ , respectively,  $b = 0.02$  [-0.24, 0.32],  $p = .786$ ,  $OR = 1.02$ .)

The main analysis (i.e., the one that included all subjects and trials) also revealed a nonsignificant negative relationship between age and knew-it-all-along responses,  $b = -0.30$  [-0.94, 0.36],  $p = .370$ ,  $OR = 0.74$ . In addition, there was no interaction between age and the generic versus specific format of the facts learned,  $b = 0.20$  [-0.08, 0.58],  $p = .200$ ,  $OR = 1.22$  (see Table 3).

These results suggest three main conclusions. First, the generic knew-it-all-along effect is not simply an artifact of comparing generic facts with facts that describe one-time events or behaviors. In this study, we found a difference between the generic and the specific facts even though the latter described *habitual* characteristics of individuals. Second, the present results speak against the possibility that the generic knew-it-all-along effect occurred simply because children did not believe that the experimenter was ignorant of the facts and therefore felt uncomfortable admitting their own ignorance of the seemingly important generic facts. In this study, we modified the procedure to further diminish any pressure children may have felt to claim knowledge (e.g., we eliminated the book and introduced the familiar filler facts); we also added a question to screen out children who did not believe the experimenter to be ignorant. Even with all these safeguards in place, the results revealed a robust generic knew-it-all-along effect. Third, this study implemented a more sensitive test of the “meaning through generics” alternative but again failed to find any evidence for this alternative. Overall, the findings of the present experiment provide strong evidence for a generic knew-it-all-along effect and for the proposal that the early conceptual system privileges kinds.

### Experiment 4

In Experiment 4, we investigated whether the knew-it-all-along effect uncovered in Experiments 1–3 is unique to generic information (as would be predicted by the view that kinds are privileged in children’s thinking), or whether heightened knew-it-all-along impressions would also arise when children learn information about multiple individuals. To adjudicate between these possibilities, in Experiment 4 we compared facts about *some animals* (e.g., “Some dogs get sick after eating carbamates”) with facts about a *single animal* (e.g., “This dog gets sick after eating carbamates”). If plurality is sufficient to cause an

increase in knew-it-all-along errors, we should find a significant difference here as well. In contrast, if it is generic facts per se that are particularly likely to induce these errors, we should find no difference between facts about some individuals versus one.

Importantly, this comparison also addresses the possibility that children used a superficial “familiarity rule” to decide whether they had prior knowledge of the facts in Experiments 1–3. For instance, when they learned a new fact about dogs, children might have reasoned, “I am familiar with dogs, so maybe I was familiar with that fact too.” In contrast, when they learned a new fact about a particular dog, they might have thought, “I am not familiar with that particular dog, so I probably didn’t know that fact about it.” One reason to doubt that such a familiarity rule can account for our results is that the prevalence of knew-it-all-along responses for facts about *familiar* kinds in Experiments 1–3 (see Table 3) was similar to the prevalence of knew-it-all-along responses for facts about *unfamiliar* kinds in other studies in the literature (e.g., 65.5% for facts about grambees in Esbensen, Taylor, and Stoess’s (1997) Experiment 1). These numbers contradict the “familiarity rule” alternative, according to which children should have been much more likely to think that they already knew facts about dogs, birds, and so on, than facts about grambees (a wholly unfamiliar kind). Although the comparison with Esbensen et al.’s (1997) data is suggestive, the current study can provide a more definitive test of this alternative. After all, children have seen *some* dogs (and birds, etc.) before but have never seen the particular dog (or bird, etc.) that the experimenter is showing them. Thus, if children relied exclusively on a familiarity rule, knew-it-all-along responses should be more frequent for facts about some members of a category than for facts about a particular (unfamiliar) individual. In contrast to this prediction, if the generic knew-it-all-along effect is instead a byproduct of how the early conceptual system handles generic information, there should be no difference in children’s knew-it-all-along impressions for these two types of nongeneric facts.

### Method

**Participants.** The participant sample recruited for this experiment was 50% larger than that of Experiments 1–3 (i.e., 72 instead of 48) so as to enable us to detect a significant effect even if this effect was smaller in magnitude than those obtained so far ( $M = 5.95$  years,  $SD = 1.07$ , range = 4.03 to 7.99; 36 boys and 36 girls). Children were demographically similar to those in the previous experiments.

**Items and procedure.** The procedure was identical to that of Experiment 3 (including the pictures of single animals), except that we replaced the facts about kinds (e.g., “Dogs get sick after eating carbamates”) with facts about plural sets (e.g., “Some dogs get sick after eating carbamates”). We thus compared these plural facts with facts describing habitual characteristics of individual animals (e.g., “This dog gets sick after eating carbamates”).

As in Experiment 3, children said that they knew the vast majority of the filler facts (97.0%), which suggests that the fillers performed their intended function of allowing children to demonstrate their knowledge to the experimenter.

## Results and Discussion

Even with a substantially larger sample size, this experiment revealed no significant difference between the frequency of knew-it-all-along responses for the facts about some animals ( $M = 47.6\%$ ) and the facts about a single animal ( $M = 44.1\%$ ),  $b = 0.14$   $[-0.13, 0.44]$ ,  $p = .280$ ,  $OR = 1.16$ . Additionally, no difference was found when analyzing individual participants' response patterns. Only 27.8% of the children gave more knew-it-all-along responses for facts about some animals than for facts about a single animal, which was not significantly different from the 19.4% of children who displayed the opposite pattern,  $p = .392$  by a sign test. Similarly, there were no differences between the two types of facts when we restricted the dataset to include only (a) the children who thought that the experimenter was ignorant of the facts ( $N = 45$ ;  $M_{age} = 6.22$ ),  $M_{Some} = 43.3\%$  versus  $M_{Individual} = 38.3\%$  knew-it-all-along responses,  $b = 0.16$   $[-0.25, 0.57]$ ,  $p = .328$ ,  $OR = 1.17$ ; and (b) the facts for which children felt that it would be hard to guess the meaning of the low-frequency word,  $M_{Some} = 37.7\%$  versus  $M_{Individual} = 35.4\%$  knew-it-all-along responses,  $b = 0.19$   $[-0.12, 0.62]$ ,  $p = .184$ ,  $OR = 1.21$ . (There was no difference between the two types of facts in the percentage of low-frequency words children thought it would be easy to guess the meaning of,  $M_{Some} = 36.5\%$  vs.  $M_{Individual} = 34.4\%$ ,  $b = 0.06$   $[-0.12, 0.24]$ ,  $p = .464$ ,  $OR = 1.06$ ).

The main analysis (including all participants and trials) also revealed that knew-it-all-along responses decreased significantly with age,  $b = -1.44$   $[-2.41, -1.10]$ ,  $p < .001$ ,  $OR = 0.24$ , and that there was no significant Fact Format  $\times$  Age interaction,  $b = 0.23$   $[-0.07, 0.54]$ ,  $p = .110$ ,  $OR = 1.26$  (see Table 5 for separate means for the younger and older children). Thus, the findings here parallel those of the previous studies, with the crucial exception of the fact that there was no difference between fact types.

Finally, to test whether there was a significant difference between "some" and generic facts in their ability to induce height-

ened knew-it-all-impressions relative to the facts about individuals, we conducted a multilevel mixed-effects logistic regression on the pooled data from Experiments 1–4. This analysis included the following predictors, along with all of their two- and three-way interactions: whether the fact presented on each trial was singular or plural (Plurality; a dichotomous variable); whether the plural fact used in a study was generic (Experiments 1–3) or indefinite (Experiment 4) (Type of Plural Fact; a dichotomous variable); and children's exact age in years (Age; a continuous variable). Crossed random effects for subject- and item-level intercepts were also included in the model. Our main prediction was of an interaction between Plurality (singular vs. plural) and Type of Plural Fact (generic vs. indefinite). That is, we expected the plural versus singular difference in knew-it-all-along responses to be significantly greater when the plural fact was generic (e.g., about dogs) than when the plural fact was indefinite (e.g., about some dogs). Consistent with this expectation, the multilevel regression revealed a marginally significant Plurality  $\times$  Type of Plural Fact interaction,  $b = -0.13$   $[-0.31, 0.01]$ ,  $p = .058$ ,  $OR = 0.88$ . Moreover, the magnitude of this two-way interaction did not vary significantly with age, as indicated by the absence of a three-way interaction between Plurality, Type of Plural Fact, and Age,  $b = 0.08$   $[-0.08, 0.26]$ ,  $p = .310$ ,  $OR = 1.08$ . These supplemental analyses provide additional support for claims of a special status for information about kinds in early conceptual development.

In summary, the results of this study suggest two main conclusions. First, facts about nongeneric plural sets appear to be similar to facts about single individuals with respect to the frequency with which they elicit knew-it-all-along errors. In combination with the differences found consistently in the first three studies between generic and specific facts, this result suggests that heightened knew-it-all-along impressions may accompany the learning of information about kinds per se. Second, the results of the present study speak against the possibility that children in Experiments 1–3 used a shallow familiarity rule to answer the experimenter's questions (e.g., "I'm familiar with  $x$ , so I may be familiar with this fact about  $x$  as well"). Such a rule should have led to a difference in the present experiment, but no such difference was found.

## Experiment 5

In Experiment 5, we introduced several changes to the stimuli and the design in order to test the robustness of the generic knew-it-all-along effect. First, to verify that this effect is not unique to generic facts conveyed with bare plural noun phrases (see Table 1), in Experiment 5 we instead used generic facts conveyed with indefinite singular noun phrases (e.g., "A diamond doesn't break, even when someone runs over it with a car"; see Table 6). Because these noun phrases can also refer to specific individuals, this change offered the additional advantage of allowing us to use Individual facts that are more closely matched to their Kind counterparts than in previous studies (e.g., "A diamond didn't break, even when someone ran over it with a car"). In this study, Kind and Individual facts differed only in the tense of the verbs they used: present for the Kind facts and past for the Individual facts.

Second, we no longer used facts that were novel simply by virtue of including a low-frequency, unfamiliar word (e.g., "carbamates"). In this study, we instead used facts that were novel by

Table 5

*Average Percentage of Trials on Which Children Thought They Had Known the Facts All Along in Experiment 4 (Standard Deviations in Parentheses)*

	Age group	Fact type	
		"Some"	Individual
All responses	Overall	47.6 (50.0)	44.1 (49.7)
	4- and 5-year-olds	63.2 (48.4)	62.5 (48.6)
	6- and 7-year-olds	31.9 (46.8)	25.7 (43.8)
Experimenter ignorant <sup>a</sup>	Overall	43.3 (49.7)	38.3 (48.8)
	4- and 5-year-olds	65.0 (48.1)	63.3 (48.6)
	6- and 7-year-olds	32.5 (47.0)	25.8 (44.0)
Hard to guess novel word <sup>b</sup>	Overall	37.7 (48.6)	35.4 (48.0)
	4- and 5-year-olds	55.4 (50.0)	54.6 (50.0)
	6- and 7-year-olds	19.8 (40.1)	15.2 (36.1)

*Note.* Given that the multilevel logistic regressions were computed over the trial-level data (i.e., individual "yes"/"no" responses), the standard deviations were likewise calculated over individual trials rather than at the participant or item level.

<sup>a</sup> These averages include only children who believed the experimenter to be ignorant. <sup>b</sup> These averages include only responses for which, in Part 2, children thought it would be hard to guess what the low-frequency word meant.

virtue of their overall content, even though all the words used to express them were familiar to children (see the example above and Table 6). This change was designed to investigate whether our effect might have been due to shallow response strategies brought about by the novel words. Specifically, it is possible that children just ignored the novel words and instead judged their prior knowledge based on only the remainder of the facts. For example, if children ignored the word “carbarnates,” they would be left with a familiar generic fact (that dogs get sick) but with a potentially unfamiliar specific fact (that the particular dog in the picture gets/got sick). It is worth noting, however, that such a response strategy cannot account for the full set of results obtained so far: Reliance on this strategy should have also led to more knew-it-all-responses to facts about some animals compared to facts about a particular animal, yet no such difference was found (Experiment 4). Even so, the novel facts used in the present experiment are not vulnerable to this alternative explanation.

Third, rather than teaching children facts about animals (as in Experiments 1–4), in Experiment 5 we provided them with facts about people (e.g., doctors, engineers) and inanimate objects (e.g., diamonds, chocolate; see Table 6). This change was meant to investigate the breadth of the generic knew-it-all-along effect.

Finally, rather than manipulating the format of the facts within subject (as in Experiments 1–4), in Experiment 5 we manipulated it between subjects. That is, children were randomly assigned to hear either eight facts about kinds or eight facts about individuals. A between-subjects design eliminates the opportunity to compare the generic and specific facts (which might have made it easier to differentiate between them in previous studies) and thus affords a conservative test of the generic knew-it-all-along effect.

## Method

**Participants and design.** To achieve sufficient power (> 80%) to detect a significant between-subjects effect of a magnitude comparable with the within-subject effect found in Experiments 1–3, we increased the sample size to 192 children. This sample size was determined with G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) using an estimate of the expected effect size derived by applying Cohen’s  $d_z$  formula to the data from Experiments 1–3 (Cohen, 1988; Rosenthal, 1991; see also Lakens, 2013). The participating children were 5.98 years old on average ( $SD = 1.15$ , range = 3.99 to 7.99; 97 boys and 95 girls). Children were randomly assigned to the Kind or the Individual condition ( $n = 96$  each). Children were demographically similar to those in the previous experiments. One additional child was tested but not included in the final sample because he refused to complete the task.

**Items and procedure.** The procedure was similar to that of Experiments 3 and 4, with three differences in the facts used (see Table 6 for the full list of items). First, the subject noun phrase was always an indefinite singular noun (e.g., “a diamond”), in both the Kind and the Individual conditions. The only difference between the Kind and the Individual facts in this study was that they used verbs in the present and past tense, respectively. Prior work has suggested that children as young as 4 are able to rely on verb tense to determine whether an indefinite singular noun phrase is generic or specific (Cimpian, Meltzer, & Markman, 2011). The second major difference from previous studies concerned the targets of the

Table 6  
*The Novel Facts Used as Stimuli in Experiment 5*

Kind	Individual
A diamond doesn’t break, even when someone runs over it with a car.	A diamond didn’t break, even when someone ran over it with a car.
A plane turns off its autopilot when it is in a thunderstorm.	A plane turned off its autopilot when it went in a thunderstorm.
A chocolate bar is made when someone mixes cocoa with butter. <sup>a</sup>	A chocolate bar was made when someone mixed cocoa with butter.
A blinker flashes faster right before it burns out.	A blinker flashed faster right before it burned out.
A person goes to school for 25 years before they become a doctor. <sup>a</sup>	A person went to school for 25 years before they became a doctor.
A lawyer doesn’t get paid until their trial is over.	A lawyer didn’t get paid until their trial was over.
A baby can’t taste salt until it is 4 months old. <sup>a</sup>	A baby wasn’t able to taste salt until it was 4 months old.
An engineer gets a metal ring when they are finished with school. <sup>a</sup>	An engineer got a metal ring when they were finished with school.

<sup>a</sup> These items were used in Experiment 6 as well.

facts: Half of the facts in Experiment 5 were about people, and half were about inanimate objects. Third, the facts did not include a low-frequency word but were nevertheless chosen to be unfamiliar to young children.

To verify that young children are indeed unfamiliar with the facts in this study, we recruited a sample of 8-year-olds ( $N = 12$ ;  $M_{age} = 8.59$  years) for a norming study. In addition to the eight target facts (i.e., the generic facts from the main task), children heard eight filler facts, four of which were obviously true (e.g., “A water bottle gets cold when you put it in the freezer”) and four obviously false (e.g., “A person doesn’t eat until they are 5 years old”). The experimenter presented these 16 facts in random order and, after each, asked children whether the fact was “right” or “not right.” The percentage of “right” responses for the target facts ( $M = 46.9\%$ ) did not differ from chance (50%),  $t(11) = 0.56$ ,  $p = .586$ , as would be expected if children are generally unfamiliar with these facts. Moreover, children gave significantly fewer “right” responses for the target facts than for the true filler facts ( $M = 95.8\%$ ),  $t(11) = 9.40$ ,  $p < .001$ , and significantly more “right” responses for the target facts than for the false filler facts ( $M = 2.1\%$ ),  $t(11) = 6.78$ ,  $p < .001$ . In sum, the results of this norming study suggest that the facts used in Experiment 5 are indeed unfamiliar to young children. (It is also worth noting that these norming results are conservative, as they were obtained with children who are slightly older than the children in our main sample and thus more knowledgeable about a variety of facts).

## Results and Discussion

Despite all the changes to the stimuli and the design, children again felt as though they had known all along the generic facts more often than the specific facts,  $M_{Kind} = 44.8\%$  versus  $M_{Individual} = 37.6\%$ ,  $b = 0.26$  [0.02, 0.56],  $p = .030$ ,  $OR = 1.30$ . Moreover, this difference held when we restricted the analysis to only the children who believed the experimenter was ignorant of

the facts ( $N = 132$ ,  $M_{age} = 5.99$ ),  $M_{Kind} = 39.4\%$  versus  $M_{Individual} = 30.6\%$ ,  $b = 0.33$  [0.07, 0.71],  $p = .024$ ,  $OR = 1.40$ . The main analysis (including all children) also revealed that knew-it-all-along responses decreased significantly with age,  $b = -0.51$  [-0.82, -0.29],  $p < .001$ ,  $OR = 0.60$ , and that there was no Fact Form  $\times$  Age interaction,  $b = 0.02$  [-0.25, 0.28],  $p = .844$ ,  $OR = 1.02$  (see Table 3).

The results of this experiment highlight the robustness of the generic knew-it-all-along effect. Even though the sentences expressing the Kind and Individual facts had identical subject noun phrases and were tightly matched overall (differing only in verb tense), and even though the Kind and Individual format of the facts was manipulated between subjects (preventing comparisons between the two types of facts), our findings nevertheless uncovered—for the fourth time—a generic knew-it-all-along effect. Further, these results suggest that heightened knew-it-all-along impressions are not (a) restricted to generic facts conveyed using bare plural nouns, or (b) byproducts of a shallow response strategy (namely, ignoring unfamiliar words encountered in the facts). In sum, this study provides further evidence for the centrality of information about kinds in early cognition.

### Experiment 6

Although the experiments so far have provided consistent evidence for a generic knew-it-all-along effect, they have also revealed a surprisingly high level of knew-it-all-along responses overall, regardless of the generic or specific format of the facts (see Tables 3 and 5). It is remarkable that children would so routinely believe that they had prior knowledge of facts they in fact just learned. While these results are largely consistent with the prior literature on young children's inability to identify the sources of their knowledge (e.g., Taylor et al., 1994), they might also raise concerns about unforeseen problems with our stimuli. Thus, our goal in this last study was to test whether, under the right circumstances, even young children would recognize their prior ignorance about the facts we used in our studies. Such a result would reinforce the conclusion that the generic knew-it-all-along effect identified here is indeed due to children's metacognitive difficulties (difficulties that can be ameliorated by experimental intervention) rather than being a methodological artifact. Our strategy (modeled on Taylor et al., 1994) was to manipulate whether the learning event (e.g., learning that a person goes to school for 25 years before they become a doctor) was preceded by an open-ended question (e.g., "How many years does a person go to school to become a doctor?") designed to make children's ignorance of this fact salient. Failing to answer these open-ended questions correctly should make it clear to children that they did not know these facts prior to learning them from the experimenter. This is the main prediction explored in Experiment 6.

### Method

**Participants.** We recruited 32 children aged 4 and 5 to participate in this study ( $M = 4.98$  years,  $SD = 0.71$ , range = 4.03 to 6.03; 16 boys and 16 girls). We focused here on younger children because they gave the most knew-it-all-along responses in previous studies. Aside from their age, children were demographically similar to those in previous studies.

**Design, items, and procedure.** Children were randomly assigned to one of two conditions: Ignorance-Salient or Control. On each trial in the Ignorance-Salient condition, children were asked an open-ended question designed to reveal their ignorance of the target fact (e.g., "How long does a person go to school to become a doctor?"). With the exception of a single trial, children never guessed the target facts. (The experimenter modified the one fact that was correctly guessed in order to maintain its novelty and thus retain it in the dataset).

After children gave their answer, the experimenter provided the correct answer by reading it from the back of a picture that was said to have been given to her by a friend ("Actually, it says here that . . ."). As in previous studies, the experimenter acted surprised after reading each fact ("Oh! Cool!") and then asked children whether they had known the fact before they heard it just then. This script was followed for each of the four facts used in this study, which were a subset of the generic facts from Experiment 5 (see the marked items in Table 6). The four facts selected for the present study were ones about which we could formulate felicitous open-ended questions.

The script in the Control condition was identical to what children in the Ignorance-Salient condition heard after the open-ended questions. That is, children were read the facts from the backs of the pictures and asked whether they had known them all along (just as in previous studies).

### Results and Discussion

As predicted, children in the Ignorance-Salient condition gave substantially fewer knew-it-all-along responses than children who, as in previous experiments, were simply asked to judge their prior knowledge ( $M_s = 15.6\%$  and  $45.3\%$  knew-it-all-along responses, respectively),  $b = -1.06$  [-2.79, -0.44],  $p < .001$ ,  $OR = 0.35$ . Children's age was not significantly related to the prevalence of their knew-it-all-along responses (recall, however, the restricted age range in this study),  $b = -0.29$  [-1.48, 1.34],  $p = .738$ ,  $OR = 0.75$ , neither was the interaction between age and condition,  $b = -0.52$  [-2.25, 0.77],  $p = .344$ ,  $OR = 0.60$ .

These findings suggest that the high frequency of knew-it-all-along responses across our studies was likely due to children's metacognitive difficulties in distinguishing new knowledge from old. When this distinction is made salient, as we did in this study by highlighting for children that they did not know the target facts before hearing them from the experimenter, even young children were able to correctly recognize that they had learned something new. These findings speak against the idea that the generic knew-it-all-along effect identified in the present set of studies is a methodological artifact. Instead, they are consistent with our claim that children's heightened knew-it-all-along impressions for new generic facts stem from heightened difficulties telling apart new and old generic facts.

### Analyses Across Studies

To estimate the generic knew-it-all-along effect and its developmental trajectory with more precision than was possible in the separate studies that investigated this effect (Experiments 1, 2, 3, and 5), we pooled the data across these four studies ( $N = 336$ ,  $M_{age} = 5.96$ ) and submitted them to a multilevel mixed-effects

logistic regression with the format of the facts (dichotomous), children's age (continuous), and their interaction as predictors. The model also included nested random intercepts for subjects and studies (with subjects nested within studies).

As expected, this pooled analysis revealed a significant relationship between Fact Format and knew-it-all-along responses,  $b = 0.35$  [0.24, 0.54],  $p < .001$ ,  $OR = 1.42$ , with children giving more knew-it-all-along responses after learning facts about kinds ( $M = 46.0\%$ ) than after learning facts about individuals ( $M = 37.3\%$ ). We also found that age was inversely related to children's knew-it-all-along responses,  $b = -0.55$  [-0.77, -0.41],  $p < .001$ ,  $OR = 0.58$ , such that younger children were significantly more likely to feel as though they had prior knowledge of the newly learned information. Importantly, however, even with the statistical power afforded by combining the data across four studies, the analysis uncovered no significant interaction between Fact Format and Age,  $b = 0.06$  [-0.06, 0.20],  $p = .298$ ,  $OR = 1.07$ . That is, the magnitude of the generic knew-it-all-along effect did not change significantly over the 4-year age span included in our studies (as illustrated in Figure 1). Although this nonsignificant interaction with age suggests that the generic knew-it-all-along effect may have been present even in the youngest children, we were also able to test this claim directly by restricting our analytic sample to just 4-year-olds ( $N = 87$ ,  $M_{age} = 4.47$ ). As predicted, the generic knew-it-all-along effect was present even among this young group,  $b = 0.38$  [0.05, 0.83],  $p = .020$ ,  $OR = 1.46$ . This result speaks to the special role of information about kinds in the early stages of development.

### General Discussion

According to recent proposals, the rapid pace of early conceptual development is fueled in part by a bias favoring knowledge about *kinds of things* in the world (e.g., Cimpian & Erickson, 2012; Csibra & Gergely, 2009; Gelman, 2010; Leslie, 2008). These proposals motivated the prediction that new information about

kinds would give children a false impression that this information was known all along (which we have termed the *generic knew-it-all-along effect*). The present findings are consistent with this prediction and thus support broader proposals that kind representations hold a privileged status in early cognition.

### Summary of the Results

The six experiments reported here provide consistent evidence for the predicted generic knew-it-all-along effect (see Table 2 for a summary of the experimental designs and findings). In Experiment 1, children were taught several new facts about kinds and individuals by an experimenter who signaled that she had no prior knowledge of these facts. After learning each fact, children were asked whether they had known this fact before they heard it from the experimenter. As predicted, children were significantly more likely to think they had already known the novel facts when these facts were about kinds than when they were about individuals.

Follow-up studies ruled out several alternative explanations for this difference. In Experiment 2, we tested the "meaning through generics" alternative: Namely, the possibility that the facts about kinds induced a greater sense of familiarity with the low-frequency words (by imposing stronger constraints on their meaning), which may have caused these facts to appear more familiar themselves. Contrary to this alternative, children did not report more knowledge of the low-frequency words when they were embedded in kind-wide facts as compared with individual-specific facts. Moreover, the predicted difference in knew-it-all-along impressions between facts about kinds and facts about individuals was obtained even when we excluded from consideration all items for which children thought they knew the low-frequency words.

Experiment 3 established three further conclusions. First, it suggested that the generic knew-it-all-along effect was not an artifact of the specific foils used in Experiments 1 and 2, which described one-time events ("Last night . . ."). Even when we changed the specific facts so that they describe habitual properties instead, these facts still evoked fewer knew-it-all-along impressions than the facts about kinds. Second, this experiment suggested that the generic knew-it-all-along effect was not due to a task-induced pressure to claim knowledge of the generic facts. Even when we (a) further reduced any such pressure (e.g., by introducing eight familiar fillers that enabled children to truthfully demonstrate their knowledge); and (b) screened out any children who believed the experimenter to be knowledgeable (despite the many suggestions to the contrary provided throughout the task), the results still uncovered a robust generic knew-it-all-along effect. Third, Experiment 3 provided a more sensitive test of the "meaning through generics" alternative: Instead of asking children if they knew the low-frequency words, we asked them whether these words would be easy or hard to guess. Nevertheless, adjusting for children's responses to this question had no effect whatsoever on the magnitude of the generic knew-it-all-along effect (similarly to Experiment 2). Together, these results suggest that the source of the generic knew-it-all-along effect lies in children's hypothesized difficulty recognizing that they have learned generic facts rather than in our choice of comparison facts, the manner in which these facts were presented to children, or children's inferences about the meaning of the low-frequency words.

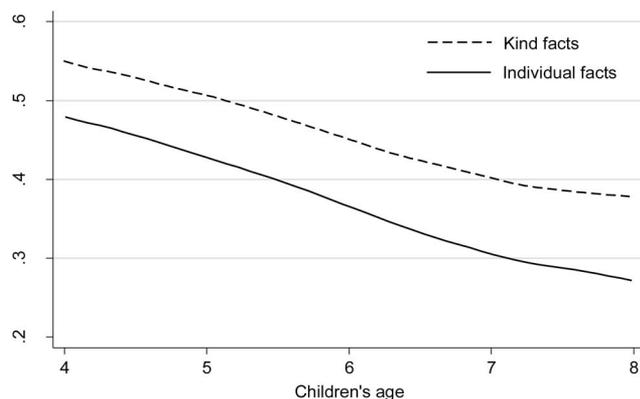


Figure 1. The relationship between the proportion of knew-it-all-along responses to Kind and Individual facts and children's age (Experiments 1, 2, 3, and 5). This graph was generated via local-mean smoothing with the *lpolys* command in Stata 12 (with bandwidth = 1). Local-mean smoothing provides a flexible way of plotting the relationship between two variables without having to make a priori assumptions about the shape of their relationship.

In Experiment 4, we tested whether it is information about kinds *per se* or simply information about multiple individuals that causes heightened knew-it-all-along impressions. The results revealed no significant difference in the number of knew-it-all-along errors between (nongeneric) plural and singular facts, which reinforces the unique status of generic information in children's thinking. Additional support for this conclusion was provided by our finding that the difference in knew-it-all-along errors between the generic and the specific facts in Experiments 1–3 was significantly greater in magnitude than the difference between the plural and the singular facts in Experiment 4 (albeit only marginally so). Finally, this experiment tested the alternative possibility that children in Experiments 1–3 had used their relative familiarity with the protagonists of the generic versus specific facts (e.g., dogs as a kind [familiar] vs. the dog in the picture [unfamiliar]) to answer the prior-knowledge questions. Such a familiarity rule should lead children to give more knew-it-all-along responses to the plural facts than to the singular facts about unfamiliar individuals (because, for instance, children are familiar with some dogs but not with the dog in the experimenter's pictures.) The fact that children's responses showed no such difference in Experiment 4 speaks against the possibility that they were using a superficial familiarity rule to answer the experimenter's questions.

In Experiment 5, we further highlighted the robustness and breadth of the generic knew-it-all-along effect by showing that it holds when using facts (a) whose genericity was expressed with a different type of noun phrase than in previous studies (namely, an indefinite singular noun phrase); (b) whose structure was more closely matched across the generic and specific sets than in previous studies; (c) that were novel solely by virtue of their content rather than by including unfamiliar words, as in previous studies (ruling out the possibility that the effect occurred simply because children ignored the unfamiliar words); and (d) that were about entities from different domains than in previous studies (namely, about people and inanimate objects). Moreover, this study found the predicted knew-it-all-along difference between generic and specific facts even though this manipulation was implemented between subjects rather than within subject, as in previous studies.

Experiment 6 provided one last bit of evidence against artifactual explanations of our findings. Specifically, this experiment suggested that the high prevalence of knew-it-all-along responses across our studies was most likely due, as we would expect, to children's inability to distinguish newly acquired knowledge from existing knowledge. When we drew children's attention to their ignorance of a fact prior to teaching them this fact, which arguably made it easier to recognize that something new was being learned, the number of knew-it-all-along responses dropped to near-floor levels even for young (4- and 5-year-old) children.

In light of all this evidence, we maintain that the most plausible explanation for the generic knew-it-all-along effect is that it stems from the privileged status of information about kinds in young children's thinking. Although the present data do not speak to the precise pathways by which this privileged status leads to heightened knew-it-all-along responses, there are at least two possible mechanisms that may underlie this effect. First, new information about kinds might be processed and integrated efficiently into children's existing memory structures (e.g., Cimpian & Erickson, 2012; Hollander et al., 2002; Riggs et al., 2014), which might in turn make it difficult for children to recall their prior state of

ignorance about this new information—especially considering their poor ability to reflect on and remember the sources of their knowledge (e.g., Roberts & Blades, 2000). Second, children may also rely on a belief that generic knowledge is widely shared (Cimpian & Scott, 2012) when trying to reconstruct whether they had prior knowledge of a newly learned generic fact. As a result, they may be even more likely to erroneously conclude that they already knew this fact. We expect that these two factors lead, either individually or jointly, to an inflated sense that newly learned generic information was known all along.

## Open Questions and Future Directions

These studies suggest several directions for future work. As just discussed, more research is needed to pinpoint the mechanisms behind the generic knew-it-all-along effect. Similarly, it would be worthwhile to identify the key qualities of generic facts that are responsible for this effect (e.g., their perceived importance, their memorability, the ease with which children understand and reason about them). In addition, assuming that generic facts retain their privileged status across development (e.g., Leslie, Khemlani, & Glucksberg, 2011; Sutherland, Cimpian, Leslie, & Gelman, *in press*), it is possible that adults would themselves show a generic knew-it-all-along effect, at least under some circumstances (e.g., with more challenging tasks similar to those used in studies of the hindsight bias). Finally, to explore the boundaries of this effect, it would be useful to investigate whether it holds for information about unfamiliar kinds, which might make it particularly easy for children to realize their prior ignorance (e.g., if one has never heard of echidnas before, then one couldn't have known much about them). Although prior research by Esbensen et al. (1997) suggests that children actually make frequent knew-it-all-along errors for facts about unfamiliar kinds, a direct comparison between closely matched generic and specific facts about members of such kinds would license stronger conclusions on this matter. In sum, future work could help to elucidate the scope of, and the mechanisms responsible for, the generic knew-it-all-along effect uncovered in the present studies.

## A Note Regarding the Magnitude of the Effects

Although the generic knew-it-all-along effect was obtained in four different samples of children (Experiments 1, 2, 3, and 5) and is thus a reliable, robust phenomenon, it is also true that the magnitude of this effect was often modest. Two considerations are relevant to interpreting this aspect of our results. First, it is important to keep in mind how similar the generic and specific facts were in our studies—these two sets of facts were identical in content and differed only in their genericity. Thus, it may not be surprising that the differences found in our studies were not dramatic. Second, we should point out that the delay between children's exposure to the new fact and the subsequent memory probe was very brief, on the order of a few seconds. The brevity of this delay leaves little time for children to forget what they used to think before they learned the fact, which in turn leaves limited room for the mechanisms hypothesized to underlie the generic knew-it-all-along effect to operate. For example, the shorter the delay, the less information children will need to "fill in" when trying to retrieve their prior knowledge states, and thus the less

likely it is that children will rely on their broad beliefs about the shared nature of generic knowledge (Cimpian & Scott, 2012) to reconstruct these prior knowledge states. Therefore, the knew-it-all-along differences between generic and specific facts may have been small in part because of the short delay between exposure to these facts and the memory probes. (This observation suggests another possible follow-up study that would manipulate the length of the delay and test for corresponding differences in the magnitude of the generic knew-it-all-along effect.) In sum, although the generic knew-it-all-along effect was robust and replicable, its magnitude in the current studies was small due in part to a few conservative design decisions.

### Further Theoretical Implications

The theoretical implications of finding that children experience heightened knew-it-all-along impressions for generic information extend beyond the proposal concerning the privileged status of kind representations in early conceptual development. For example, the evidence for a generic knew-it-all-along effect also brings to light an intriguing new aspect of the process of knowledge acquisition. If newly learned generic information appears to have always been known, this information is likely to also become particularly robust and hard to revise. In other words, children's belief that they have always known the generic facts they currently know may give these facts an aura of inviolable truth. To illustrate, without memory for the learning event, children would not be able to subsequently reevaluate the quality of the information learned by going back and considering the circumstances in which the learning took place (e.g., where, how, and from whom the information was acquired). This heightened tendency to forget the source of one's generic knowledge may be beneficial in some respects, because having this knowledge robustly encoded in semantic memory makes it readily available to guide one's reasoning about the world. The potential disadvantages are also apparent, though. Children are frequently exposed to generic information of which they should be skeptical, including stereotypes about different groups of people (e.g., Cvencek, Meltzoff, & Greenwald, 2011). A generic knew-it-all-along effect would make this questionable information harder to dislodge than if children were able to realize that this information had not always been in their possession.

The evidence for a generic knew-it-all-along effect also has implications for theories that chart the development of source memory. Although the development of children's ability to recall details of a learning event, such as how or from whom one learned some information, has been extensively investigated (e.g., Ghetti, Lyons, Lazzarin, & Cornoldi, 2008; Gopnik & Graf, 1988; Kovacs & Newcombe, 2006; Ratner, Foley, & Gimpert, 2002; see Roberts & Blades, 2000, for an excellent overview), comparatively little research has investigated—as we did—the more fundamental ability to recall *whether* one has learned anything at all (but see Gopnik & Astington, 1988; Taylor et al., 1994). Moreover, by manipulating the *content* of the information learned and demonstrating that such differences in content affect children's awareness of the learning event, the present research makes a novel contribution to an aspect of the development of source memory that has seldom been studied.

### Conclusion

In sum, the present studies suggest that children are particularly prone to believe they have known all along generic information they just learned. Rather than being a mere cognitive quirk, these errors may reveal a fundamental feature of the human mind—namely, that it privileges reasoning and learning about kinds.

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