Kind-Relevant Information Supports the Fast-Mapping of Novel Labels

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By school age, children can name most objects in their surroundings, understand their functions and some of their properties, and even know their individual histories. Children acquire this knowledge effortlessly and at a pace that is nothing short of impressive: between ages four and six, children learn about 7-10 words a day (Anglin, 1993). This is remarkable considering that words are not predictive of their meaning: nothing about chairs perceptually indicates that the word "chair" is linked to them. The nonpredictive pairing between word forms and their meanings needs to be stored in semantic memory, and children perform this task effortlessly.

Children's rapid acquisition of words has been extensively investigated. In their seminal study, Carey and Bartlett (1978) showed that limited exposure to novel words is sufficient for 3- and 4-year-olds to learn their meanings, and retain aspects of their meaning for a long time. Children learnt a novel color word, "chromium," and after a month, most of them remembered that "chromium" was a color term, but not the exact color. The phenomenon of quickly identifying and learning the meaning of a word, termed "fast mapping," has been documented for adjectives, nouns, and verbs (for a review, see Jaswal & Markman, 2001). Word learning is facilitated by the repetition (Woodward et al., 1994), or production of the novel word (Vlach & Sandhofer, 2012).

A less known factor is how word learning is influenced by other information children know about an object. For instance, children first ask about functions when exposed to novel artifacts (Greif et al., 2006). This suggests that children conceptualize artifacts in terms of their function, and prioritize this information when forming a new category. Additionally, children use functional knowledge to name novel objects (Kemler Nelson et al., 2003), suggesting a connection between functional information and labels in children's object representations. However, it is unclear how facts (like functions and properties of objects) and words (like object labels) interact in memory and whether knowledge about an object modulates the learning of its label. When each type of in-

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formation is paired with a different object, children can fast-map one label and one fact even when tested after one month (Markson & Bloom, 1997). Remembering novel information from brief exposures is remarkable in and of itself, yet research to date disregarded two crucial aspects of children's real-life experience. First, children are hardly ever exposed to one information item at a time. Introducing only one novel label (Markson & Bloom, 1997) may highlight its corresponding novel object, and oversimplify children's task. In preschool years, children are estimated to learn up to ten words a day. To better gauge children's fast mapping capacity and its specificity, our study introduced four information items (i.e. two labels and two facts). Second, in real-life settings labels and facts are not segregated between objects, but may appear together at the same time. The present study addressed questions about fast-mapping processes when labels and facts are paired together or presented separately for different objects.

An additional concern of this study is how different types of facts modulate the acquisition of object labels. Facts can refer to kinds (hereafter "kind-relevant facts"), or tokens (hereafter "individual-relevant facts"). Kind-relevant facts represent object properties (e.g., "*Tables are four-legged*") or functions (e.g., "*Pencils are for drawing*"). Individual-relevant facts reveal the history or individuating properties of an object (e.g., "*My T-shirt is blue.*"). The distinction between kind- and individual-relevant facts indicates their relation to an object kind (Gelman, 2003). Kind-relevant facts capture common properties considered essential for kind membership (e.g., "*Lamps make light*"). Individual-relevant facts distinguish members of a category (e.g., "*This lamp is red*"). Children interpret kind-relevant facts as essential for a category (Cimpian & Markman, 2009), and prioritize them in memory compared to information about individuals (Gülgöz & Gelman, 2015). Since object labels are attached to kinds, and not individuals, this conceptual difference is crucial when evaluating the interaction of labels and facts in memory.

In three experiments, we investigated short-term and long-term memory for labels, kind-relevant and individual-relevant facts paired with novel objects. Here the terms 'short-term' and 'long-term' memory distinguish between immediate (minutes after presentation), and delayed retention (days after presentation). We operationalised the contrast between kind- and individual-relevant facts as functionally-relevant information (about object kinds) versus historical information (about individuals). We designed an object-matching game to present children incidentally with information about novel objects while engaging them in another task. Items were introduced in an ostensive-communicative manner resembling natural social interactions. Children always heard four information items, two facts and two labels, but how they were associated to objects differed between experiments. In Experiment 1, facts and labels were introduced separately, one for each target object, and children were either exposed to kind- or individual-relevant facts (between-subjects). Their memory was tested immediately and after a one-week delay. In Experiment 2, a label and a fact (kind- or individual-relevant) were presented together for two target objects. In Experiment 3, a label and a kind-relevant information were introduced for two target objects with a time gap in between.

1. Experiment 1: Separate Information
1.1. Methods

Twenty-four preschoolers (M = 4.2; SD = 0.44 years; age range: 3.2 to 5.0 years) participated and were included in the final analysis. Five other children participated but were excluded from the design for not participating in the second session. Participants were tested in three kindergartens in Budapest and were native Hungarians. Parents gave their informed consent prior to children's participation.

The experimental game introduced novel objects and some information (labels, kind- or individual-relevant facts) about them to children.

Objects. The game used 10 objects and a game board: six novel and four familiar objects. Novel objects were created to avoid similarities to familiar objects, were similar in size, and could be easily distinguished from one another. The game board was 130 x 60 cm. in size, and had two sides displaying large photos of the 10 objects (see *Figure 1*). The photos and order of photos differed between the two sides.

Figure 1. (A) One side of the game board used in Experiments 1-3, displaying photos of each of the ten objects; (B) The other side of the same board.

Novel Labels. They followed a consonant-vowel-consonant-vowel (CVCV) structure ("*püke*" and "*kabó*"), complied to Hungarian phonotactics and were not close to Hungarian words known to children.

Individual-Relevant Facts. We used two such facts: "*I got this from my grandma*" and "*I bought this in Szeged*" (Szeged is a Hungarian city). These phrases presented information about the history of individual objects, and could apply only to a token as opposed to a kind. The facts were opaque and unrelated to the appearance of the objects. The words and syntactic constructions were simple and known by 4-year-olds.

Kind-relevant Facts. The two facts were: "*This shines in the dark*" and "*This floats on water.*" The phrases syntactically referred to individuals, but introduced functions or properties ("projectible properties," see Goodman, 1983) that could apply not only to an individual, but to an object kind. The kind-relevant information was not accessible visually, could apply equally well to any of the objects in the game, and could not be probed during the game. This ensured that children could learn the kind-relevant information only from the Experimenter. The words and grammatical constructions were known by 4-year-olds.

Children were tested individually in a quiet room. The experiment had two sessions, with a one-week gap in between (Figure 3). Children were randomly assigned to the Individual- or the Kind-relevant Facts conditions. Participants sat at a table with the game board, opposite the Experimenter, who had a box with the objects on her side. The first session consisted in the Training, Induction, and Immediate Test Phase. In the Training Phase children learnt the game. The Experimenter took the objects out of the box, one by one, and children matched them to their picture on the board. When children misplaced objects, they were instructed to look again and find the right photo. If children failed repeatedly, the Experimenter showed them the correct placement. After all objects were matched, the Experimenter put them back in the box with children's help, who handed objects one by one following the Experimenter's pointing instructions.

In the Induction Phase the Experimenter turned the game board on the other side. During this phase she provided novel information (two labels and two facts) about four target objects. The game continued as during the Training Phase: children matched objects to their photos. For each target object, the Experimenter presented a label or a fact, embedded in short sentences and repeated three times. For example, labels were introduced as *"Look! This is a püke. This is the püke. Where does the püke go?",* and facts were presented as *"Look! I got this from my grandma. This is the one I got from my grandma. Where does the one that I got from my grandma go?".* Participants heard two individual facts or two kind facts, depending on their assignment. The target objects were the same for all children, but the object-information pairing was counterbalanced across participants. The presentation of labels and facts alternated. Non-target objects were accompanied by phrases such as "*I will put this here*" or "*We also have this one*". They were presented in a random order, three always intercalated between the four target objects, and the other three before the first or after the last target object.

In the Immediate Test Phase the Experimenter asked participants to help her put the objects back in the box, starting with two target objects and using the novel information to refer to them. The first question tested the retention of a label (e.g., "*Can you give me the püke?*"); the second question tested a fact (e.g., "*Can you give me the one that my grandma gave me?*"). Children received no feedback for their responses. The labels and facts tested in the first and second sessions were counterbalanced across participants. The first session lasted 8 minutes on average. The second session took place after one week. When the participants entered the testing room, they found the ten objects matched to their photos. Children were reminded of the game and were instructed to help the Experimenter place the objects back into the box. As in the Immediate Test Phase, the first two questions tested the retention of one label and one fact, those items that had not been tested the previous week. The second session lasted 2 minutes on average.

Both sessions were video-recorded for further analyses. A second passive experimenter was in the room during the sessions; she never interacted with the participants but rated their responses. These responses were double-checked by the experimenters against the recordings after the sessions.

1.2. Results

Participants' responses were coded correct if the object they selected during the test phases corresponded to the information they had been presented during the Induction Phase for that particular object. Each participant provided four data points in total: one for a label and one for a fact per session.

Chance level was calculated for labels as 1/6 (0.16), assuming that the participants considered that the label referred to one of the six novel objects. Chance level for facts was calculated as 1/9 (0.11) given that facts could refer to any of the nine objects still on the board when the question was asked (the label question was first, so one object was in the box when facts were tested). Binomial cumulative probability tests showed that, in the Immediate Test Phase, performance was above chance for the Kind-revelant Facts group (labels: 6/12, $p = .008$; facts: 11/12, $p < .001$) as well as for the Individual-relevant Facts group (labels: 6/12, $p = .008$; facts: 7/12, $p < .001$). After one week, children responded above chance only for the facts in the Kind Facts group (10/12, $p < .001$) (see Figure 2).

We further analyzed children's responses as a function of condition and test delay for facts and labels separately.

Facts. An overall analysis of correct answers for facts was performed using a Binomial Generalized Linear Model along two factors: Condition (Kind Facts vs. Individual Facts) and Test (Immediate vs. One-Week-Delay). We found a main effect of Condition (Wald $\chi^2(1) = 14.96$, $p < .001$), with a better performance for Kind Facts (M = .875) than for Individual Facts (M = .375). To explore this difference, we performed Fisher's exact tests. Performance was better for Kind than Individual Facts in the One-Week-Delay Test ($p = .003$), yet there was no difference between them immediately ($p = .155$). The effect of Test did not reach significance (Wald $\chi^2(1) = 3.25$, $p = .072$), but there was a trend towards a better performance in the Immediate (M = .75) compared to the One-Week-Delay Test (M = .50). To test whether the lower performance for Individual Facts reflected difficulty in encoding one of the facts, we conducted a Fisher's exact test and found no difference between "*I got this from my grandma*" and "*I bought this is Szeged*" ($p = .400$).

Labels. A binomial GLM on correct answers for labels with Condition (Kind vs. Individual Facts) and Test (Immediate vs. One-Week-Delay) as factors revealed a main effect of Test (Wald $\chi^2(1) = 10.91$, $p < .001$), due to a better performance immediately (M = .50) than after a delay (M = .08). The effect of Condition and the interaction were not significant.

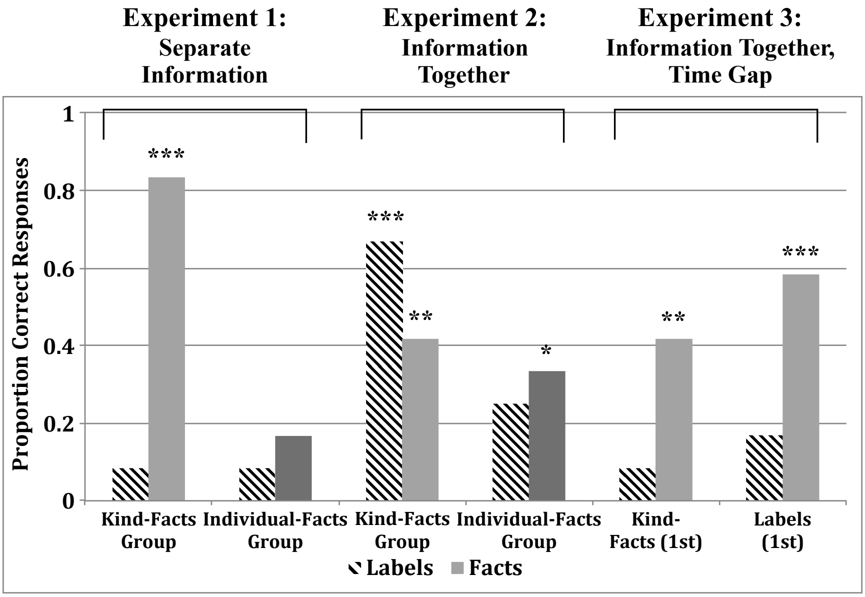

Figure 2. Proportion of Correct Responses after a 1-week delay for Experiments 1-3. Labels are presented in the black and white dashed columns, kind-relevant facts are displayed in light grey, and individual-relevant facts are in dark grey. Stars indicate significance against chance level. For labels, chance level was 1/6, while for facts it was calculated as 1/9.

1.3. Discussion

We found that, overall, children remembered kind-relevant better than individual-relevant facts. This is in line with previous research showing a more robust memory for kind-relevant facts than for idiosyncratic information about individuals (Cimpian & Erickson, 2012; Gelman & Raman, 2007). We found this advantage in the absence of common generic forms. Here, genericity could only be inferred from the projectibiliy and functional significance of the properties of individual objects. Children base their object categorization and naming on functional information (Kemler Nelson et al., 2003). Here, kind-relevant facts might have provided the basis for conceptually understanding novel kinds of objects. The functionally-relevant information was introduced ostensively, which favors the interpretation that this information refers to kinds, and not tokens (Csibra & Gergely, 2009; Csibra & Shamsudheen, 2015).

By contrast, individual-relevant facts displayed information about object history. Preschoolers understand object-specific properties, such as their history or who they belong to (Gelman et al., 2012). Crucially, in the first session performance was the same for kind and individual-relevant facts. Thus, the superior retention of kind facts cannot be attributed to a difference in the level of interest between the types of facts, but reflects a faster rate of forgetting of individual compared to kind-relevant facts.

The memory for labels decayed significantly over time, resulting in a chance level performance after a one-week delay. This is surprising, considering that preschoolers learn roughly 10 words per day (Anglin et al., 1993), most of which are labels. In previous experiments, children fast-mapped a label for up to a month after exposure (Carey & Bartlett, 1978; Markson & Bloom, 1997), when presented with only one label. Here we introduced two labels to avoid highlighting one single object (Axelsson & Horst, 2013). Thus, our results in the second session might reflect a computational limitation and difficulty in retaining two novel items in long-term memory after a brief presentation.

Previous studies showed that repetition (Woodward et al., 1994), and prompting learners to produce the novel words (Haley & Sandhofer, 2012) boost word acquisition. Beyond these manipulations targeting the strength of the novel lexical item, semantic information about the referent may also facilitate the retention of word-referent mappings. This is especially likely for kind-relevant information about the object, since these facts are robustly represented in memory and could act as anchors for labels. This hypothesis was explored next. In Experiment 2, we tested whether knowing a fact about an object benefits the memory for that object's label. We used the same task as in Experiment 1 with two notable differences: first, we used two target objects per participant; second, each target object was presented with a label and a fact.

2. Experiment 2: Information Together

2.1. Methods

Twenty-four Hungarian children (M = 4.3 years; SD = 0.42 years; age range: 3.4 to 4.8 years) were included in the final analyses. Seven children participated but were replaced in the final design due to failure to complete the second session.We used the same objects, labels and facts as in Experiment 1. The procedure was identical, except for a crucial difference in the Induction Phase (see Figure 3). Here the four information items were paired (one label + one fact) and assigned to two target objects. The information was embedded in sentences, and each item was repeated three times, alternating the presentation of the label and the fact. For example, in the Individual-relevant Facts condition the information was introduced as follows: *"Look! This is a püke. I got this from my grandma. This is the püke that I got from my grandma. Where does the püke that I got from my grandma go?"*. The Kind-relevant Facts condition followed the same pattern: *"Look! This is a püke. This is the one that shines in the dark. This is the püke that shines in the dark. Where does the püke that shines in the dark go?"*. For half of the participants we used two target objects from Experiment 1, and for the other half we used the other two target objects. Each session tested the retention of one label and one fact, corresponding to different target objects.

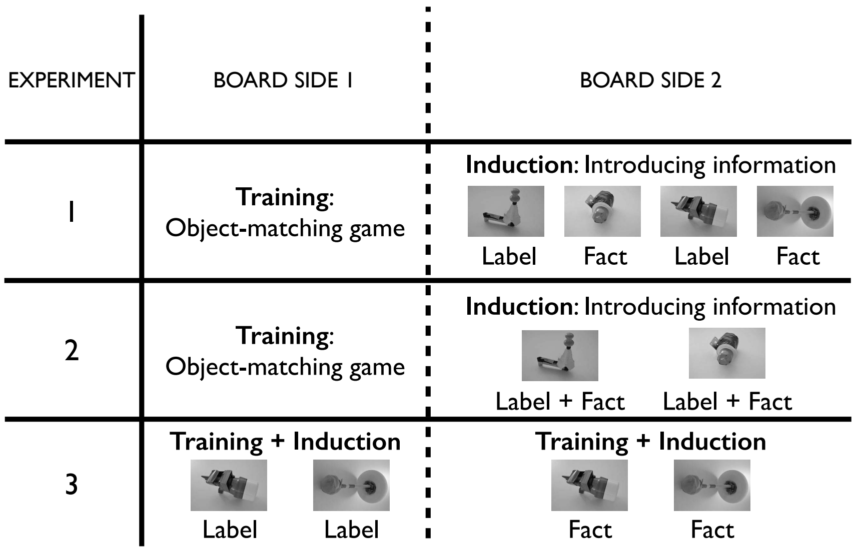

Figure 3. Schematic representation of the Training and Induction Phases for Experiments 1-3.

2.2. Results and Discussion

Performance in the Kind-relevant Facts condition was above chance immediately (labels: 8/12, p < .001; facts: 9/12, p < .001), and also after one week (labels: 8/12, p < .001; facts: 5/12, p = .007; see Figure 2). In the Individual-relevant Facts condition, only labels were retained above chance immediately (labels: 6/12, p = .008; facts: 3/12, p = .138), but only the facts were remembered after one week (labels: 3/12, p = .320; facts: 4/12, p = .035).

Facts. A binomial GLM on the correct responses as the dependent variable, with Condition and Test as factors revealed a main effect of Condition (Wald $\chi^2(1) = 4.29$, p = .038). Children remembered Kind (M = .58) better than Individual-relevant Facts (M = .29). A Fisher's exact test revealed no difference in performance between the two Individual-relevant facts (p = .370).

Labels. A similar analysis for labels revealed a main effect of Condition (Wald $\chi^2(1) = 4.22$, p = .039), due to a better memory for labels presented together with Kind Facts (M = .67) compared to labels presented with Individual Facts (M = .38).

We found again an advantage in remembering kind-relevant facts compared to individual-relevant facts, confirming the results of Experiment 1. However, the results for labels were different. When introduced together with the label for the same object, the type of fact modulated label retention. Labels paired with a kind-relevant fact were better retained than labels paired with an individual-relevant fact. Moreover, presenting labels and facts together led to above-chance performance after a week, only when the facts were kind-relevant. Our interpretation is that children interpret functionally-relevant information about a novel artifact as applicable to a kind, of which the object in hand is an exemplar (Csibra & Shamsudheen, 2015). This functional information is treated as generic for a novel object kind, worth storing in memory for later use together with the visual features of the exemplar. Functionally-irrelevant information, like individual-relevant facts, is not indicative of the object kind, and it does not call for positing a novel object kind. The superior memory for kind-, compared to individual-relevant facts may indicate that children do not link verbally conveyed information directly to object appearance in their memory (which would have predicted no difference between conditions), but via a postulated object kind. Furthermore, the representation of this postulated object kind stores not only conceptual (such as functionally-relevant properties) and perceptual information (such as visual features of the exemplar) about the kind, but also allows children to map a label applied to an exemplar to the new object kind. Thus, children's better memory for labels linked to kind-relevant facts might be due to the representation set up for a novel object kind, which in turn depends on the availability of conceptual information about the kind.

This account predicts that children learn labels more easily for objects about which they possess conceptual information than for objects without such information. This is not necessarily true the other way around: having a label for an object may not promote the memory for kind-relevant information about the same object. To this end, Experiment 3 explored the relation between labels and kind-relevant information. We investigated whether the order of presentation of labels and kind-relevant facts differentially affected the retention of words. We introduced a time gap between the presentation of kind facts and labels to explore if children can tie these two information items together in memory when they are presented separately.

3. Experiment 3: Information Together, Time Gap

3.1. Methods

Twenty-four Hungarian children (M = 4.3 years; SD = 0.49 years; age range: 3.6 to 5.7 years) were included in the final analyses. Ten additional children participated but were replaced in the final design because they did not complete the second session (9) or they had a special needs profile (1).

The same objects, labels and kind-relevant facts as in Experiment 1 were used. No individual-relevant facts were introduced during this experiment. The procedure was similar to the Kind-relevant Facts condition of Experiment 2, as there were two target objects, each introduced with a label and a fact. The crucial difference was that the label and the fact associated to the same object were presented apart in time and on different sides of the board (Figure 3). On one side of the board, the two target objects were assigned labels, while on the other side of the board the same target objects were assigned facts. Depending on the condition (Labels First or Facts First), children received one or the other type of information first. This study had no separate Training Phase.

3.2. Results and Discussion

Correct and incorrect responses, as well as chance level for labels and generic facts were calculated like in Experiment 1.

In the Facts First condition, performance was above chance in the immediate session for both facts and labels (labels: 5/12, $p = .031$; facts: 5/12, $p = .007$), while after a one-week delay only the facts were still remembered (labels: 1/12, $p = .877$; facts: 5/12, $p = .007$). On the other hand, when labels were presented on the first side of the board (Labels First condition), only facts were retained above chance in both sessions (Immediate Session: 7/12, $p < .001$; 1-week Delay Session: 5/12, $p < .001$; see Figure 2).

Facts. We ran a binomial GLM on the correct responses for facts with Test (Immediate vs. One-Week-Delay) and Condition (Labels First vs. Facts First) as factors. This analysis revealed no significant effects.

Labels. A similar binomial GLM on the correct responses for labels revealed no significant results.

In this experiment, after a week, kind-relevant facts were well-retained in children's memory, but labels were forgotten. In Experiment 2, when presented concomitantly for an object, kind-relevant facts supported the long-term retention of labels. Against our prediction, the order of presentation did not modulate the long-term retention of labels. This suggests that, when children encountered a target object for the second time in the Facts First condition, they did not spontaneously recall the fact previously learnt about that object. Had they recalled this information, the label attached to the object could have been linked to the generic property, and would have enjoyed privileged memory as in Experiment 2. Nevertheless, in the first session, labels were remembered only in the Facts First condition, indicating that facts may have facilitated word learning. This result may also simply reflect a recency effect (in this condition, labels were presented closer to the first test phase).

Overall, performance in Experiment 3 was lower than in Experiments 1 and 2. We attribute this difference to the absence of a training phase, which may have increased children's attention to the matching game, and reduced their attention to the incidental information about the objects.

4. General Discussion

In natural social interactions, children learn new words and facts incidentally, from an intermixed input. Knowing that children prioritize the retention of kind-relevant information over information about tokens (e.g., Cimpian & Erickson, 2012), here we asked how novel words (labels for objects) interact in memory with each of these two types of facts (kind- and individual-relevant) when presented together for the same object. Here we implemented this fact distinction by using functional properties of objects (kind-relevant) and historical properties (token-relevant). We found that kind facts were prioritized and stable in children's memory. When presented together for the same object at the same time, kind facts supported the long-term retention of labels.

Across three experiments, we consistently found that kind-relevant facts were robust in children's memory even after brief incidental presentations during a game. Our kind-relevant facts introduced projectible (i.e., functionally relevant) properties of objects. Our findings support previous research showing that children prioritize category-relevant information about objects in memory (Kelmer-Nelson et al., 2004). Though we did not test directly children's generalisations of functional information to other exemplars, previous studies support this interpretation. Children show robust biases to spontaneously generalise to categories, when presented with specific, quantified, or generic statements (Leslie & Gelman, 2012; Gelman et al., 2015). Nevertheless, there may also be alternative explanations for the effect we found. One possibility is that fact retention was modulated not by kind relevance, but by how useful the information item was for potential future use of the object in hand: functional properties were highly relevant, while object histories were irrelevant. Although this interpretation might not entail the extension of the function to other exemplars of the same kind, it still posits that this fact was interpreted as generic on the temporal dimension. Another alternative explanation is that the kind-relevant facts we used were more unusual than the individual facts and hence they were more informative. This account could hardly hold for our facts: both kind-relevant facts introduced properties already familiar to children this age, and the individual-relevant facts presented low probability information about objects' history. A third possible explanation is that our individual-relevant facts claimed ownership (by the Experimenter), which reduced their relevance, as the probability for children to interact in the future with objects owned by someone else was limited. Other studies found a reduced memory for information about particulars, even when no ownership information was conveyed (Gelman & Raman, 2007). In addition, none of these alternative explanations accounts for the superior memory for object labels introduced with kind-relevant facts, which we found in Experiment 2. Importantly, in our study, we used phrases that, on the surface, applied both kind-relevant ("This floats on water") and individual-relevant ("I bought this in Szeged") facts to individuals. Kind or individual relevance was conveyed not by the syntax, but by the semantic content of the phrase: projectible properties/functions for the kind-relevant facts, and individual histories as individual-relevant facts. Children's differential treatment of these facts suggests that they understand the types of properties that objects belonging to the same kind tend to share, and prioritize this information in memory.

The superior memory for labels, when presented together with kind-relevant facts indicates that memory decay for labels in all the other experiments was not due to computational limitations. Our results go against accounts of word learning as a process of storing associations between visual characteristics of objects and arbitrary speech sounds in memory. Such an account would have predicted no differences in performance for labels between conditions. In contrast, our findings reflect that object labels are attached to kind concepts that are stored in semantic memory, rather than to individual objects. In this context, our findings indicate that it is easier, or children are more motivated, to set up a kind placeholder for a novel object when conceptual information (e.g., a functional property) is available. Such a placeholder can store, beyond conceptual information, both the perceptual properties of the exemplars of kind members (in our experiment, the visual features of the novel object), and a label for the kind, if provided. In fact, some studies suggest that pre-existing conceptual knowledge supports the fast learning of labels even in infancy (e.g., Yin & Csibra, 2015). In Experiments 1 and 2, hearing the kind-relevant facts prompted children to recall the object kind, which reminded them of the perceptual features of the object belonging to that kind. In the absence of a kind concept associated with them, individual-relevant facts lacked the power to do so. In Experiment 2, the kind placeholder produced in response to the kind-relevant information about the exemplar, provided a seat to accommodate the concurrently presented label, which in turn was sufficient for identifying the object.

Nevertheless, the results of Experiment 3 suggest that knowing the function of an object was not sufficient for remembering its label days later. When kind-relevant facts and labels were introduced for the same objects with a 2-minute gap in between, the labels were not remembered a week later. The different results between Experiments 2 and 3 indicate that the perceptual features of the labelled object did not reactivate the conceptual information previously associated with it. Had this been the case, we should have found superior memory for labels in the Facts First condition of Experiment 3. This suggests that semantic memory is organized in conceptual rather than perceptual terms. If this is true, then receiving conceptual information primes recalling perceptual information about the associated object via the kind placeholder, which leads to high memory performance. Yet, seeing the object does not obligatorily bring the associated kind concept into mind, a necessary step for linking the label and kind-relevant fact when introduced with a time gap in between. This account is consistent with findings from adult participants that semantic memory is organized along conceptual ('pizza' primes 'hot dog') rather than along perceptual features ('pizza' does not prime 'coin'; Pecher et al., 1998).

We find it remarkable that children display a robust memory for kind-relevant facts, which in turn facilitate the storage of novel words in memory. This finding contributes to our understanding of what information children learn on the basis of minimal exposure, how information is organized in semantic memory, and the contexts that support the long-term memory for novel object labels.

References

Anglin, Jeremy. M., Miller, George A., & Wakefield, Pamela C. (1993). Vocabulary development: A morphological analysis. *Monographs of the Society for Research in Child Development*, 58(10), s-238.

Axelsson, Emma L., & Horst, Jessica S. (2013). Testing a word is not a test of word learning. *Acta Psychologica*, 144(2), 264-268.

Carey, Susan, & Bartlett, Elsa (1978). Acquiring a Single New Word. *Proceedings of the Stanford Child Language Conference*, 15, 17-29.

Cimpian, Andrei, & Erickson, Lucy C. (2012). Remembering kinds: New evidence that categories are privileged in children's thinking. *Cognitive Psychology*, 64(3), 161-185.

Cimpian, Andrei, & Markman, Ellen M. (2009). Information learned from generic language becomes central to children's biological concepts: Evidence from their open-ended explanations. *Cognition*, 113(1), 14-25.

Csibra, Gergely, & Gergely, György (2009). Natural pedagogy. *Trends in Cognitive Sciences*, 13(4), 148-153.

Csibra, Gergely, & Shamsudheen, Rubeena (2015). Nonverbal generics: Human infants interpret objects as symbols of object kinds. *Annual Review of Psychology*, *66*, 689-710.

Gelman, Susan A. (2003). *The essential child: Origins of essentialism in everyday thought*. Oxford Series in Cognitive Development.

Gelman, Susan A., Manczak, Erika M., & Noles, Nicholaus S. (2012). The nonobvious basis of ownership: Preschool children trace the history and value of owned objects. *Child Development*, 83(5), 1732-1747.

Gelman, Susan A., & Raman, Lakshmi (2007). This cat has nine lives? Children's memory for genericity in language. *Developmental Psychology*, 43(5), 1256.

Gelman, Susan A., Leslie, Sarah- Jane, Was, Alexandra M., & Koch, Christina M. (2015). Children's interpretations of general quantifiers, specific quantifiers and generics. *Language, Cognition and Neuroscience*, *30*(4), 448-461.

Goodman, Noah (1983). *Fact, fiction, and forecast.* Harvard University Press.

Greif, Marissa L., Kemler Nelson, Deborah G., Keil, Frank C., & Gutierrez, Franky (2006). What do children want to know about animals and artifacts? Domain-specific requests for information. *Psychological Science*, 17(6), 455-459.

Gülgöz, Selin, & Gelman, Susan A. (2015). Children's recall of generic and specific labels regarding animals and people. *Cognitive Development*, 33, 84-98.

Jaswal, Vikram K., & Markman, Ellen M. (2001). Learning proper and common names in inferential versus ostensive contexts. *Child Development*, 72(3), 768-786.

Kemler Nelson, Deborah G., Russell, Rachel, Duke, Nell, & Jones, Kate (2003). Two−year−olds will name artifacts by their functions. *Child Development*, 71(5), 1271-1288.

Leslie, Sarah-Jane, & Gelman, Susan A. (2012). Quantified statements are recalled as generics: Evidence from preschool children and adults. *Cognitive Psychology*, *64*(3), 186-214.

Markson, Lori, & Bloom, Paul (1997). Evidence against a dedicated system for word learning in children. *Nature*, 385(6619), 813.

Pecher, Diane, Zeelenberg, René, & Raaijmakers, Jeroen G. (1998). Does pizza prime coin? Perceptual priming in lexical decision and pronunciation. *Journal of Memory and Language*, *38*(4), 401-418.

Vlach, Haley, & Sandhofer, Catherine M. (2012). Fast mapping across time: memory processes support children's retention of learned words. *Frontiers in Psychology*, 3, 46.

Woodward, Amanda L., Markman, Ellen M., & Fitzsimmons, Colleen M. (1994). Rapid word learning in 13-and 18-month-olds. *Developmental Psychology*, 30(4), 553.

Yin, Jun & Csibra, Gergely (2015). Concept-based word learning in human infants. *Psychological Science, 26*(8), 1316-1324.

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