CHILDREN’S UNDERSTANDING OF SUBORDINATE KIND AND BRAND CATEGORIES

by

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B.A., The University of British Columbia, 2018

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

The Faculty of Graduate and Postdoctoral Studies

(Psychology)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

August 2021

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Children’s Understanding of Subordinate Kind and Brand Categories

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the degree of  Master of Arts
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Abstract

Prior research has left it unclear whether – and if so when – children understand two distinct types of category of manufactured objects: kind categories defined by the maker’s intended function and brand categories defined by the maker’s identity. In three studies, 408 4- to 8-year-olds and adults participated in a forced-choice task in which they extended a novel label from one manufactured household object (the target) to another object that shared either the maker's intended function (the kind) or the maker's identity (the brand). By five years, participants who were introduced to a novel name for the target's brand were significantly more likely to select the object that matched in terms of the maker's identity than those who were introduced to a novel noun for the target's kind. Additionally, by five years, participants who heard a kind label systematically chose the object that shared the maker's intended function. By age seven, participants who heard a brand label systematically chose the object that shared the maker's identity. These findings indicate that children as young as five years understand kinds and brands as distinct types of artifact category, though their knowledge of kind categories may emerge earlier than that of brand categories. We discuss the implications of these results for our understanding of children’s knowledge and learning of subordinate categories, as well as the development of their knowledge of artifact categories.
**Lay Summary**

We encounter countless manufactured objects in our daily lives, but how do we organize them into categories? One well-studied way to categorize manufactured objects is by kind: categories that reflect a shared maker's intended function, labelled with common nouns. A less-studied way to categorize manufactured objects is by brand: categories based on the maker's identity, labelled with proper names. Past work leaves open the question of whether children, like adults, have distinct representations of kind and brand categories. This research reveals that children as young as five years distinguish between the two types of categories, though their understanding of kind categories appears to arise earlier (by five years) than their understanding of brand categories (by seven years). We discuss the implications of our findings for our understanding of children’s knowledge and learning of artifact categories.
Preface

This thesis is an original, unpublished intellectual product of the author, E. Dharmawan. The research was conducted by the author at the University of British Columbia under the supervision of D.G. Hall, who was heavily involved in the research design, writing process and data analysis. All work and associated methods were approved by the University of British Columbia’s Research Ethics Board (H20-00496: Categorizing and evaluating artifacts by maker).
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Acknowledgements

First and foremost, I would like to thank my advisor, Geoff Hall, for his continuous guidance, patience and support. Thank you for constantly challenging me to think critically and making me a better researcher.

Thank you to my committee members, Andy Baron and Janet Werker, for encouraging me to think about my research interests through different perspectives. Your feedback has been invaluable.

To the members of the Language Development Centre, past and present, in particular, Lauren Denusik, Davin Kim and Eugene Maltsev thank you for keeping me sane throughout the entirety of the program. The incredible work you have done at the lab has helped me immensely and does not go unnoticed. To Jennifer Campbell, Kristan Marchak and Kyle Dadgar thank you for your words of encouragement and your advice throughout my master’s degree.

To the Developmental area specifically, Denitza Dramkin and Carolyn Baer, thank you for your support. I don’t know what I would have done with your advice.

To the friends who provided me with emotional support, thank you all for sitting through rounds of practice.

Thank you to the children, caregivers and teachers that participated in or helped facilitate these studies. None of this work would have been possible without you.

To my family, thank you for allowing me to pursue my interests and passions. I’m sorry I introduced new labels for gloves, bowls, spoons and combs at home.
Introduction

Human artifacts (e.g., a car) may be categorized at multiple levels in an inclusion hierarchy, from the superordinate (e.g., VEHICLE), to the basic (e.g., CAR) to the subordinate (e.g., CONVERTIBLE, STATION WAGON). Prior research has established the psychological primacy of the basic level: Children typically learn basic-level categories earlier than those at other levels and people show greater accuracy in categorizing using basic-level categories than those at other levels (for a review, see Murphy, 2002; see also Markman, 1989). The advantage of basic-level categories over those at the subordinate level is often attributed to the fact that categories at both levels are similarly informative but basic-level categories are significantly more distinctive (Murphy & Brownell, 1985). Specifically, artifact categories at both the basic level and the subordinate level typically include members that share the same general function and form, but basic-level categories lack the additional specific criteria that make members of subordinate-level categories less distinguishable from each other (Murphy & Lassaline, 1997; Tversky & Hemenway, 1984). The current research explores a previously unexamined difference between two types of subordinate-level artifact category, asking whether this difference affects when and how children learn them.

Past research has focused on one particular type of subordinate-level artifact category, typically labelled by a simple (“convertible”) or compound (“station wagon”) common noun. These linguistic expressions designate kinds in the adult language (e.g., Gelman, 2003; Macnamara, 1982; Matan & Carey, 2001). Yet prior investigations of artifact categorization have often also included subordinate-level stimuli of a different type, those that are labelled by expressions with proper names, which designate brands in the adult language (Clankie, 2000). For example, McMullen and Purdy (2006; see also Collin, 1999; Collin & McMullen,
2005; Vitkovitch & Tyrell, 1999) used “Corvette” and “Porsche” alongside “limousine” and “hatchback” as subordinate to “car”; “Concorde” in addition to “glider” as subordinate to “plane”; and “Jet ski” along with “yacht” as subordinate to “boat”. Rosch, Mervis, Gray, Johnson and Boyes-Braem (1976) included “Phillips screwdriver” along with “regular screwdriver” as subordinate to “screwdriver”; and “Levis” alongside “double knit pants” as subordinate to “pants” (see also Tversky & Hemenway, 1984). See Figure 1. The conflation of common nouns (kind terms) and expressions with proper names (brand terms) in past research on subordinate-level categorization raises the question of whether there are any systematic differences between the two types of category.

![Figure 1. Example of an artifact category hierarchy.](image)

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1 In many languages, a number of proper names for brands have evolved into common nouns for kinds (e.g., “escalator”, “thermos” and “trampoline”) through the process of genericization (see Clankie, 2002). In this work, we focus on brand names, introduced as proper names, that designate the maker of a product.
The answer is yes: Within a basic-level artifact category, subordinate-level kind categories (labelled by common nouns) and subordinate-level brand categories (labelled by proper names) have different types of membership criteria. For kind subordinates, the criterion pertains to function, with different subordinate types having minor functional modifications, often associated with modifications to form potentially reflected in differences in parts or attributes (Murphy & Lassaline, 1997; Tversky and Hemenway, 1984). For example, CONVERTIBLE and STATION WAGON are subordinate-level categories whose members differ slightly in their makers' intended function (to allow or not to allow roofless driving), reflected in a function-related form difference (the presence or absence of a retractable roof). On the other hand, brand subordinates are distinguished by a different type of criterion: the identity of their maker, which may be indicated by a unique marking (e.g., a logo) and/or other proprietary features not linked to function. For example, CORVETTE and PORSCHE are subordinate-level categories whose members differ in their makers' identity (Chevrolet/General Motors or Porsche) signalled by a distinct logo (a stylized fleur-de-lis or a coat of arms with elements of the Free People's State of Wuerttemburg and the city of Stuttgart) and other perceptual features (distinctive bodywork) linked to the identity of the maker. To date, no research has explored whether the distinct membership criteria of subordinate-level kind and brand artifact categories affect when and how they are learned.

**Children's knowledge of artifact kind categories**

Prior research has provided evidence that young children understand that a shared intended function – specifically, the creator's intended function – is criterial for membership in a kind of artifact (e.g., Bloom & Markson, 1998; Chaigneau & Barsalou, 2008; Gelman & Bloom, 2000; Kelemen & Carey, 2007). Although the creator’s intended function is often
unknown to individuals other than the creator, it constrains the physical features (e.g., shape) of the product. Features like shape, therefore, are an important cue but not a requirement for membership in a particular kind category (Bloom, 1996). For example, Diesendruck, Markson and Bloom (2003) explored the role of function and form in preschoolers' extensions of common nouns for artifacts. Three-year-olds saw triads of novel objects, consisting of a target; a shape match that did not fulfill the same function as the target; and a function match that did not share the same shape as the target. Children extended a novel common noun given to the target to the function match but not to the shape match. Moreover, children were more likely to extend the novel common noun to the function match, when they knew the intended function of each object in the triad. These results indicate that children use intended function to guide their artifact kind categorization and that they do not use shape if shape is inconsistent with this intended function. Matan and Carey (2001) compared the role of the current intended function to that of the creator's intended function in artifact kind categorization. In their label judgement task, four- and six-year-olds learned about a familiar object (e.g., a watering can) that was made by the creator to fulfill the creator’s intended function (e.g., to water plants) but was currently being used by another person for another function (e.g., to make tea). They were then asked to categorize the object by choosing one of two familiar common nouns for it. Matan and Carey found that by six years of age, children chose the label that was consistent with the creator’s intended function (e.g., “watering can”) rather than the one that was consistent with the product's current intended function (e.g., “teapot”). This study indicates that young children rely specifically on the intended function of the creator when determining membership in a kind of artifact.
Children's knowledge of artifact brand categories

Much less is known about children's understanding that membership in a brand of artifact depends on the identity of its maker. Previous research indicates that by their second birthday, American children ask for some products using their brand name (Schor, 2004), and by the time they begin primary school, children can identify numerous – perhaps as many as 200 – products using their brand name (Arnas, Taş & Oğul, 2016; Derscheid, Kwon & Fang, 1996; McAlister & Cornwell, 2010; Schor, 2004; Valkenburg & Buijzen, 2005). McAlister and Cornwell (2010) found that 3- to 5-year-old Australian children could accurately sort the products of two competing brands (e.g., “Coke” and “Pepsi”) into two categories. Achenreiner and John (2003) showed 8-, 12-, and 16-year-olds pairs of identical-looking products (e.g., two pairs of jeans), one labelled with a prestige brand name (e.g., “Levi's”) and the other labelled with a non-prestige brand name (e.g., “K-mart”). Eight-year-olds attributed favourable evaluative statements (about the product or its users) equivalently to both products. By twelve years, children ascribed these favourable evaluative statements more to the artifact with the prestige brand name. Prior work thus indicates that children associate both perceptual and conceptual information with brand categories, but the research does not indicate whether or when children recognize that a specific maker is criterial for membership in a brand category (Clankie, 2002).

Children's knowledge of subordinate-level categories

The existing evidence leaves it unclear whether – and if so, when in development – children understand the distinct membership criteria underlying subordinate-level kind and brand artifact categories. Prior work does indicate that children as young as two years can label and categorize objects at the subordinate level of abstraction, especially when they
know the common noun for the basic-level category (e.g., Gelman, Wilcox & Clark, 1989; Taylor & Gelman, 1989; Waxman & Hatch, 1992; Waxman, Shipley & Shepperson, 1991). For example, Waxman & Hatch (1992) found that three-year-olds produced subordinate category labels for familiar artifacts and natural kinds for which they already knew a basic-level category label. Yet this prior work did not probe the criteria underlying children's subordinate-level categories, leaving open if and when children understand that membership in a subordinate-level kind depends on the creator's intended function, whereas membership in a subordinate-level brand centres on the creator's identity.

**Current studies**

The current research explored whether – and if so, when – children understand that subordinate-level artifact kind categories (introduced with common noun labels) are organized in terms of the creator’s intended function whereas subordinate-level artifact brand categories (introduced with proper name labels) are organized in terms of the identity of the creator. In each study, participants saw triads of familiar artifacts from the same basic-level category and completed a task in which they were asked to extend a novel label from one (the target) to one of the two others (the kind match or the brand match). The kind match was described as having the same creator’s intended function but a different maker; the brand match was described as having the same maker but a different creator’s intended function. In addition, the kind match had the same shape, colour, size, and texture as the target (to indicate functional similarity), while the brand match had the same attached logo as the target (to indicate the same maker).

In this work, some participants heard the label introduced as a common noun marking a kind; others heard it introduced as a proper name marking a brand. If participants
understand that kinds and brands are distinct types of subordinate categories, we expected that participants would be more likely to extend the novel label to the brand match when it was introduced as a proper name for the brand than when it was introduced as a common noun for the kind. Further, if participants understand the distinct criteria underlying subordinate-level kind and brand categories, we expected that those who heard the label introduced as a common noun for the kind would systematically extend it to the kind match, whereas those who heard it introduced as a proper name for the brand would systematically extend it to the brand match.

Experiment 1A was a test of the hypothesis with a sample of adults. Experiment 1B was a test of our hypothesis with a sample of four- to seven-year-old children. Experiment 2 was a modified replication of Experiment 1B with a new sample of four- to eight-year-old children, designed to test whether using simplified wording in the task would enhance children's tendency to map the proper name for the brand to the brand match. Finally, Experiment 3 was a modified replication of Experiment 2 with a new sample of six- and seven-year-olds, designed to test whether including the basic-level category term along with the proper name for the brand would increase children's choice of the brand match.
Study 1A

Method

Participants

48 English-speaking undergraduate students participated individually or in small
groups (of up to three) for university course credit. They were randomly assigned in equal
numbers to either the kind condition ($M_{age} = 19.79$ years, $SD = 2.02$ years, 17 females) or the
brand condition ($M_{age} = 19.83$, $SD = 1.69$, 20 females). Data from one adult were excluded
due to experimenter error.

Stimuli

There were four sets of stimuli, each consisting of three familiar household artifacts
from the same basic-level category (GLOVE, BOWL, SPOON, and COMB). Each triad
contained (1) a target with a fabric logo attached with a plastic tie (e.g., a thin glove with a
shamrock logo), (2) a kind match that had the same perceptual features (shape, colour, size,
and/or texture) as the target but had a different logo (e.g., a thin glove with an elephant logo),
(3) a brand match that had slightly different perceptual features (shape, colour, size, and/or
texture) from the target but had the same logo (e.g., a thick glove with a shamrock logo).
Table 1 lists all stimulus items, including the novel labels used for each set.
<table>
<thead>
<tr>
<th>Basic Level</th>
<th>Basic Level Function</th>
<th>Target Label</th>
<th>Target Object Description</th>
<th>Target Function</th>
<th>Brand Match Description</th>
<th>Brand Match Function</th>
<th>Kind Match Description</th>
<th>Kind Match Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowl</td>
<td>To hold your food</td>
<td>WIBBER</td>
<td>Small bowl with a bunny marker</td>
<td>To serve one person</td>
<td>Large bowl with a bunny marker</td>
<td>To serve two people</td>
<td>Small bowl with a star marker</td>
<td>To serve one person</td>
</tr>
<tr>
<td>Comb</td>
<td>To keep your hair neat and tidy</td>
<td>DAXIT</td>
<td>Short comb with an airplane marker</td>
<td>For short hair</td>
<td>Long comb with an airplane marker</td>
<td>For long hair</td>
<td>Short comb with a baseball marker</td>
<td>For short hair</td>
</tr>
<tr>
<td>Spoon</td>
<td>To help you eat and stir your food</td>
<td>BIZZLE</td>
<td>Large metal spoon with a flower marker</td>
<td>To eat soup</td>
<td>Small wooden spoon with a flower marker</td>
<td>To eat cereal</td>
<td>Large metal spoon with a bee marker</td>
<td>To eat soup</td>
</tr>
<tr>
<td>Glove</td>
<td>To keep your hands warm and clean</td>
<td>POGON</td>
<td>Thin glove with a shamrock marker</td>
<td>To wear in the fall</td>
<td>Thick glove with a shamrock marker</td>
<td>To wear in the winter</td>
<td>Thin glove with an elephant marker</td>
<td>To wear in the fall</td>
</tr>
</tbody>
</table>

*Table 1. Stimulus sets. Each object set was comprised of three objects of the same basic-level kind.*
Additional materials were (1) three black placemats of the same size, with three cards (marked A, B, and C) to allow participants to indicate their object choices during the task, (2) a response booklet which included spaces for participants to record their answers, and (3) a small stuffed monster used to keep the task engaging for children (who were tested in Experiment 1B, 2 and 3) and to keep the procedure comparable for both groups.

**Procedure**

The experimenter sat at a table across from the participant(s) and introduced their stuffed monster friend, noting that they would be using it to keep the procedure comparable to the procedure that was followed with children. The experimenter told participants that they would hear some simple stories and be asked to respond to some simple questions. They asked participants to answer using their first intuitions and told them that there were no right or wrong answers. The procedure involved four trials, each with a different stimulus set, and each consisting of three parts: training, labelling and testing phases. The order of the four sets was counterbalanced across participants. We will describe a trial, using the GLOVE stimulus set as the example.
Training Phase. The experimenter placed the three objects from the stimulus set on separate placemats in front of the participant(s). The target (a thin glove with a shamrock logo) was put on a placemat (with a card marked A) in the middle, closer to the experimenter. The kind match (a thin glove with an elephant logo) and the brand match (a thick glove with a shamrock logo) were put on placemats (with a card marked B on the right placemat and a card marked C on the left placemat) beside each other and below the target, closer to the participant(s). The side placement of the kind match and the brand match was counterbalanced across trials. See Figure 2. For each object in the stimulus set, the experimenter then described the maker's intended functions and the maker's identity; half the participants in each condition heard the functional information first, and half heard the identity information first.
Figure 2. Sample triad for the basic-level category, GLOVE, showing the target (top), kind match (bottom left) and brand match (bottom right).
Maker’s intended function information. The experimenter gestured to all three objects and told participants the maker's general intended function ("These three gloves were all made to keep your hands warm and clean"). The experimenter then told participants the maker's specific intended function for each object. They first gestured to the target and the kind match and stated their shared function ("These two gloves were both made to wear in the fall"); they then repeated this information while pointing to each object individually ("This glove was made to wear in the fall and this glove was made to wear in the fall"). They then gestured to the brand match and stated its function twice ("This glove was made to wear in the winter").

Maker’s identity information. The experimenter gave participants information about the maker's identity for each object. They first gestured to the target and the brand match and gave information about their shared maker ("These two gloves were made by the same company"). They then gestured to the identical-looking logos attached to these objects and stated their connection to the maker's identity ("The company put the same marker on them to show that they were made by the same company"). They then repeated this information while pointing to each object individually ("The company put this marker on this glove when they made it, to show that it was made by the company, and the company put this marker on this glove, when they made it, to show that it was made by the same company"). The experimenter then pointed to the kind match and gave information about its different maker ("This glove was made by a different company"). They then gestured to the different-looking logo attached to the object and stated its connection to the maker's identity twice ("The company put a different marker on it to show that it was made by a different company").
**Check on functional and maker’s identity information.** The experimenter conducted two comprehension checks to confirm that participants had learned the functional and maker information associated with each object. To pass the functional information check, the participants had to indicate correctly using the letters (A, B or C) on the placemats that the target and the kind match had the same specific intended function (“Which two were made to be worn in the fall?”) and that the brand match had a different specific intended function (“Which one was made to be worn in the winter?”). To pass the maker information check, the participants had to indicate correctly using the letters (A, B or C) on the placemats that the target and the brand match shared the same maker (“Which two were made by the same company?”) and that the kind match had a different maker (“Which one was made by a different company?”). Participants provided written responses in their response booklet.

**Labelling Phase.** The experimenter picked up the target object on placemat A, held it in front of the participant(s), and provided a novel label for it. In the kind condition, the experimenter introduced the label as a common noun (preceded by a determiner) for the kind (“This kind of glove is called a POGON”). In the brand condition, the experimenter introduced the label as a proper name (with no determiner) for the brand, (“This brand of glove is called POGON”). Only two words distinguished the two conditions: the word “kind” or “brand” to signal the type of subordinate category, and the presence/absence of a determiner to signal whether the novel label was a common noun or a proper name. The experimenter repeated the labelling expression and asked the participant(s) to repeat the novel word out loud.
**Testing Phase.** The experimenter asked participants to help the stuffed monster to identify another referent of the novel label (“My friend wants another POGON. Can you show him another POGON?”). The request was phrased identically in the two conditions, in a sentence position that is felicitous for both kind terms and brand terms (e.g., “another convertible”, “another Corvette”). Participants were asked to choose either the kind match or the brand match by marking B or C in their response booklet. The experimenter thanked the participants, removed the stimuli from the table, and moved on to the next trial until all four trials were completed.

**Results and Discussion**

Participant’s responses (“kind match” = 0; “brand match” = 1) were entered into a logistic regression model using the glm command in the stats package in R. The model included condition (kind condition = 0; brand condition = 1; between subjects). We did not run a mixed-effects logistic regression model (i.e., including subject ID or stimulus item as a random effect) because of singularity issues. There was a significant main effect of condition, $b = -7.69$, $SE = 1.13$, $p < .001$, with participants in the brand condition choosing the brand match more often than participants in the kind condition.

To determine whether adults made systematic choices in the two conditions, we compared the mean proportion of brand match choices across the four trials in each condition to chance (0.50), using the Bonferroni-Holm correction for multiple comparisons. A proportion significantly greater than 0.50 indicated a systematic extension of the novel label to the brand match. A proportion significantly less than 0.50 indicated a systematic extension of the novel label to the kind match. In the kind condition, adults responded almost categorically: The proportion of brand match choices ($M = 0.01$, $SD = 0.05$) was significantly
less than chance $t(23) = -47.00, p < .001$ [one-tailed], $d = 9.59$. Similarly, in the brand condition, adults responded almost categorically: The proportion of brand match choices ($M = 0.96, SD = 0.10$) was significantly greater than chance $t(23) = 23.60, p < .001$ [one-tailed], $d = 4.82^2$. See Figure 3.

![Figure 3. Proportion of brand match choices in Experiment 1A. Error bars represent ± 1SE. Deviations from chance (0.50) responding: * p < .05.](image)

The results of Study 1A establish that adults clearly distinguished between subordinate kind and brand categories. They systematically extended a novel kind label to an object that had the same maker’s intended function as the target, yet they systematically

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$^2$ In this thesis, we conducted one-tailed t-tests when we predicted results in a particular direction. Specifically, when we compared extension of a novel kind label to chance, we expected choices of the kind match; when we compared extension of a novel brand name to chance, we expected choices of the brand match.
extended a novel brand label to an object that had the same maker as the target. Given this evidence that adults understand the two types of subordinate-level artifact category, we asked in Study 1B whether – and if so, when – children do the same.
Study 1B

Method

Participants

Participants were 192 4- to 7-year-olds, each tested in a quiet room in a university laboratory, science museum laboratory, community centre or school. An equal number of children in each age group (n = 24) participated in the kind condition (4-year-olds: $M = 53.71$ months, $SD = 3.10$ months, 12 females; 5-year-olds: $M = 64.63$, $SD = 3.17$, 13 females; 6-year-olds: $M = 77.50$, $SD = 3.08$, 13 females; 7-year-olds: $M = 89.42$, $SD = 3.62$, 16 females) and the brand condition (4-year-olds: $M = 53.83$, $SD = 3.10$, 14 females; 5-year-olds: $M = 65.79$, $SD = 3.50$, 13 females; 6-year-olds: $M = 79.00$, $SD = 3.15$, 11 females; 7-year-olds: $M = 90.88$, $SD = 3.72$, 11 females). Data from 21 children were excluded due to experimenter error (10 children), parental interference (3 children), inattention (4 children) and withdrawn assent (4 children).

Stimuli

These were the same as in Study 1A, except that we did not use the lettered cards and answer booklets.

Procedure

This was the same as in Study 1A, except that children responded to all questions verbally and/or by pointing.

Results and Discussion

We entered participants’ responses (“kind match” = 0; “brand match” = 1) into a mixed-effects logistic regression model using the glmer command in the lme4 package in R (Bates, 2007). The model included condition (kind condition = 0; brand condition =1;
between-subjects), age (4-year-olds = 0, 5-year-olds = 1, 6-year-olds = 2 and 7-year-olds = 3; between-subjects), and their interaction as fixed-effect predictors. The age values were re-coked to address multicollinearity issues. We also included random effects for subject ID but omitted stimulus item because of singularity issues (Barr, Levy, Scheepers & Tily, 2013).

We observed a significant main effect of age, $b = -2.17, SE = 0.48, p < .001$, but a non-significant main effect of condition, $b = 1.34, SE = 0.94, p = .16$. However, these main effects have to be evaluated against a significant age-by-condition interaction, $b = 2.52, SE = 0.61, p < .001$. In post-hoc comparisons, we did not find a difference among 4-year-olds between the proportion of brand match responses in the brand and kind conditions (AME = 0.21, $SE = 0.14, p = .14$, 95% CI [-0.07, 0.48]). Starting at five years, the proportion of brand match responses was significantly greater in the brand than in the kind condition (5-year-olds: AME = 0.52, $SE = 0.08, p < .001$, 95%CI [0.37, 0.67]; 6-year-olds: AME = 0.66, $SE = 0.06, p < .001$, 95%CI [0.54, 0.79]; 7-year-olds: AME = 0.73, $SE = 0.08, p < .001$, 95%CI [0.57, 0.89]).

As in Study 1A, to determine whether children made systematic choices in the two conditions, we compared the mean proportions of brand match choices to chance (0.50), using the Bonferroni-Holm correction for multiple comparisons. For 4-year-olds, the proportion was not less than chance in the kind condition ($M = 0.40, SD = 0.33$), $t(23) = -1.55, p = .27$ [one-tailed], $d = 0.32$, or greater than chance in the brand condition ($M = 0.57, SD = 0.34$), $t(23) = 1.05, p = .39$ [one-tailed], $d = 0.21$. For 5-, 6- and 7-year-olds, the proportion was significantly less than chance in the kind condition (5-year-olds: $M = 0.29$, $SD = 0.37, t(23) = -2.79, p = .03$ [one-tailed], $d = 0.57$; 6-year-olds: $M = 0.05, SD = 0.21$, $t(23) = -10.53, p < .001$ [one-tailed], $d = 2.15$; 7-year-olds: $M = 0.01, SD = 0.05), $t(23) = -$
It was not, however, greater than chance in the brand condition (5-year-olds: M = 0.60, SD = 0.44, t(23) = 1.16, p = .39 [one-tailed], d = 0.24; 6-year-olds: M = 0.54, SD = 0.48, t(23) = 0.42, p = .39 [one-tailed], d = 0.09; 7-year-olds: M = 0.69, SD = 0.43, t(23) = 2.16, p = .10 [one-tailed], d = 0.44. See Figure 4.

Figure 4. Proportion of brand match choices in Experiment 1B. Error bars represent ± 1SE.

Deviations from chance (0.50) responding: * p < .05, † p = .10.

The findings from Study 1B reveal that, by five years, children distinguished between kind and brand subordinate categories, as did adults in Study 1A. Yet unlike the case with adults, the results also showed that children who distinguished between the two types of categories were not equally systematic in their extensions of kind and brand labels. By five
years, children systematically extended the kind labels to the objects that shared the maker's intended function; but even by seven years, children were not systematic in extending the brand labels to the objects that shared the maker's identity. These results raise the possibility that children's understanding of kind subordinates arises earlier in development than their understanding of brand subordinates.

Study 2 addresses two questions arising from Study 1B. First, why were children between five and seven years in Study 1B not systematic in their tendency to extend brand labels to objects sharing a maker? Second, at what age do children in our task systematically extend brand labels according to maker identity? It is unlikely that children in Study 1B failed to remember the information they received about the makers' identity: All children learned both functional information and maker identity information for each stimulus set, and all children had to pass comprehension checks for both types of information to be included in our final sample. We wondered, however, whether children's possible unfamiliarity with the word “company”– our term for the makers of products – disrupted their performance. To be clear, we used the word “company” because brands are, by definition, categories of products manufactured by a particular company (Cambridge University Press, n.d.; Merriam-Webster, n.d.; Oxford University Press, n.d.). Further, children did not need to know the meaning of the word “company” to understand that it was the entity that made the objects in our task. Yet we wondered whether children's difficulty in understanding the word “company” as the maker of the products could explain their lack of systematicity in the brand condition of our task. Study 2 was a modified replication of the brand condition of Study 1B, in which we replaced the word “company” with the more familiar word “people” to describe the makers.
of the products. In order to gain more insight into when children first extend the brand labels systematically in our task, we also included a group of eight-year-olds.
Study 2

Method

Participants

Participants were 120 English-speaking 4- to 8-year-olds. Of this total, 103 children were tested in a quiet room in a university laboratory, science museum laboratory, community centre or school. Due to the SARS-CoV-2 pandemic, the remaining 17 children (9 seven-year-olds and 8 eight-year-olds) were tested online in their own homes via Zoom. Each age group had 24 participants (4-year-olds: \( M = 53.38, SD = 3.57 \), 16 females; 5-year-olds: \( M = 65.92, SD = 3.89 \), 10 females; 6-year-olds: \( M = 77.63, SD = 4.22 \), 14 females; 7-year-olds: \( M = 89.83, SD = 3.67 \), 10 females; 8-year-olds: \( M = 102.13, SD = 3.17 \), 13 females). Data from 15 children were excluded due to experimenter error (4 children), inattention (8 children) and withdrawn assent (4 children).

Stimuli

These were the same as in Study 1B.

Procedure

This was the same as in the brand condition of Study 1B, except that we replaced the word “company” with the word “people” to describe the objects' makers (e.g., instead of saying “These two gloves were made by the same company”, the experimenter said “These two gloves were made by the same people”). The procedure for children tested online via Zoom was the same as the procedure for children tested in person, except for two details before the start of the session. First, the researcher asked children to point to two objects (one on the researcher's left, and one on their right) to check whether the image on their screen was reversed. Second, the researcher asked children to say whether they had trouble seeing or
hearing anything (e.g., because of Internet connectivity issues) and said that she would repeat any missed information. No children reported any such difficulties³.

**Results and Discussion**

As in Study 1B, participants' responses were entered into a mixed-effects logistic regression model using the glmer command in the lme4 package in R. The model included age group (4-year-olds = 0, 5-year-olds = 1, 6-year-olds = 2, 7-year-olds = 3 and 8-year-olds = 4; between subjects) as a fixed-effect predictor. We also included random effects for subject ID but omitted stimulus item because of singularity issues.

We observed a significant main effect of age, \( b = 0.77, SE = 0.22, p < .001 \). To determine whether children made systematic brand match choices, we compared the mean proportion of brand match choices across the four trials to chance (0.50), using the Bonferroni-Holm correction for multiple comparisons. As in Study 1B, the proportions of brand match choices made by children between the ages of four and seven years were not significantly greater than chance (4-year-olds: \( M = 0.60, SD = 0.36, t(23) = 1.42, p = .26 \) [one-tailed], \( d = 0.29 \); 5-year-olds: \( M = 0.43, SD = 0.39, t(23) = -0.92, p = 1.00 \) [one-tailed], \( d = 0.19 \); 6-year-olds: \( M = 0.46, SD = 0.38, t(23) = -0.54, p = 1.00 \) [one-tailed], \( d = 0.11 \); 7-year-olds: \( M = 0.68, SD = 0.39, t(23) = 2.21, p = .08 \) [one-tailed], \( d = 0.45 \)). However, the proportion among 8-year-olds (\( M = 0.88, SD = 0.29 \)) was significantly greater than chance \( t(23) = 6.43, p < .001 \) [one-tailed], \( d = 1.31 \). See Figure 5.

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³ An independent samples t-test revealed that the proportion of brand match choices from seven- and eight-year-olds tested online was no different from that of seven- and eight-year-olds tested in person, \( t(40.70) = -1.20, p = .24 \).
Consistent with the results of Study 1B, 4- to 7-year-old children did not systematically extend the brand label to the object that shared the same maker as the target. This finding suggests that the use of the word “company” to describe the objects' makers in Study 1B was not responsible for the lack of systematic response in the brand condition. The result is instead consistent with the possibility that children in our task understood kind subordinate categories earlier than brand subordinate categories. Study 2 also revealed that 8-year-olds did systematically extend the brand label to the brand match, suggesting an understanding at this age that brand labels should be extended to objects that share a maker.

*Figure 5. Proportion of brand match choices in Experiment 2. Error bars represent ± 1SE. Deviations from chance (0.50) responding: * $p < .05$, † $p < .10$. 
Study 3 was a modified replication of Study 2, designed to test a further hypothesis about children’s lack of systematic selection of the brand match in the brand condition. In Study 1 and Study 2, we introduced the novel word in an inclusion statement that mentioned the basic-level category term (e.g., “This brand of glove is called POGON”). Prior work suggests that the use of such statements directs learners to avoid interpreting the novel word as a synonym for the basic-level category (e.g., another word meaning GLOVE), enhancing their tendency to interpret the label as a subordinate-level category term (e.g., Callanan, 1985; Clark, Gelman & Lane, 1985; Gelman, Wilcox, Clark, 1989; Markman, Horton, & McLanahan, 1980; Saylor, Sabbagh & Baldwin, 2004; Waxman & Hatch, 1992). Yet in our testing phase, we requested a referent of the novel label in a linguistic phrase that omitted this term (“Can you show him another POGON?”). We hypothesized that the absence of the basic-level category term in this request weakened children’s tendency to interpret the novel brand label systematically as a term for a subordinate-level brand category. Further, although the novel label in our testing phase appeared in a sentence position that is felicitous for both kind and brand terms (e.g., “another POGON”; cf. “another convertible”, “another Corvette”), the position is more typical for common nouns than for proper names. As a result, we hypothesized that some children may have been led away from interpreting the term as marking the identity of the maker.

In the testing phase of Study 3, we embedded the novel label as a modifier in a phrase that incorporated the basic-level term as the head (“Can you show him another POGON glove?”) in an effort to encourage participants to increase their tendency to select the brand match. We focused only on 6- and 7-year-olds, given evidence in Study 2 that 6-year-olds
showed no tendency to extend the label in the brand condition to the brand match, while 7-year-olds showed a weak (non-significant) tendency to do so.
Study 3

Method

Participants

Participants were 48 English-speaking six- and seven-year-olds, each tested online via Zoom in their own homes. Each age group had 24 participants (6-year-olds: $M = 78.75$ months, $SD = 3.97$ months, 11 females; 7-year-olds: $M = 89.75$, $SD = 4.28$, 14 females). Data from one child were excluded due to inattention.

Stimuli

These were the same as in Study 2.

Procedure

This was the same as the procedure used to test participants via Zoom in Study 2, except that during the testing phase, the researcher inserted the basic-level category term after the novel word (e.g., “My friend wants another POGON glove. Can you show him another POGON glove?”).

Results and Discussion

As in Study 2, we entered participant's responses into a mixed-effects logistic regression model using the glmer command in the lme4 package in R. The model included age (6-year-olds = 0; 7-year-olds = 1; between subjects) as a fixed-effect predictor. We did not include stimulus item as a random effect because of singularity issues. There was a non-significant main effect of age, $b = 2.07$, $SE = 1.35$, $p = .12$. As in Study 2, comparisons to chance (0.50) using the Bonferroni-Holm correction for multiple comparisons revealed that the proportion of brand match choices made by 6-year-olds ($M = 0.63$, $SD = 0.42$) was not significantly greater than chance, $t(23) = 1.47$, $p = .08$ [one-tailed], $d = 0.30$. However, the
proportion made by 7-year-olds (M = 0.81, SD = 0.31) was significantly greater than chance, 
\( t(23) = 5.00, p < .001 \) [one-tailed], \( d = 1.02 \). See Figure 6.

![Graph showing proportion of brand match choices in Experiment 3. Error bars represent ± 1SE.](image)

*Figure 6. Proportion of brand match choices in Experiment 3. Error bars represent ± 1SE.*

*Deviations from chance (.50) responding: * \( p < .05 \), † \( p < .10 \).*

The results of Study 3 offer support for the hypothesis that the lack of systematic
collection of the brand match among 7-year-olds in the brand condition of Study 2 can be
attributed to the absence of the basic-level category term and/or to the placement of the novel
word in the head position (e.g., “another POGON”) in the researcher's request in the testing
phase. When we embedded the novel word as a modifier in a phrase with the basic-level
category term as the head, we found evidence that 7-year-olds systematically selected the
brand match, unlike Study 1B or 2. The results indicate that consistently mentioning a basic-level category term when introducing a new brand term may enhance subordinate-level brand categorization. The findings are also consistent with the possibility that hearing a novel label consistently modelled in a proper name sentence context may enhance this type of categorization. At the same time, the fact that 6-year-olds' selections in Study 3 remained unsystematic provides further evidence that children’s understanding of brand subordinate categories emerges later than their understanding of kind subordinate categories documented in Study 1B.
General Discussion

We examined whether – and if so, when – children distinguish between two different types of subordinate-level artifact category – kinds organized around a maker's intended function and brands organized around a maker's identity. Our results reveal that children distinguish between the two types by five years. At the same time, the findings indicate a difference in the age at which children systematically understand the two types: They showed a systematic understanding of kind subordinate categories by five years, but did not show a systematic understanding of brand subordinate categories until seven years.

Conflating kind and brand subordinate categories

Our results extend prior work that finds young children can label and categorize objects at the subordinate level of abstraction (e.g., Gelman, Wilcox & Clark, 1989; Taylor & Gelman, 1989; Waxman & Hatch, 1992; Waxman, Shipley & Shepperson, 1991). Our findings indicate that prior studies that conflate artifact kind and brand subordinate-level categories (e.g., Collin, 1999; Collin & McMullen, 2005; McMullen & Purdy, 2006; Rosch et al., 1976; Tversky & Hemenway, 1984; Vitkovitch & Tyrell, 1999) overlook a fundamental distinction between them. Specifically, young children understand that kind subordinates are organized around a shared creator’s intended function, whereas brand subordinates are structured around a shared identity of the creator. Rather than treating them as interchangeable, future researchers should instead direct their attention to furthering our understanding of the distinct representation and learning of these two types of subordinate-level category.
Artifact kind categories

Our results advance our understanding of children's knowledge of artifact kind categories (Chaigneau & Barsalou, 2008; Bloom & Markson, 1998; Diesendruck, Markson, & Bloom, 2003; Gelman & Bloom, 2000; Kelemen & Carey, 2007). The findings indicate that children systematically extend common nouns for subordinate level kinds of artifacts based on the maker's intended function – rather than the maker's identity – by the age of five. The findings are consistent with those of Matan and Carey (2001), who found that by six years, children come to extend common nouns for basic-level kinds of artifacts based on their maker's intended function, rather than their current intended function. Our discovery that children recognize the creator’s intended function as fundamental to artifact kind membership is consistent with Matan and Carey's proposal that children begin to construct an intuitive understanding of artifacts (cf. Dennett, 1987) before they begin school. Our results extend Matan and Carey's findings by demonstrating children's understanding of the importance of the creator's intended function in categorizing artifacts at the subordinate level of abstraction, where all objects are from the same basic-level category, sharing the same general intended function and having only fine-grained functional differences.

Artifact brand categories

Prior work on children's understanding of brand categories has not addressed the fundamental question of whether children know that these categories are organized around a maker's identity (Achenreiner & John, 2003; Arnas, Taş & Oğul, 2016; Derscheid, Kwon & Fang, 1996; McAlister & Cornwell, 2010; Schor, 2004; Valkenburg & Buijzen, 2005). Our findings represent the first demonstration that children, like adults, understand that the maker's identity is critical for membership in an artifact brand category. We found that
children as young as seven (Study 3) or eight (Study 2) years extended a novel brand name across artifacts of the same basic-level category if the objects shared a maker, but not if they shared a maker's intended function. Furthermore, we observed comparable results when the artifacts' shared maker was described either as “the same company” (Study 1B) or as “the same people” (Study 2 and 3), suggesting that labelling the maker with a more abstract or more concrete common noun was not related to performance on our task.

**Learning the two types of subordinate category**

The results of these studies indicate that children’s ability to categorize artifacts in terms of creator identity (i.e., at seven or eight years of age) emerges later than their ability to categorize artifacts in terms of the creator’s intended function (i.e., at five years of age). Why might children come to understand artifact kind categories earlier than artifact brand categories? Several factors might account for this asymmetry. First, it is likely that children hear many more artifact kind terms than artifact brand terms for manufactured objects early in development, though they no doubt do hear many brand labels (Schor, 2004). Further, young children might view kind categories as supporting more useful inferences about artifacts than brand categories (Murphy, 2002): Knowing what an object was made for (its kind) might be generally more informative than knowing who made it (its brand). Yet an earlier understanding of kind categories might also be attributable to an intuitive tendency to think about artifacts in terms of their design, purpose and function (Dennett, 1987; Matan & Carey, 2001) – not their maker. If young children conceptualize manufactured objects in this way, they might be more inclined to interpret labels for such objects as terms for kinds, organized around the designer's intended function. To the extent that this manner of thinking
about artifacts is prevalent in early childhood, children would thus tend to acquire terms for kind categories in advance of terms for brand categories.

**Future directions**

This research opens up new avenues for future investigation. First, our task provides a strict test of the ability to distinguish the two types of subordinate-level category, by dissociating kind-related information from brand-related information. This dissociation allows for a clear assessment of children's understanding of the membership criteria underlying the two types, but it might not be so sharp in but many real-world cases. In particular, members of the same subordinate brand category might also belong to the same subordinate kind category (e.g., sets of gloves might share not only a maker – and logo – but also a specific intended function – and associated shape, size, colour, and/or texture). Similarly, members of different subordinate brand categories might belong to different subordinate kind categories. A valuable task for future work is to explore children's understanding of the importance of maker identity in the categorization of objects that belong to familiar real-world brands, especially when these objects also share subordinate kind membership.

Another avenue for future research concerns children's use of perceptual cues in kind and brand categorization. As noted in the introduction, prior work has revealed that children often rely on an artifact's structure (especially its shape) in making judgments about its kind category, unless they learn that the structure does not support the intended function of members of the kind (Diesendruck et al., 2003). Less is known about children's dependence on perceptual cues – such as a logo or other trademark – in making judgments about an artifact's brand category. For example, do children understand that artifacts with an
authorized maker are members of a brand category even if they have no external marker (logo or trademark)? How do they categorize (and evaluate) artifacts that bear a logo or trademark but were created by an unauthorized maker (i.e., counterfeits or knock-offs)?

Another area for future research centres on understanding the relation between labels for brand categories and labels for kind categories, and in particular the phenomenon in which proper names that initially stand for a brand of product (e.g., “Band-aid”, “Kleenex”) evolve into common nouns that stand for the kind of product (e.g., “band-aid”, “Kleenex”). This phenomenon – called genericization (Clankie, 2000) – has been well documented in the history of English and other languages and raises questions about the psychological process by which the referential scope of brand categories broadens into that of kind categories.

When learning a label for an artifact category, what factors influence whether children and adults make a brand or a kind interpretation?

Finally, what is the role of input in children's learning of labels for brand and kind categories? The learning of both types depends not only on the child’s internal interpretative abilities but also on social information (e.g., labelling) provided by caregivers. Discovering the nature of caregivers’ linguistic input in introducing brand labels and kind labels is thus an important task. Do caregivers introduce brand terms for artifacts as proper names, and do they introduce kind terms for artifacts as common nouns? What other information do they provide to guide children's mapping to the appropriate type of category? Do they ever – and if so when do they – genericize brand names by modelling them linguistically as common nouns (e.g., pluralize them or provide them with determiners)? Addressing such questions will illuminate the potential contribution of social information – specifically, caregiver linguistic input – to children’s successful acquisition of brand and kind categories.
References


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