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RESEARCH ARTICLE

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A ladybug bear can fly and climb trees: Children prefer conjunctions of labels and properties for cross-classifiable toys

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Abstract

The present studies (*N* = 159) investigated children's and adults' preferences for label and property conjunctions for cross-classifiable toys. In Study 1, 4-year-olds, 5-year-olds, and adults participated in a labelling and property attribution task involving experimental toys that belong to two categories and control toys that belong to only one category. In Study 2, the same age groups were tested on a version of the task focusing on the control toys. In Study 3, 4- and 5-year-olds were tested on a modified version of the labelling and property attribution task involving the experimental and control toys. Finally, Study 4 tested a younger age group, 3-year-olds. Overall, the results indicated that by age 3 years, individuals prefer assigning experimental toys (but not controls) with joint labels that are a conjunction of two single category labels. By age 4 years, individuals prefer assigning experimental toys (but not controls) with dual properties that are a conjunction of two single properties. These results document the development of how different types of toys elicit preferences for conjunctions of labels that denote membership in two distinct categories and conjunctions of properties that combine features of these categories.

Highlights

- This study examines children's preferences in labeling and attributing properties to cross-classifiable toys.

- Children labeled and attributed properties to toys that belonged to two categories (experimental) and one category (control).
- The results reveal that by 4 years, children prefer both label and property conjunctions for the experimental toys that can be cross-classified into more than one category, but not for the control toys.

KEYWORDS

categorization, cross-classification, language

1 | INTRODUCTION

Every day, children encounter a variety of items that test category boundaries. There is a plethora of examples within the realm of toys in which new products are introduced to the market that do not fit neatly into one category. For example, over 30 million pillow pets, stuffed animals that can be folded into pillows, have been sold since 2010 (Glazer, 2017). Toys like pillow pets create a unique opportunity to explore how children mentally represent items that challenge category boundaries. How might children prefer to mentally represent toys like pillow pets given that they can be potentially cross-classified in many ways? From a child's perspective, are pillow pets pillows, pets, or both? Do pillow pets possess properties of pillows, pets, or both? Although the answers to these questions are charming, studying how children name and attribute properties to cross-classifiable toys speaks to children's lexical usage and classification practices. The aim of this investigation is to examine children's preferences in naming and property attribution of cross-classifiable toys.

Our work draws from the extensive developmental literature on children's representational abilities in language and categorization. Seminal research by Clark and colleagues (Clark, Gelman, & Lane, 1985; Gelman, Wilcox, & Clark, 1989) found that children as young as age 2 years often coin compound nouns in an effort to label subcategories of a taxonomic category. For instance, a category like apple may have subcategories like apple-knife: the first noun, apple, is the modifier, and the second noun, knife, is the head, such that apple-knife is not a kind of apple, but rather a kind of knife. Waxman and Hatch (1992) have also found that 3- and 4-year-olds are able to produce different labels for objects at the subordinate, basic, and superordinate hierarchical levels (e.g., collie, dog, and animal). Research has also shown that labelled categories within a taxonomy are not necessarily equivalent in that they may vary substantially in their inductive potential (e.g., Gelman & Davidson, 2013). For example, 4- to 5-year-olds are more likely to make inferences based on categories at the basic level (e.g., dog) instead of the superordinate level (e.g., animal, Gelman & O'Reilly, 1988). Three-year-olds are also more likely to make inferences based on categories at the basic level than the subordinate level (e.g., collie, Waxman, Lynch, Casey, & Baer, 1997).

The many-perspectives account of lexical acquisition proposes that children learn to use different labels for the same object to mark the different perspectives they bring to bear on the object and that perspective choice is fundamental to how speakers categorize the object they wish to speak about (Clark, 1997). For example, Clark and Svaib (1997) found that 2- to 4-year-olds are able to produce a second word (e.g., animal and sailor) for a character that has already been labelled (e.g., cat) during a book reading session with Richard Scarry-like drawings of animals. Deák and colleagues (Deák & Maratsos, 1998; Deák, Yen, & Pettit, 2001; see also Deák, Ray, & Pick, 2002) have also examined

polynomy, the ability to produce many labels for an item, each denoting a different category. They have found that 3- and 4-year-olds believe that two or more words can be used to refer to a representational object that has various functions (e.g., naming a dinosaur-shaped crayon a dinosaur crayon). Related research has found that 4- and 5-year-olds can provide contrasting labels that distinguish the appearance and reality of deceptive items (e.g., saying that a crayon shaped like a car looks like a car, but is really a crayon, Merriman, Jarvis, & Marazita, 1995; see also Hansen & Markman, 2005, for discussion on disambiguating appearance-reality tasks for 3-year-olds).

Although this prior work has shown that children as young as age 2 and 3 years have representational abilities in language, we are unaware of any studies that have demonstrated similar levels of ability at this age in children's *cross-classification*, which is the ability to categorize an item into more than one category. In a typical test of cross-classification, a target item is presented to children during two different classification trials. For example, on one trial, children are asked to classify a target item based on taxonomic relations (e.g., categorizing cake as a food). On another trial, children are asked to classify the same target item based on script relations (e.g., categorizing cake as a birthday party item). Crucially, cross-classification is determined by children's accuracy on both trials (see Nguyen & Girgis, 2014). Studies have revealed that children have a strong ability for cross-classification by age 4 years (e.g., Nguyen, 2007, 2012; Nguyen & Gelman, 2012; Nguyen & Murphy, 2003).

Similar age-related findings have been found when testing *simultaneous cross-classification*, the ability to represent two categories at the same time on the same trial. For instance, when presented with cross-classifiable items that were assigned either appropriate or inappropriate category label pairs, 3-year-olds had difficulty verifying the category labels compared with 4- and 5-year-olds (e.g., saying that pajamas, which belong to the taxonomic category of clothes and script category of bedtime things, are bedtime clothes whereas saying that a library is not a bedtime building because it only belongs to the taxonomic category of buildings; Nguyen, 2007). Relatedly, research by Blaye and colleagues found that 3-year-olds compared with 4- and 5-year-olds have difficulty with categorical flexibility, switching between categorical relations for the same object (Blaye & Bonthoux, 2001; see also Blaye & Jacques, 2009). Additionally, a number of studies by Deák and colleagues have found similar difficulties with 3-year-olds' ability to switch between sorting criteria (e.g., Deák, 2000; Deák, Ray, & Pick, 2004).

Research has also documented that by age 4 years, children have inductive selectivity, the ability to make appropriate inductive inferences with cross-classified items (e.g., Coley, 2012; Hayes & Lim, 2013; Kalish & Gelman, 1992; Nguyen, 2012; Shafto, Coley, & Vitkin, 2007). For example, Nguyen (2012) found that 3-year-olds, but not 4- and 5-year-olds, have trouble with selectively making biochemical inferences based on a cross-classified object's taxonomic category membership and situational inferences based on the same object's script category membership. Kalish and Gelman (1992, Experiment 2) found that by age 4 years, children have expectations that items that belong to two categories, material and object kinds (e.g., glass scissors), have different properties (e.g., dispositional and functional properties, respectively).

Based on the review of the developmental literature, it is evident that children are building an impressive repertoire of representational abilities in language and categorization. An issue that arises from this literature is whether children have *preferences* in how they label and attribute properties to items that belong to multiple categories. Although we know how children reason about an item at various levels within a single taxonomy (e.g., Clark et al., 1985; Gelman & O'Reilly, 1988; Gelman et al., 1989; Waxman & Hatch, 1992; Waxman et al., 1997), what we do not know is how children prefer to treat items that belong to more than one taxonomic category. Because cross-classified items do not fit into a single taxonomy, children may choose to draw from different taxonomic category structures when reasoning about these items. For example, if a cross-classified item belongs to two taxonomic categories, a child may prefer to draw from both categories in labelling and property attribution, or they may prefer to draw from just one of these categories. Whether children draw from both or one of these categories is important to understand because it tells us about how children prefer to conceptualize complex cross-classifiable items.

The purpose of the present research is to elaborate on past research on children's representational abilities in several principal ways. First, we focus on toys that are cross-classifiable into two categories that defy common taxonomic boundaries (e.g., a ladybug bear belonging to the categories of teddy bears and ladybugs). This focus

expands on past studies of categorization that have included items that are hierarchically related within a single taxonomy (e.g., Gelman & O'Reilly, 1988; Waxman & Hatch, 1992) and items that belong to two related taxonomic and script categories (e.g., Nguyen, 2007).

Second, we explore children's preferences for joint labels versus single labels (e.g., ladybug bear vs. ladybug or bear). We build on research documenting children's ability for polynomy (e.g., Deák & Maratsos, 1998) and perspective taking (e.g., Clark & Svaib, 1997) by combining two labels into one for our joint labels. However, our focus on joint labels remains relatively distinct from studies of children's compound nouns (e.g., Clark et al., 1985) in that our joint labels highlight membership in two different categories, not necessarily a subcategory within one taxonomy.

Third, we also explore children's endorsement of dual properties versus single properties (e.g., climb trees and fly vs. climb trees or fly). Our focus on dual properties is unique from past research demonstrating children's ability for inductive selectivity (e.g., Kalish & Gelman, 1992; Nguyen, 2012) in that we examine children's tendency to combine the properties of two different categories together for a single toy.

In the present investigation, we conducted four studies. In Study 1, participants completed a forced-choice labelling task and property attribution task. In both tasks, participants were presented with exemplars of different types of toys: control ones (e.g., a ball) that belong to only one category and experimental ones that belong to two categories. There were three kinds of experimental toys: (a) *anthropomorphic* (e.g., a toaster with a human face); (b) *costume* (e.g., a bear dressed up as a ladybug); and (c) *transformational* (e.g., a plane that can be transformed into a robot). Thus, the experimental and control toys are distinct from each other in that that the experimental toys can be mentally represented as cross-classifiable whereas the control toys are most accurately mentally represented as non-cross-classifiable. We included these different types of toys to gain greater insight into children's mental representations across a myriad of items that belong to one or two categories. In addition, the experimental toys (particularly the anthropomorphic and transformational) included in the current study were different than the deceptive toys that have been used in past research on the appearance-reality distinction where items appear to look one way, but in reality are something else (hence belong to only one category; e.g., Flavell, 1986; Flavell, Green, & Flavell, 1986; Flavell, Lindberg, Green, & Flavell, 1992; Hansen & Markman, 2005; Merriman et al., 1995).

For each toy in the labelling task, participants were asked to choose among three labels: two single labels and a joint label that is a conjunction of the single labels. The two single labels (e.g., ladybug or bear) denoted membership in two different categories, and the joint label (e.g., ladybug bear) denoted membership in both categories. For each toy in the property attribution task, participants were also asked to choose among three properties: two single properties and a dual property that is a conjunction of the single properties. The two single properties were features of the two different categories (e.g., fly is a feature of ladybugs and climb trees is a feature of bears), and the dual property was the combined features of both categories (e.g., climb trees and fly). In Study 2, participants completed the same labelling and property attribution tasks focused exclusively on the control toys. In Study 3, participants were tested on a modified version of the labelling and property attribution task involving both experimental and control toys.

Given children's ability for simultaneous cross-classification by age 4 years (e.g., Nguyen, 2007, 2012; Nguyen & Gelman, 2012; Nguyen & Murphy, 2003), we were especially interested in revealing children's *preferences* for label and property conjunctions for cross-classifiable toys. In examining children's preferences, it was critical to begin by including only age groups that already have a strong ability to represent the two categories of a cross-classifiable toy in the first place. Otherwise, it would be unreasonable to expect young children to show valid preferences if they do not know what they are labelling or to what they are attributing a property. Thus, we began by testing 4- and 5-year-olds in Studies 1–3 and tested 3-year-olds in Study 4 to examine development in children's labelling and property attribution preferences. We also included adult participants as a comparison point because our methods had not been used before and we needed to establish how adults would perform in our forced-choice paradigm.

We hypothesized that if participants have a preference for conjunctions of labels and properties for cross-classifiable toys, then they should favour the joint labels and dual properties for the experimental toys, but not the control toys. Thus, this differential pattern of responding for the experimental and control toys would suggest that

participants have a preference to mentally represent the experimental cross-classifiable toys using both category representations simultaneously, rather than just one.

2 | STUDY 1

2.1 | Method

2.1.1 | Participants

Participants were 20 four-year-olds (M_{age} = 4.39 years, range = 4.02–4.96 years, 11 females), 20 five-year-olds (M_{age} = 5.43 years, range = 5.10–5.84 years, 11 females), and 20 adults (M_{age} = 19.06 years, range = 18.33–22.23 years, 11 females).

A separate group of 80 children and adults also assisted with stimuli preparation: 20 four-year-olds (M_{age} = 4.47 years, range = 3.96–4.96 years, six females), 20 five-year-olds (M_{age} = 5.42 years, range = 5.02–5.96 years, nine females), and 20 adults (M_{age} = 19.09 years, range = 18.35–20.27 years, 10 females). An additional group of 20 adults (M = 19.11 years, range = 18.35–20.34 years, 10 females) assisted with a property judgment task related to the stimuli preparation. None of these children or adults participated in the study.

All of the children and adults who participated in the study and who assisted with stimuli preparation were English speakers and typically developing. Children were students recruited from preschools and elementary schools located in a small, predominately White, middle class community located within the Southeastern United States. The adult participants were undergraduates at a university in the same location.

This study was approved by the Institutional Review Board at the University of North Carolina Wilmington and conforms to the ethical standards of the U.S. Federal Policy for the Protection of Human Subjects. Adult participants provided informed consent prior to their participation in the study. Child participants received parental consent and gave assent prior to their participation in the study.

2.1.2 | Materials

The materials included sixteen 3 in. x 3 in. colour photographs of toys obtained from online sources (e.g., Amazon and Fisher-Price). Photographs were used in lieu of actual toys to minimize the likelihood that children would become distracted by playing with the toys during testing, thereby standardizing stimuli presentation across each child. Previous research has found that children as young as 2.5 years understand that photographs are representations of their referents (DeLoache, 1991).

Twelve of the 16 toys were cross-classifiable, which we refer to as experimental toys. There were three types of *experimental toys* with four exemplars each: (a) *anthropomorphic* (an object that is an artefact and human being, e.g., a toaster with a human face); (b) *costume* (an animal wearing a costume, e.g., a bear dressed up as a ladybug); (c) *transformational* (an artefact with shifting identities, e.g., a plane that could be transformed into a robot, as indicated by a bidirectional arrow placed in between the identities; see Jakobsen, Frick, & Simpson, 2013; Liben & Downs, 1993, for children's understanding and use of arrows). There were also four exemplars of *control toys* that belong to only one category (e.g., a ball). These different types of toys were included in this study to explore children's preferences across a variety of cross-classifiable items. For instance, endorsement of conjunctions for labels and properties for anthropomorphic toys may depend upon one's appreciation of the ontological distinction between living and nonliving things (see Gelman & Opfer, 2002; Wellman & Gelman, 1992). In addition, preferences for conjunction of labels and properties for toys in costume may be influenced by children's tendency to straddle the boundary between fantasy and reality during pretend play (see Friedman, 2013; Lillard, Pinkham, & Smith, 2011; Rosengren, Johnson, & Harris, 2000). Similarly, preferences for the conjunctions of labels and properties for transformational toys may be impacted by the understanding of objects states and transformations.

2.1.3 | Stimuli preparation

To assist with stimuli preparation, particularly to identify suitable labels and properties for the toys, preliminary exploratory work was conducted with a separate group of 4-year-olds, 5-year-olds, and adults who did not partake in the actual study. A researcher conducted individual interviews with the children and adults that involved showing them photographs of the 16 toys, one at a time, and asking open-ended questions for each toy (e.g., "What would you call this toy?"). Children's and adults' spontaneous responses were transcribed by the researcher. Participants produced a total of 1,252 words. Only high-frequency words (85% or more of the time on average across ages and toys) were considered when creating the labels and properties of the toys in the studies. The two nouns within the joint labels for the experimental toys denoted two different categories that the toys can be cross-classified into, and the dual properties were features of each of these categories. In order to create comparable choices for the control toys, the two nouns within the joint labels for these toys also denoted two different categories, and the dual properties were features of each of these categories. However, because the control toys belong to only one category, one of the nouns and its corresponding feature were necessarily unrelated to category membership.

To ensure that the properties selected from the exploratory work were nonoverlapping features of the two different categories denoted in the joint labels, a property judgment task was conducted with a separate group of 20 adults. The adults were asked whether the properties were true of each of the respective categories from the joint labels for the 16 toys (e.g., "Is the following property, climb trees, true of a bear, ladybug, both a bear and a ladybug, or neither a bear or a ladybug?" and "Is the following property, fly, true of a bear, ladybug, both a bear and a ladybug, or neither a bear or a ladybug?"). A 1 was assigned to property judgments that corresponded to the appropriate category in the joint labels (e.g., choosing bear for climb trees and ladybug for fly), otherwise a 0. Adults made appropriate category-based property judgments 78% of the time, which was significantly above chance level (25%), $t(19) = 20.15$, $p < .00l$. These results suggest that the two properties selected for the toys are unique features of each category denoted in the joint labels.

For the studies, we chose to use a forced-choice paradigm because it permits the direct measurement of children's preferences in labelling and property attribution. In this paradigm, children could indicate their preference by selecting one of the choices. In deciding to implement a forced-choice paradigm, we opted for a multiple choice versus a yes/no format given the research showing that children may have a yes bias when answering yes/no questions, but no such bias when answering multiple choice questions (e.g., Peterson & Grant, 2001; see also Fritzley & Lee, 2003; Fritzley, Lindsay, & Lee, 2013). Another advantage of a forced-choice paradigm is that it emphasizes children's receptive versus expressive language given that receptive language precedes expressive language in childhood (e.g., Benedict, 1979; Gershkoff-Stowe & Hahn, 2013; Goldin-Meadow, Seligman, & Gelman, 1976).

Please see Appendix A for the complete list of toys, labels, and properties and Appendix B for sample pictures of the toys.

2.1.4 | Procedure

Children and adults were tested individually by a female researcher in a quiet area of their preschool/school and in a laboratory on a university campus, respectively, for approximately 15 minutes. Participants were initially told that they would be viewing pictures of toys and that they would be asked to answer questions about them. Children and adults were provided with a brief demonstration (Thomas the Tank Engine) and practice item (Peppa Pig). The purpose of the initial demonstration and practice item was to acquaint participants with the requirements of the task for the study. Thus, children and adults were not offered feedback during this initial phase.

Afterwards, participants were presented with 16 photographs of toys, one at a time, and asked about each toy's label and property. For each photograph, the researcher pointed directly at the toy with the exception of the transformational toys in which the researcher waved her hand in a circular motion over the shifting identities to indicate

that the questions were in regards to the toy as a whole as opposed to one or the other identity. For the label question, participants were presented with three label choices. For example, the researcher pointed at the toy and asked, "Here's a toy. Would you call this toy a bear (single label), ladybug (single label), or a ladybug bear (joint label)?" Participants then responded with one of the three label choices (e.g., "bear," "ladybug," or "ladybug bear"). For the property question, participants were presented with three property choices. For example, the researcher pointed at the toy and asked, "If you were playing with this toy, what would a (participant's label choice) be able to do? Does a (participant's label choice) climb trees (single property), fly (single property), or climb trees and fly (dual property)?" Participants then responded with one of the three property choices (e.g., "climb trees," "fly," or "climb trees and fly").

The 16 toys were presented to participants in one of two orders. The label and property questions were asked in a fixed order with the label question preceding the property question for each toy. Therefore, participants first answered the label question for a toy and then immediately answered a property question for the same toy. The three choices within the label and property questions were also presented in random order to each participant.

2.2 | Results and discussion

We applied a similar scoring strategy to the label and property questions. Participants' selection of the joint labels and dual properties, which signalled preference for conjunctions of labels and properties, was assigned a 1. Otherwise, a 0 was assigned when participants selected either of the two single labels and properties. A label summary score and a property summary score were created for each of the four types of toys (anthropomorphic, costume, transformational, and control) by summing the scores of their respective toys and then converting these totals into proportions. If participants have a preference for conjunctions of labels and properties for the experimental toys (anthropomorphic, costume, and transformational), then they should favour the joint labels and dual properties for these toys, but not the control ones.

2.2.1 | Label question

The results of a 3 × 4 (Age Group [4-year-olds, 5-year-olds, adults] × Toy Type [anthropomorphic, costume, transformational, control]) ANOVA showed a significant main effect of Age Group, $F(2, 57) = 10.69$, $p < .001$, $\eta_p^2 = 0.27$, and Toy Type, $F(3, 171) = 205$, $p < .001$, $\eta_p^2 = 0.78$. These main effects are best understood in light of a significant interaction between Age Group and Toy Type, $F(6, 171) = 7.17$, $p < .001$, $\eta_p^2 = 0.20$. Please see Figure 1.

To follow up this interaction, a series of six paired sample *t* tests were conducted for each age group. Bonferroni-adjusted significance level of .008 (.05/6) was calculated for these tests to account for the increased possibility of type I error. The results for 4- and 5-year-olds were virtually the same. Children were significantly more likely to select joint labels for each of the experimental toys (which did not differ significantly from each other) versus the control toys, $ts(19) > 7$, $ps < .001$, $ds > 1.77$. For the adults, there was a significant difference between all four toy types, transformational, costume, anthropomorphic, and control, $ts(19) > 3$, $ps < .001$, $ds > 0.79$. Adults were significantly more likely to select joint labels for the transformational toys followed by the costume, anthropomorphic, and control toys.

Participants' selection of the joint labels was also compared to chance (33%) for each toy type. Both 4- and 5-year-olds were significantly above chance on the anthropomorphic, transformational, and costume toys, $ts(19) > 7.80$, $ps < .001$, $ds > 1.75$, but significantly below chance on the control toys, $ts(19) > -6.22$, $ps < .001$, $ds > -1.39$. Adults' performance on the control toys was not compared to chance given that the mean was zero. Adults were significantly above chance on the transformational and costume toys, $ts(19) > 10.0$, $ps < .001$, $ds > 2.25$, but were at chance on the anthropomorphic toys, $t(19) = 1.06$, $p = .30$.

We also used binomial theorem to clarify adults' chance performance (33%) on the anthropomorphic toys. In particular, 15% of adults (3 out of 20) consistently selected joint labels for all four anthropomorphic toys ($p = .011$), 10% (two) selected joint labels for three anthropomorphic toys ($p = .096$), 25% (five) selected joint labels for two anthropomorphic toys ($p = .293$), 25% (five) selected joint labels for one anthropomorphic toy ($p = .397$), and 25% (5 out of 20) selected joint labels for none ($p = .201$).

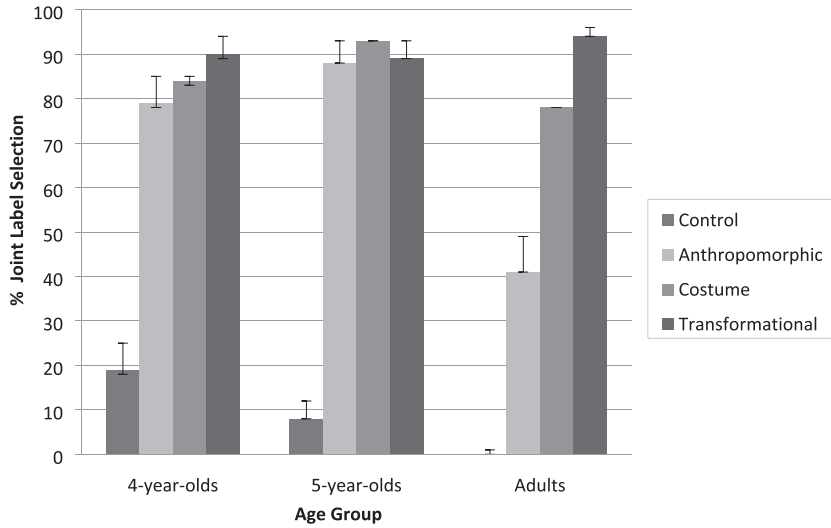

FIGURE 1 Study 1: Percentage of joint label selection by age group for each toy type. Error bars represent standard error of the mean

2.2.2 | Property question

The pattern of results for the property question parallels the pattern from the label question. A 3 × 4 (Age Group [4-year-olds, 5-year-olds, adults] × Toy Type [anthropomorphic, costume, transformational, control]) ANOVA indicated a significant main effect of Age Group, $F(2, 57) = 9.14$, $p < .001$, $\eta_p^2 = 0.24$, and Toy Type, $F(3, 171) = 96.82$, $p < .001$, $\eta_p^2 = 0.62$, moderated by an interaction between Age Group and Toy Type, $F(6, 171) = 2.84$, $p = .01$, $\eta_p^2 = 0.09$. Please see Figure 2.

To investigate this interaction, we performed paired sample *t* tests for each age group separately (Bonferroni-adjusted alpha level of .008). The results for 4- and 5-year-olds were extremely similar: Both age groups' dual

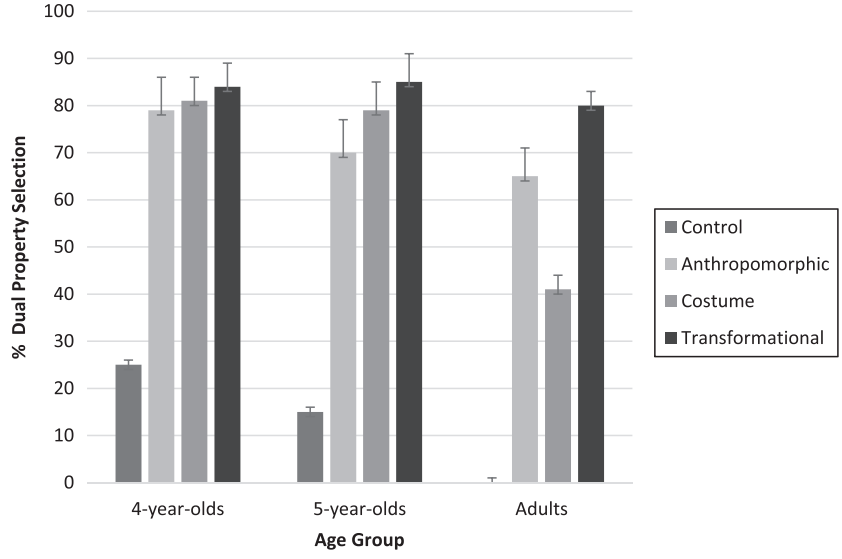

FIGURE 2 Study 1: Percentage of dual property selection by age group for each toy type. Error bars represent standard error of the mean

property selection was significantly higher for each of the experimental toys (which did not differ significantly from each other) compared with the control toys, *ts*(19) > 5, *ps* < .001, *ds* > 1.10. Adults' dual property selection was also significantly higher for each of the experimental toys compared with the control toys, *ts*(19) > 7, *ps* < .001, *ds* > 1.66. Adults' dual property selection was also significantly higher for transformational toys compared with costume toys, $t(19) = 6.94$, $p < .001$, $d = 1.55$. There were no other significant differences.

Participants' selection of the dual properties was also compared to chance (33%) for each of the toy types. Four- and 5-year-olds were significantly above chance on each of the experimental toys, anthropomorphic, costume, and transformational, *ts*(19) > 5.0, *ps* < .001, *ds* > 1.11. Four-year-olds were at chance, $t(19) = -1.22$, $p = .23$, and 5-year-olds were significantly below chance on the control toys, $t(19) = -2.81$, $p = .011$, $d = -0.63$. Adults were also significantly above chance on the anthropomorphic and transformational toys, *ts*(19) > 2, *ps* = .01, .00, *ds* > 0.57, but were at chance on the costume toys, $t(19) = 1.49$, $p = .15$. Adults' performance on the control toys was not compared to chance given that the mean was zero.

Inspection of individual 4-year-old's responses to the control toys reveals that this age group's chance level performance was driven mainly by individual differences, and not by chance performance (33%) across all 4-year-olds. As determined by binomial theorem, 5% (1 out of 20) of 4-year-olds consistently selected dual properties for all four control toys ($p = .011$), 5% (1) selected dual properties for three control toys ($p = .096$), 20% (4) selected dual properties for two control toys, 25% (5) selected dual properties for one control toy ($p = .397$), and 45% (9) selected dual properties for none of the control toys ($p = .201$).

To clarify adults' chance performance (33%) on the costume toys, we inspected the distribution of individual adult's responses. Based on binomial theorem, 5% (1 out of 20) consistently selected dual properties for all four of the costume toys ($p = .011$), 10% (2) selected dual properties for three of the costume toys ($p = .096$), 40% (8) selected dual properties for two of the costume toys ($p = .293$), 35% (7) selected dual properties for one of the costume toys ($p = .397$), and 10% (2) selected dual properties for none of the costume toys ($p = .201$).

2.2.3 | Relationship between label and property questions

We also examined whether participants' label selections influenced their property selections. To do so, we calculated Pearson correlation coefficients for each age group separately, focusing on the label and property selections for experimental and control toys combined. Results indicate that label and property selections are moderately and positively correlated for 4-year-olds, 5-year-olds, and adults, *rs* = .456, .578, .485, *ps* = .043, .008, .030. This finding suggests that participants who choose a joint (single) label are somewhat more likely to choose a dual (single) property. This finding is also in line with the child and adult concepts literature, which has found that words tend to invite categorization and that categories promote property inferences (see Murphy, 2002, for a review).

Across the labelling and property questions, both 4- and 5-year-olds assigned joint labels and attributed dual properties to each of the experimental toys equally. A closer look at each of the experimental toys within the context of the conceptual development literature offers insight into how children may have reasoned about these toys. Although children distinguish animate from inanimate objects (e.g., Wright, Poulin-Dubois, & Kelley, 2015), children still preferred joint labels and dual properties that cut across the categories of artefacts and humans for the anthropomorphic toys. This preference may not be very surprising given the prevalence and popularity of anthropomorphized characters (e.g., talking inanimate objects) in children's media, including books and movies (see Geerdts, 2016; Geerdts, Van de Walle, & LoBue, 2016) as well as the emergence of new technologies like personified robots (Severson & Carlson, 2010; Severson & Lemm, 2016). There is also reason to suspect that children's tendency to select joint labels and dual properties for costume toys may be inspired by their appreciation for the fantasy–reality distinction. Past research has revealed that children begin to make this distinction as early as age 3 years, including distinguishing real and pretend entities (see Woolley & Ghossainy, 2013). Thus, consistent with this research, children in the present investigation may have been entertaining real and pretence representations for toys in costume. It is also conceivable that children's tendency to choose label and property conjunctions for transformational toys reflects

children's understanding of object states and transformations. Prior research has shown that 3- and 4-year-olds can think of an object in two states (e.g., broken and intact cup) and can identify the transformation that occurs between these states (e.g., inferring that a hammer or glue mediates the two object states; Gelman, Bullock, & Meck, 1980). Three- to 6-year-olds also know that naturally occurring transformations take place in animals over time (e.g., metamorphosis and growth; Rosengren, Gelman, Kalish, & McCormick, 1991).

Unlike children, adults appeared to differentiate between the experimental toy types when assigning joint labels (transformational > costume > anthropomorphic) and attributing dual properties (transformational > costume). One explanation for these findings is based on differences in pretend play between the age groups; children compared with adults may more frequently engage in pretend play activities with toys similar to the ones in this study. Pretend play activities include treating items as if they have fictional identities and properties (e.g., see Abelev & Markman, 2006; Harris, Kavanaugh, Wellman, & Hickling, 1993; Wyman, Rakoczy, & Tomasello, 2009). Research has documented that pretend play peaks between ages 3 and 5 years (Lillard et al., 2013) and declines by age 11 years (Smith & Lillard, 2012). Therefore, given this developmental trajectory, it seems unreasonable to expect that the adults in this study would engage in pretence at the same rate as children and assign make-believe joint labels and dual properties to the experimental toys.

This explanation of course is not to insinuate that children's endorsement of label and property conjunctions is limited to pretence (see also Abelev & Markman, 2006) but rather intended to point out how adults may have viewed the toys in this study in comparison with the children. For example, closer inspection of adults' 35% selection of single labels for the anthropomorphic toys reveals a preference for the artefact label (e.g., bus, hammer, toaster, and phone), selecting them 98% of the time over the human label (e.g., girl, person, boy, and man). Also, further examination of adults' 41% selection of dual properties for the costume toys shows a preference for the animal-relevant property (e.g., climb trees, growl, hop, and go cluck cluck), choosing them 79% of the time over the costume-relevant property (e.g., fly, grow on a farm, grow in a garden, and eat carrots). These particular preferences suggest that some adults adopt a view of the toys that is based more in reality than in pretend play. Indeed, previous research has shown that adults tend to limit pretence possibilities to animate entities whereas children are more willing to confer pretence onto inanimate objects (Lillard, Zeljo, Curenton, & Kaugars, 2000).

Another explanation for the nuances observed in adults is related to their beliefs about the function of artefacts. This explanation is particularly relevant to the transformational toys for which adults assigned joint labels to more often than costume and anthropomorphic toys. Previous research has shown that adults tend to categorize artefacts based on the designer's intended function of the artefacts. In other words, the real or true function of an artefact is the one designated by the designer. Children under age 6 or 7 years instead tend to conceptualize artefacts based on goal-directed functions (i.e., what the artefact is being used for in the moment such as during pretend play; e.g., Defeyter, Avons, & German, 2007; Defeyter & German, 2003; Defeyter, Hearing, & German, 2009). Therefore, it is possible that adults in the present study prioritized transformational toys over the other experimental toys based on the intentionality of their function (i.e., what they were made for). Adults may have perceived the transformational toys as intentionally created to be conceptualized as two simultaneous entities given their design (e.g., the robot can physically transform into a standalone plane and vice versa). Adults may have also perceived the function of anthropomorphic (e.g., toaster with a human face) and costume (e.g., teddy bear with ladybug spots and wings) toys as intentionally designed to be ambiguous in order to engage the imagination of children during pretend play. Thus, the designer's intended function and pretence may offer complementary explanations for the adults' pattern of responding. Future empirical work could evaluate these explanations by more directly assessing adults' and children's function judgments and pretend play.

Altogether, the results do show the general pattern of 4-year-olds, 5-year-olds, and adults favouring joint category labels and dual properties for the experimental toys, but not the control toys. However, a concern is that participants did not consistently choose the joint labels and dual properties for the control toys because these labels and properties included unbelievable or implausible combinations. For example, when presented with a jump rope, a control toy, participants may not have selected the joint label, “jump rope cookie,” because it is a false choice with no obvious connection between jump ropes and cookies. For the same reason, participants may not have selected the dual property, “spins and tastes yummy.” In contrast, for the experimental toys, there was an obvious connection

between the combinations in the joint labels and dual properties. Therefore, the differential responding between experimental and control toys may simply be due to methodology.

3 | STUDY 2

Study 2 focuses on the control toys and addresses a concern related to the believability of the labels and properties for these toys. Participants in Study 1 may not have favoured the joint labels and dual properties for the control toys because they did not include believable combinations. We therefore designed a version of the task in which participants heard only believable joint labels and dual properties for the control toys. In this task, participants were tested on the control toys from Study 1 but were offered choices of joint labels and dual properties that included combinations with more obvious connections. For example, "jump rope bracelet" and "spins and goes on your wrist" (something that children might pretend to do in some instances and for which the features afford the label and/or property) replaced "jump rope cookie" and "spins and tastes yummy." If participants favour the joint labels and dual properties for the control toys in Study 2, then this would suggest that the believability of the labels and properties influenced responses to the control toys in Study 1.

3.1 | Method

3.1.1 | Participants

Participants included a new group of 20 four-year-olds (M_{age} = 4.49 years, range = 4.05–4.84 years, seven females), 20 five-year-olds (M_{age} = 5.26 years, range = 5.01–5.76 years, 10 females), and 20 adults (M_{age} = 19.07 years, range = 18.15–20.59 years, 14 females). Data were excluded from an additional six children due to experimenter error. Participants were drawn from the same demographic population as Study 1.

3.1.2 | Materials and procedure

The stimuli were four photographs of the control toys from Study 1 (ball, blocks, crayons, and jump rope). The procedure was the same as Study 1, except for the removal of the experimental toys and that the control toys had more believable or plausible labels and properties. Please see Appendix C for these labels and properties.

3.2 | Results and discussion

We implemented the same scoring scheme from Study 1 in Study 2 for both the label and property questions for the control toys. Next, we compared performance in Study 1 versus Study 2 to determine the impact of label and property believability. Please see Figure 3 for the percentage of participants' selection of joint labels and dual properties for the control toys in Study 1 versus Study 2. Four-year-olds', 5-year-olds', and adults' performance in Study 2 was compared with their respective age group's performance on the control toys in Study 1 through a series of three independent sample *t* tests per question (Bonferroni-adjusted alpha level of .016, .05/3). As predicted, for the label question, there was not a significant difference between Study 1 versus 2 for each age group considered separately, 4-year-olds, 5-year-olds, and adults, *p*s = .25, .03, .17. This was also the case for the property question for 4-year-olds, 5-year-olds, and adults, *p*s = .55, .18, .32.

We also compared participants' performance in Study 2 against chance (33%). For the label question, 4- and 5-year-olds selected the joint labels for the control toys at chance levels, *t*s(19) = −.38, −.91, *p*s = .70, .37. Adults' selection of the joint labels for the control toys was significantly below chance, *t*s(19) > −10.69, $p < .001$, $d = -2.41$. For the property question, 4- and 5-year-olds selected the dual properties for the control toys at chance levels, *t*s(19) = −.21, −.81, *p*s = .81, .42. Adults' selection of the dual properties for the control toys was significantly below chance, $t(19) = -12.20$, $p < .001$, $d = -2.72$.

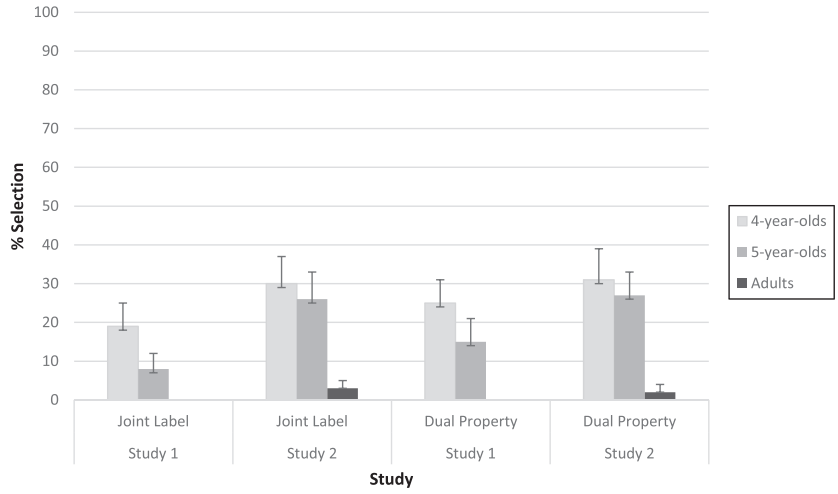

FIGURE 3 Study 1 and Study 2 control toys: Percentage of joint label and dual property selection for each age group. Error bars represent standard error of the mean

Closer examination of individual 4- and 5-year-olds' responses reveals that children's chance level performance (33%) was driven largely by individual differences as opposed to chance performance across all of the children. According to binomial theorem, for the label question, 10% of the 4-year-olds (2 out of 20) consistently selected joint labels for all four of the control toys (p = .011), 10% (2) selected joint labels for three of the control toys (p = .096), 15% (3) selected joint labels for two of the control toys (p = .293), 20% (4) selected joint labels for one of the control toys (p = .397), and 45% (9) selected joint labels for none of the control toys (p = .201). The distribution was similar for 5-year-olds: 5% (1 out of 20) consistently selected joint labels for all four of the control toys (p = .011), 15% (3) selected joint labels for three of the control toys (p = .096), 10% (2) selected joint labels for two of the control toys (p = .293), 20% (4) selected joint labels for one of the control toys (p = .397), and 50% (10) selected joint labels for none of the control toys (p = .201).

According to binomial theorem, for the property question, 10% of the 4-year-olds (2 out of 20) consistently selected dual properties for all four of the control toys (p = .011), 15% (3 out of 20) selected dual properties for three of the control toys (p = .096), 10% (2 out of 20) selected dual properties for two of the control toys (p = .293), 20% (4 out of 20) selected dual properties for one of the control toys (p = .397), and 45% (9 out of 20) selected dual properties for none of the control toys (p = .201). Similarly, for the 5-year-olds, 5% (1 out of 20) consistently selected dual properties for all four of the control toys (p = .011), 10% (2) selected dual properties for three of the control toys (p = .096), 15% (3) selected dual properties for two of the control toys (p = .293), 30% (6) selected dual properties for one of the control toys (p = .397), and 40% (8) selected dual properties for none of the control toys (p = .201).

3.2.1 | Relationship between label and property questions

As in Study 1, we examined the relationship between participants' label and property selections. The results show that label and property selections for the control toys are strongly and positively correlated for each age group considered separately, 4-year-olds, 5-year-olds, and adults, rs = .936, .889, .890, ps < .001.

Taken together, these findings do not support the alternative interpretation to the results of Study 1 regarding the believability of the joint label and dual property choices for the control toys. In Study 2 as in Study 1, 4-year-olds, 5-year-olds, and adults generally did not prefer the joint labels and dual properties for the control toys, even when presented with combinations that included obvious connections. Of course, this is not to suggest that the believability of the joint labels and dual properties in Study 2 had absolutely no effect at all. As seen in the individual difference

data, some children were responsive to the combinations offered in these labels and properties. Such a finding is not surprising though given that Study 2 was purposefully designed to include more convincing joint labels and dual properties for the control toys than those in Study 1.

4 | STUDY 3

Study 3 was conducted to address two assumptions of Studies 1 and 2. First, Studies 1 and 2 assume that children understand that the experimental toys belong to two categories whereas the control toys belong to one category. However, an argument could be made that preference for label and property conjunctions does not necessarily mean that children viewed the experimental toys as cross-classifiable and the control toys as non-cross-classifiable. For example, if a child selects "ladybug bear" as a label or "climb trees and fly" as properties for a toy, it is unclear whether the child thinks that the toy actually belongs to *both* the category of ladybugs and bears or that it is a type or subcategory of a bear. Thus, in Study 3, children were asked to explicitly categorize the toys. For example, children were asked if a toy was a ladybug, a bear, or *both* a ladybug and bear. Children were also asked if the toy could climb trees, fly, or *both* climb trees and fly. If children view the experimental toys as belonging to two categories and the control toys as belonging to one category, then children should tend to select the *both* choice for the former, but not the latter toys.

Second, the interpretation of the positive correlation found between participants' responses on the label and property questions in Studies 1 and 2 assumes that labels play a causal role in the perception of the toys' properties. That is, participants may be classifying the toys in the label task and then using the label to identify the toys' properties. However, it could be argued that this relationship is merely the result of participants' attempt to appear consistent by responding in the same way to the property question as they did to the label question. It is difficult to determine the likelihood of this possibility given that participants first answered the label question for a toy and then immediately answered the property question for the same toy. Therefore, in Study 3, the label and property questions were separated and presented in two separate blocks (e.g., label questions came first or second). If labels play a causal role in the perception of the toys' properties, then selection of property conjunctions should be higher when the label question is presented before versus after the property question.

4.1 | Method

4.1.1 | Participants

Given the similar pattern of responding in 4- and 5-year-olds in both Study 1 and Study 2, we tested a single age group of 4- to 5-year-olds in Study 3. Participants included 17 four- to 5-year-olds (M_{age} = 4.75 years, range = 4.02–5.46, seven females). Participants were drawn from the same demographic population as the previous studies. One additional child was tested but excluded from analysis because of experimenter error.

4.1.2 | Materials and procedure

We used a combination of materials from the previous studies. Specifically, we used the experimental trials from Study 1 and the control trials from Study 2.

The procedure for Study 3 was the same as in Study 1 except for two major modifications. First, we asked children either a block of 16 label questions about 16 experimental and control toys first (and then a block 16 property questions about the same toys second) or a block of 16 property questions about the 16 toys first (and then a block of 16 label questions about the same toys second). Because the property question did not immediately follow the label question, we removed reference to children's label choice in the property question. In Study 3, nine children

were presented with the block of label questions first (and property questions second), and eight children were presented with the block of label questions second (and property questions first).

Second, we incorporated the word "both" into the joint label and dual property choices. We also incorporated the word "and" into the joint label, which was previously only a part of the dual property choices in Study 1.

An example of a label question and choices for an experimental toy was "Here's a toy. Would you call this toy a bear, ladybug, or both a ladybug and bear?" An example of a label question and choices for a control toy was "Here's a toy. Would you call this toy a jump rope, bracelet, or both a jump rope and bracelet?"

As for the property question and choices, an example for an experimental toy was "Here's a toy. If you were playing with this toy, what would it be able to do? Does it climb trees, fly, or both climb trees and fly?" An example of a property question and choices for a control toy was "Here's a toy. If you were playing with this toy, what would it be able to do? Does it spin, go on your wrist, or both spin and go on your wrist?"

Children were tested either in a quiet area of their school or in a laboratory located on a university campus.

4.2 | Results and discussion

We scored the data similar to Studies 1 and 2. In addition, we combined the experimental toys into a single variable in order to compare overall performance against the control toys. To examine the assumption regarding categorization, we conducted two paired sample *t* tests comparing children's performance on the experimental toys versus the control toys for the label and property questions (Bonferroni-adjusted alpha level of .025, .05/2). For the label question, the results showed that children selected the *both* choice more often for the experimental toys (M = 74%, SD = 30%) than the control toys (M = 39%, SD = 42%), $t(16) = 3.47$, $p = .003$, $d = 0.84$. This was also the case for the property question: Children selected the *both* choice more often for the experimental toys (M = 75%, SD = 30%) than the control toys (M = 48%, SD = 35%), $t(16) = 3.17$, $p = .006$, $d = 0.77$. These results provide support that the experimental toys are indeed viewed by children as more cross-classifiable than the control toys.

To examine the assumption regarding the role of labels on children's perception of the toys' properties, we then conducted two independent sample *t* tests comparing children's pattern of property attribution when the label questions were presented either before or after the property questions (Bonferroni-adjusted alpha level of .025, .05/2). For the experimental toys, the results showed a trend towards a significant difference between children's selection of the *both* choice when the block of label questions was presented before versus after the property questions, $t(15) = 2.29$, $p = .03$. Specifically, there was a trend towards selecting the *both* choice for the property questions less often when the block of label questions was presented first (M = 60%, SD = 36%) versus second (M = 90%, SD = 9%). For the control toys, children's selection of the *both* choice was virtually the same when the block of label questions was presented before and after the property questions (Ms = 50%, 47%; SDs = 28%, 45%), $p = .86$. Interestingly, these results indicate that labels do not necessarily play a causal role in the perception of the toys' properties. In fact, there was a hint of an opposite pattern of predicted results. Thus, labels do not appear to have a strong facilitative effect on children's selection of property conjunctions.

5 | STUDY 4

Thus far, we have found that by age 4 years, children prefer joint labels and dual properties for the experimental toys, but not the control toys. The aim of Study 4 was to examine the development of these preferences. Study 4 included a younger age group, namely, 3-year-olds, by using a version of the task that combines the experimental toy trials from Study 1 with the control toy trials from Study 2. Given that children do not have a strong ability for simultaneous cross-classification until age 4 years (e.g., Nguyen, 2007, 2012; Nguyen & Gelman, 2012; Nguyen & Murphy, 2003), we predicted that 3-year-olds would not consistently favour the joint labels and dual properties for experimental versus control toys.

5.1 | Method

5.1.1 | Participants

Participants included 22 three-year-olds (M_{age} = 3.37 years, range = 2.89–3.73, 13 females). Participants were from the same demographic population as in Studies 1–3.

5.1.2 | Materials and procedure

We used a combination of materials from the previous studies. Specifically, we used the experimental trials from Study 1 and the control trials from Study 2.

The procedure was identical to Study 1. Children were tested either in a quiet area of their school or in a laboratory located on a university campus.

5.2 | Results and discussion

We scored the data as in Study 1 and Study 2 and performed a series of six paired sample *t* tests comparing the different types of toys (Bonferroni-adjusted alpha level of .008).

The results provide only partial support for our prediction. Unexpectedly, for the label question, 3-year-olds favoured the joint labels for experimental versus control toys. The results revealed that 3-year-olds selected the joint labels significantly more often for the anthropomorphic, costume, and transformational toys (which did not differ significantly from each other, *M*s = 72%, 77%, 70%; *SD*s = 38%, 35%, 36%) than the control toys (*M* = 49%, *SD* = 43%), *t*s(21) > 3, *p*s < .008, *d*s > 0.60.

However, for the property question, 3-year-olds did not consistently favour the dual properties for experimental versus control toys. The results showed that 3-year-olds did not select the dual properties significantly more often for the anthropomorphic, costume, and transformational toys (*M*s = 52%, 45%, 36%; *SD*s = 41%, 45%, 38%) than the control toys (*M* = 43%, *SD* = 35%), *p*s > .008. Three-year-olds' dual property selection was also significantly higher for anthropomorphic toys than transformational ones, *t*(21) = 3.30, *p* = .003, *d* = 0.70. There were no other significant differences.

Three-year-olds' selection of the joint labels and dual properties was also compared to chance (33%) for each toy type. For the label questions, children were significantly above chance on the anthropomorphic, costume, and transformational toys, *t*s(21) > 4.70, *p*s < .001, *d*s > 1.0, but at chance on the control toys (*M* = 49%, *SD* = 43%), *t*(21) = 1.74, *p* = .10. For the property questions, children were above chance only on the anthropomorphic toys (*M* = 52%, *SD* = 41%), *t*(21) = 2.18, *p* = .04, *d* = 0.46. Children were at chance on the costume, transformational, and control toys (*M*s = 45%, 36%, 43%; *SD*s = 45%, 38%, 35%), *t*s(21) < 1.50, *p*s > .05.

To summarize, Study 4 shows that 3-year-olds prefer joint labels for experimental toys, but not for control ones. This finding was unexpected given past research showing that 3-year-olds have difficulty verifying the category label pairs for simultaneously cross-classifiable items (Nguyen, 2007). Methodological differences may account for the observed difference (i.e., Nguyen, 2007, tested children on items that belong to taxonomic and script categories, not two taxonomic categories as in the current Study 4). This overall labelling preference in 3-year-olds was also found in Study 1 and Study 2 with 4-year-olds, 5-year-olds, and adults, suggesting that the preference for joint labels for experimental toys versus control toys develops by at least age 3 years. Study 4 also shows that 3-year-olds do not prefer dual properties for experimental toys over control ones. This overall lack of property attribution preference in 3-year-olds is dissimilar to what was found in Studies 1 and 2, suggesting that a preference for dual properties for experimental toys versus control toys may not develop until about age 4 years. This finding with 3-year-olds dovetails with previous findings showing that 3-year-olds have trouble selectively making inductive inferences with items that could be cross-classified sequentially on different trials (Nguyen, 2012).

6 | GENERAL DISCUSSION

Overall, the results of Studies 1–4 provide insight into children's preference to mentally represent cross-classifiable toys using two category representations simultaneously, rather than just one. These results support the hypothesis that if children have a preference for label and property conjunctions for cross-classifiable items, then they should choose the joint labels and dual properties more often for the experimental versus control toys. Study 1 found that 4-year-olds, 5-year-olds, and adults generally prefer to name experimental toys (anthropomorphic, costume, and transformational) that belong to two different categories with joint labels that capture both category memberships. Moreover, each age group preferred to attribute dual properties to experimental toys that combine the features of two categories. In contrast, each age group did not display this preference for joint category labels and dual properties when considering the control toys that belonged to only one category. Even when more believable combinations were used in Study 2, the pattern of responses stayed the same, with each age group still favouring the single category labels and properties for the control toys. A similar pattern of results was found in Study 3 when children participated in a modified version of the procedure involving blocks of label and property questions and explicit category choices. Finally, Study 4 revealed that although 3-year-olds prefer to name experimental toys (but not controls) with joint labels, 3-year-olds do not prefer to attribute dual properties more to experimental toys than control toys.

In sum, our findings with 4- and 5-year-olds converge with the developmental literature described in the Introduction documenting children's representational abilities in language and categorization. However, our findings elaborate on this literature by showing how different types of stimuli (anthropomorphic, costume, and transformational toys) tend to elicit children's and adults' preferences for joint labels that denote membership in two distinct categories and more uniquely, dual properties that combine features of these categories. Specifically, our findings with items that defy common taxonomic boundaries extend the results of past studies that have typically tested children on hierarchically related items within the same category (e.g., Waxman & Hatch, 1992) or items belonging to two interrelated categories (e.g., Nguyen, 2007). Our findings with joint labels that mark category membership in two categories also extend the findings of prior studies that have focused on compound nouns for a subcategory within one taxonomy (e.g., Clark et al., 1985).

A major contribution from this investigation is the evidence that it brings to bear on children's conceptualization of cross-classified toys. Markman (1989) describes that whereas some groupings are based on shared arbitrary features, others are richly structured in that they reflect an item's essence. Thus, items belong to only one richly structured category that can be used as a basis for induction. Although past studies have documented that children can selectively use categories for inferences about one property at a time (e.g., Kalish & Gelman, 1992; Nguyen, 2012), to the best of our knowledge, the present findings are the first to show that 4- and 5-year-old children prefer to combine properties across two different categories simultaneously for cross-classifiable items. That is, 4- and 5-year-olds are using two richly structured categories at the same time as a basis for attributing properties to cross-classifiable toys. Future research will be necessary to better understand why 3-year-olds did not prefer choices that combined properties of two categories and how this is related to children's category representations. For example, perhaps sufficient priming is needed to facilitate young children's inductive selectivity with items that can be cross-classified simultaneously in the same trial (see Nguyen, 2012).

We speculate that 4- and 5-year-old children and adults may represent the experimental toys as hybrids to some extent, especially given that the dual properties and the joint labels were aggregates of two categories. Borrowing from the adult concepts literature, hybridization is one way that adults interpret conceptual (noun–noun) combinations (Mashal & Coblentz, 2014; Wisniewski, 1996). Specifically, additive hybrids are formed from the union of the two constituent concepts including the two sets of attributes. For example, flashflight slippers are indoor shoes that have a built-in light, sharing the properties of both flashlights (bulbs and batteries) and slippers (soft indoor shoes). Hybrids can also become more integrative when conflicting attributes of the two constituent concepts are identified and resolved with the introduction of emergent attributes. For example, the battery inside a pair of flashlight slippers could be recharged while walking in them (Gibbert, Hampton, Estes, & Mazursky, 2012).

Interestingly, past research has shown that hybrid concepts found in natural language usually combine similar concepts (e.g., singer songwriter) and that adults resist forming hybrids out of dissimilar concepts (Wisniewski, 1997). However, recent research demonstrates that hybridization of dissimilar concepts is becoming increasingly prevalent with the advent of new products in the marketplace (e.g., refrigerator television, Gibbert et al., 2012). Research in marketing and cognitive psychology has revealed how adult consumers conceptualize new products that do not clearly belong to existing product categories: adults will use their prior knowledge of multiple existing product categories to understand a novel product if the innovation shares features with members of these different categories (e.g., Febreze can be applied to fabrics like detergents and eliminates odours like air freshener, Moreau, Markman, & Lehmann, 2001). Among the new products that are introduced into the marketplace each year are thousands of toys (Handler Miller, 2014), including the pillow pets described in the Introduction. These trends perhaps help us to understand why adults and 4- and 5-year-olds in our research were not only willing to choose joint labels for experimental toys that combined concepts that are arguably quite dissimilar (e.g., a toaster boy) but also willing to choose dual properties that blended attributes from each concept (e.g., cook and sing).

In future research, it will be interesting to examine the degree to which children and adults view some toys as hybrids. In particular, participants could be asked to explain the relationship between the labels in the label conjunctions and the properties in the property conjunctions. These explanations could also help rule out other interpretations of conceptual combinations that have also been discussed within the cognitive development literature (e.g., relational linking, Krott, Gagne, & Nicoladis, 2009, 2010; Nicoladis, 2003; property similarity, Parault, Schwanenflugel, & Haverback, 2005).

6.1 | Limitations and future directions

As with many methodologies, we recognize that the forced-choice paradigm that we implemented in the current investigation has its drawbacks, such as forcing children to choose a label that they would not have thought of spontaneously, and how this could yield artificial results. In our preliminary work, we used a free labelling task with people of the same age as those in the studies. The data were used as a basis for creating labels and properties that were thought to be relevant and applicable to the toys. Because we were ultimately interested in children's preferences, had we used a free labelling task in the actual study, we would have faced the challenge of how to appropriately interpret the data. For example, if a child does not immediately provide a label, this may be due to the child not having a preference, or due to other reasons such as the child is unwilling to provide a label on demand, the child is too shy or intimidated to provide a label, and a label not being readily assessable or salient to the child. If a child provides a label, this may also be difficult to interpret. For instance, a child may provide a single label not because of preference, but because of task demands such as the perception that the researcher is expecting to hear a conventional label that is customarily used in the English language. Also, instead of revealing preference, a single label may be more reflective of a child's limited verbal working memory capacity or experience of verbal inhibition in that the first label activated interferes with the production of other labels (see Gathercole & Adams, 1993; Gershkoff-Stowe, 2002). Given these concerns, we decided to use a forced-choice task that emphasizes children's receptive versus expressive language. In future research, however, it will be crucial to examine how different methodologies could be combined with an eye towards minimizing unintended carry-over effects of successive labelling tasks (e.g., perseveration and cumulative interference; Booth & Vitkovitch, 2008; Charest, 2017).

We also recognize that the use of pre-existing toys limited our ability to systematically vary the category membership and category-relevant features of the toys that may influence label and property preferences. Our decision to use pre-existing toys in this study as opposed to creating novel experimenter-designed toys was informed by the need for more research on children's concepts of complex, potentially confusing items (see Bloom, 2007; water as a hybrid concept; Jipson & Gelman, 2007, robots; Saylor, Somanader, Levin, & Kawamura, 2010, humanoid robots). Indeed, Keil, Grief, and Kerner (2007) have argued that the heterogeneity of artefacts is often overlooked and

underrepresented in research. Now that we have established how children in this study prefer to label and attribute properties to anthropomorphic, costume, and transformational toys, in future work, novel toys as well as a broader array of items can be used as a means of answering additional questions about factors (e.g., category membership and category-relevant features) that may impact preferences. One specific avenue for future research will be to compare child and adult preferences in labelling and property attribution for toys and nontoy items in play and nonplay contexts. For example, what preferences might children and adults have when reasoning about a toy animal in a costume versus a real animal in a costume (see also Keil, 1989)? Extensions such as these will help to elucidate the range of circumstances under which children and adults prefer certain labels and properties over others.

We also recognize that pragmatic demand characteristics of the task used in this present research may have affected participants' performance. In particular, understanding the pragmatic meaning of the property question and choices above and beyond their literal meaning was crucial to the task. Although young children are capable of using a variety of pragmatic cues to determine adult semantic intentions (e.g., see L. Bloom, 1998; Tomasello, 2001), there may not have been enough pragmatic information in our task to properly communicate to participants what the researcher was talking about. Consequently, some of the participants, especially 3-year-olds, may have been pragmatically confused by the property question and choices and interpreted them literally (e.g., a ladybug bear would not be able to climb trees or fly because it is a toy). In future research, sufficient pragmatic context and intentions will be needed in addition to our demonstration and practice item to support every participant's understanding of the meaning of the property question and choices.

Finally, because the current sample is drawn from a predominately White, middle class community and university, we acknowledge that the findings may not be generalizable to all children and adults (see Nielsen, Haun, Kärtner, & Legare, 2017, & Syed, Santos, Yoo, & Juang, 2018, for discussion regarding sampling bias in developmental science). In future research, a broad, representative sample could be recruited using population-based probability sampling (e.g., stratified and clustered, see Bornstein, Jager, & Putnick, 2013). Such a sample would allow exploration of how sociodemographic characteristics (e.g., socioeconomic status and ethnicity) may affect preferences in labelling and property attributions for cross-classified toys.

6.2 | Conclusions

In closing, the results of the present investigation reveal how 4-year-olds, 5-year-olds, and adults prefer to endorse pairs of conceptually supported labels and properties for toys that belong to two categories compared with toys that belong to one category. The results also reveal how these preferences emerge in 3-year-olds. Studying how different cognitive processes (e.g., creativity, see Mashal & Coblentz, 2014) might contribute to children's preference for label and property conjunctions will be an important next step in future research. Such research holds promise for further illuminating our understanding of lexical usage and classification practices within the context of complex items from toys to other objects and entities.

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APPENDIX A
STUDY 1 STIMULI

Toy: Label choices (single, single, joint); *Property choices (single, single, dual)*

Control

Ball: Ball, Duck, Duck Ball; *Bounce*, *Go quack*, *Bounce & Go quack*

Blocks: Blocks, Hat, Hat Blocks; *Stacks up high*, *Goes on your head*, *Stacks up high & Goes on your head*

Crayon: Crayon, Bird, Bird Crayon; *Color*, *Chirp*, *Color & Chirp*

Jump Rope: Jump Rope, Cookie, Jump Rope Cookie; *Spins*, *Tastes yummy*, *Spins & Tastes Yummy*

Experimental

Anthropomorphic

Hammer with a human face: Hammer, Person, Hammer Person; *Pound nails*, *See things*, *Pound nails & See things*

Phone with a human face: Phone, Man, Phone Man; *Ring*, *Talk*, *Ring & Talk*

School bus with a human face: Bus, Girl, Girl Bus; *Need gas*, *Breathe*, *Need gas & Breathe*

Toaster with a human face: Toaster, Boy, Toaster Boy; *Cook*, *Sing*, *Cook & Sing*

Costume

Black bear in a ladybug costume: Bear, Ladybug, Ladybug Bear; *Climb trees*, *Fly*, *& Climb trees & Fly*

Brown bear in a cornstalk costume: Bear, Corn, Corn Bear; *Growl*, *Grow on a farm*, *Growl & Grow on a farm*

Bunny in a carrot costume: Bunny, Carrot, Carrot Bunny; *Hop*, *Grow in a garden*, *Hop & Grow in a garden*

Chicken in a bunny costume: Chick, Bunny, Chick Bunny; *Go cluck cluck*, *Eat carrots*, *Go cluck cluck & Eat carrots*

Transformational

Car that transforms into a monster: Car, Monster, Car Monster; *Go zoom zoom*, *Has special powers*, *Go zoom zoom & Has special powers*

Mickey Mouse that transforms into a truck: Mickey Mouse, Truck, Mickey Mouse Truck; *Rescues people*, *Go honk honk*; *Rescues people & Go honk honk*

Plane that transforms into a robot: Plane, Robot, Plane Robot; *Goes in the sky*, *Fight*; *Goes in the sky & Fight*

Princess that transforms into a cupcake: Cupcake, Princess, Cupcake Princess; *Tastes sweet*, *Dance*, *Tastes sweet & Dance*

APPENDIX B

STUDY 1 SAMPLE PICTURES

Control

Jump Rope

Experimental

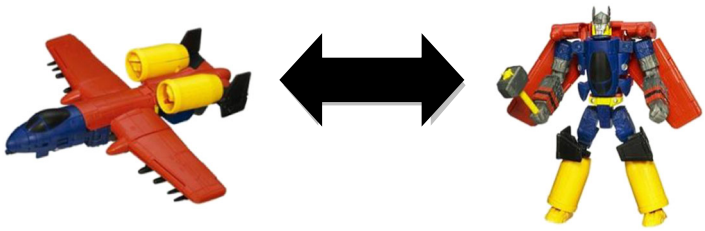
Anthropomorphic

Toaster with a human face

Costume

Black bear in a ladybug costume

Transformational



Plane that transforms into a robot

APPENDIX C

STUDY 2 STIMULI

Toy: Label choices (single, single, joint); *Property choices (single, single, dual)*

Ball: Ball, Candy, Candy Ball; *Bounce*, *Tastes yummy*, *Bounce & Tastes yummy*

Blocks: Blocks, Train, Train Blocks; *Stacks up high*, *Goes choo choo*, *Stacks up high & Goes choo choo*

Crayon: Crayon, Chapstick, Chapstick Crayon; *Color*, *Go on your lips*, *Color & Go on your lips*

Jump Rope: Jump Rope, Bracelet, Jump Rope Bracelet; *Spins*, *Goes on your wrist*, *Spins & Goes on your wrist*