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Comparing Apples to Fruit: Parent's Comparisons of Labels are Related to First and Second Label Learning

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Abstract

Young children often find it difficult to learn two labels for a single object. However, there is a great deal of variability across studies in children's bias to reject second labels. In this study, we investigated three possible factors affecting this variability including age, task, and parental input in a cross-sectional sample of children from 12- to 28-months-old. We show that children reject second labels differently depending on their age, task demands, and the amount and type of parental input. Importantly, there is also a correlation between the ways in which parent's use second labels and children's acceptance of first and second labels for objects. These results suggest that both previous experience and the task at hand determine children's learning of second labels.

Keywords: Word learning, language acquisition, vocabulary, parental input

Introduction

Sometime after their first birthday, children begin to add words to their vocabulary at an increasingly greater rate. These words almost exclusively share a one-to-one relationship with object categories. Learning more than one label for the same object, like "banana" and "fruit", can be difficult, especially for younger children (Liittschwager & Markman, 1994; Markman & Wachtel, 1988). The propensity to reject second labels can be useful when it comes to learning a new novel name. For example, when shown two objects, one familiar and one unfamiliar, and asked to hand the experimenter a "dax", children can correctly choose the unfamiliar object. But, this tendency can sometimes make it hard to learn certain kinds of words like adjectives (Hall, Waxman, & Hurwitz, 1993), part labels (Hansen & Markman, 2009; Saylor, Sabbagh, & Baldwin, 2002), proper names, (Gelman & Taylor, 1984) and labels at different levels of specificity (Au & Glusman, 1990).

Converging evidence from a variety of tasks supports the idea that children prefer a single label per object. There is also a great deal of variability from study to study in the degree to which children reject second labels. Context factors shown to influence this bias include: bilingual input (Au & Glusman, 1990; Davidson & Tell, 2005; Merriman & Kutlesic, 1993), pragmatic information (Bloom, 2000; Clark & Grossman, 1998; Diesendruck & Markson, 2001), and parts of speech and relationship between words (e.g. part versus a whole object or level of specificity) (Hall, Waxman, & Hurwitz, 1993; Saylor, Sabbagh, & Baldwin, 2002; Waxman & Senghas, 1992). All of these influences have in common that they depend on parental input. In this study we investigate the impact that the relationships between these different parental factors and how children learn second labels. Though attempts have been made to construct a unified explanation that includes all of these factors (Hollich et al., 2000), few studies have directly investigated the interaction between these input factors and the resulting impact on the learning of second labels.

In this study, we investigate the relationship parent input and the *process* of word learning. Specifically, we investigated the link between second label learning and the context in which second labels are learned. Both task differences and object properties may influence second label learning. We investigate both context variables in relation to parent's use of second labels in a naturalistic task.

Second Label Learning Tasks

In general, tasks used to measure second label learning can be separated into two groups (see Figure 1). They either 1) directly measure the child's ability to learn two labels for one object or they 2) require the child to infer by exclusion to which object a second label applies. This difference in task is often confounded with age such that older children do better than younger children when learning by exclusion (Markman, Wasow, & Hansen, 2003).

In direct learning, children are presented with a familiar object (e.g. a ball) and told that it is a "dax". They are then asked to identify the "dax" among one or more distractors. In this way, children are required to directly map the word

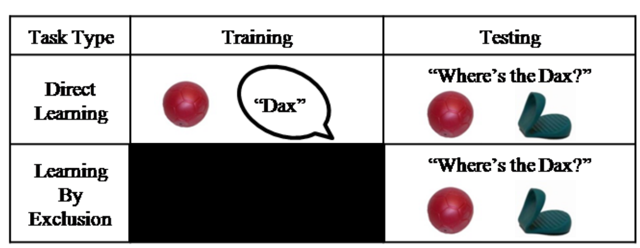

Figure 1. Examples of tasks used to test label learning.

"dax" to an object (Liittschwager & Markman, 1994; Mervis, Golinkoff, & Bertrand, 1994). Tasks requiring learning by exclusion, on the other hand, require that children infer the referent of a second label. For example, children may be shown two objects – one that they already have a name for and one that is unfamiliar. They are then simply asked to choose the "dax". Experimenters never directly label the unfamiliar object as "dax". Thus, children must infer that the novel word should refer to the unfamiliar object (Hollich et al., 2000; Markman, Wasow, & Hansen, 2003).

Parental Input

Several papers have also suggested that parental input influences second label learning. This is based on studies showing that parents differ in the amount and type of second labels they use for different age groups. This difference is related to vocabulary size (Callanan & Sabbagh, 2004; Masur, 1997). This conjecture is reasonable given that parental input effects language development in several ways (Girolametto, Weitzman, Wiigs, & Pearce, 1999; Hoff & Naigles, 2002; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). The drawback to studies showing a difference in parent input is that they do not investigate the subsequent impact on children's biases. Furthermore, these studies have not investigated the interaction between amount and type of parental input and the type of task used to test children's second label learning. Different types of input may affect first and second label learning differently and may interact with task.

In this study, we investigate the amount and type of second labels that parents use and any to second label learning across age. Five age groups, from 12- to 28-months, were tested on their ability to learn first and second labels directly and by exclusion. These same children were also videotaped playing with one of their parents. This allowed us to not only determine the amount and type of second label use by parents but look at the interaction between parental input and task type.

Method

Participants

One-hundred and twenty child-parent dyads were recruited for the study, including 24 dyads per each of five age groups, included 12-, 16-, 20-, 24, and 28-month-olds. Equal numbers of males and females were included and were distributed approximately equally across age groups.

Materials

Parents completed a vocabulary checklist of words their child says using the MacArthur Communicative Development Inventories (MCDI) (Fenson et al., 1994). Total vocabulary size was determined using the number of items that parents indicated their child knew. In addition, parents and children completed two tasks twice, once each in two different sessions. The two tasks were always completed in the same order at each session. Tasks are described separately below.

Label Learning Task Children were taught four new labels (e.g. "lep") for four new objects, counterbalanced across two sessions. At one session they were taught two new labels for two familiar objects (i.e. a ball and a spoon). At the second session they were taught two different new labels for two unfamiliar objects (i.e. a rubber pot holder and a honey dipper). At each session, during training children saw eight objects in the following order: three objects that weren't labeled, one object that was labeled with a first new label, three more objects that weren't labeled, and a final object that was labeled with a second new label.

Children were then tested on six types of trials. The first two trial types were control trials: 1) known label trials where they were asked to pick an object they knew (e.g. doll) from two familiar objects and 2) no label trials where they were asked to "pick one" of two objects – one target and one non-target object. The remaining four trials tested 3) first labels (unfamiliar objects) directly and 4) by exclusion and tested 5) second labels (familiar objects) directly and 6) by exclusion (see Figure 2). The direct learning questions tested children's abilities to learn new words for objects where the new word was either a second label for a familiar object (i.e. ball) or a first label for an unfamiliar object (i.e. pot holder). Learning by exclusion trials were similar to the direct trials except that children were now asked to identify a "toma", a fifth new word that they had not heard in training, such that the unlabeled distractors from training now became the target objects.

Input Task This task consisted of a simple play session in which children and one of their parents (the primary caregiver when possible) played with four separate sets of toys for four minutes each. They played with two sets during one session and the other two sets at a second session, counterbalanced within and across sessions. The four sets included a sea animals set, a construction vehicles set, a fruit and vegetables set, and a kitchen utensils set. Each set consisted of 14 objects including 12 objects from the relevant category (roughly half familiar and half unfamiliar to the 20-month-olds according to MCDI percentages), one thematically related object, and one taxonomically related object. For example, the fruits and

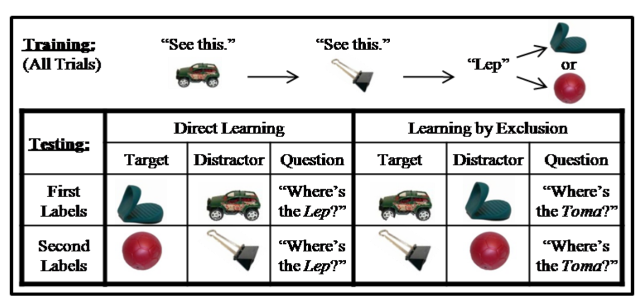

Figure 2. Testing trials design label learning task.

vegetables set included 12 related food toys (an orange, an apple, a banana, asparagus, a bean, an onion, a tomato, a slice of watermelon, a radish, an eggplant, a carrot, and a pepper), one thematic toy (a cutting board), and one taxonomic toy (an egg). Parents were told to sit on a large floor mat and play with their children as if they were at home. Audio and video was recorded.

Procedure

Parent/child dyads attended two sessions within two weeks of each other. Parents completed the MCDI vocabulary checklist on or close to the first session. At each session, the dyads completed the input task first and the label learning task second. Parents did not participate, but were present, for the label learning task.

Coding

Following data collection, all videos of child-parent dyads were reviewed. Coding of the videos consisted of two phases; one to identify instances of labeling and one to identify the types of relations used between first and second labels.

Label Identification First, all instances of the parent labeling an object were identified. Children's labeling instances were not considered. Specifically, the number of times that parents labeled the object was recorded separately for each different label used for each object. For example, a parent might label the orange object "orange" twice and "ball" three times. Four separate measures were calculated using this information including: 1) the proportion of objects that were labeled, 2) the proportion of labeled objects that were given two or more labels, 3) the number of times an object was labeled, and 4) the proportion of labeling instances that were applied to objects given two or more labels. Each measure was calculated separately for familiar and unfamiliar objects, giving us a total of eight input measures. Familiarity was determined separately for each child based on parent report.

Second Label Relations After all instances of second labeling had been identified, the videos were reviewed a second time and the relationship between each label pair was coded into one of eight categories: 1) no relation or labels separated in time (NR), 2) parent indicated that one label was "not" correct (NT), 3) parents stated that one label was not correct but that the object looked like another object (LK), 4) parent used one label as a proper name and one as a common name (PP), 5) parent used one label as a shortened version of the other (e.g. "crab" and "crabby") (SV), 6) parent stated that an object could be named using one label "or" another label (OR), 7) parent indicated that they didn't know which of two labels were correct (DK), and 8) parent stated that an object could be named using one label "and" another label (AND).

Results

Vocabulary

Both children's total vocabulary and their knowledge of the 56 items in the play sets was assessed using parental report. Overall, although children's total vocabulary scores did increase with age, $F(4,115)=92.94$, $p<.001$, their average vocabulary percentile rank did not, $F(4,115)=1.21$, $p=.31$. On average, children knew 23.65 ($SD=12.42$) of the 56 test objects. This average increased with age, $F(4,115)=25.24$, $p<.001$.

Label Learning Task

For each of the six trial types, the average number of times that each child chose the target object was recorded. The known and no label trials were analyzed separately from the four label learning trials.

Known and No Label Trials An analysis of the known label trials showed that overall children were able to correctly identify the known objects above chance, $t(113)=21.45$, $p<.001$, with older children doing better, $F(4,109)=11.94$, $p<.001$. In addition, all five age groups separately identified the target object greater than chance, all p's<.05. A similar analysis of the no label trials showed that, overall, children continued to choose the target object greater than chance, $t(119)=3.44$, $p<.01$. This did not vary by age, $F(4,115)=.80$, $p=.53$.

Label Learning Trials An initial 2 (learning type: direct or by exclusion) x 2 (label type: first or second labels) x 5 (age group) was conducted (see Table 1 for means and comparisons to chance). Results showed a main effect of age, $F(1,115)=25.52$,$p<.001$, such that older age groups learned labels more easily. A main effect of label type, $F(4,115)=16.05$,$p<.001$, showed that children learned first labels better than second labels overall. This interacted with learning type, $F(4,115)=4.81$,$p<.01$, such that this difference was greater when children had to learn labels by exclusion rather than by direct means. Finally, a significant 3-way interaction suggested that the greater difference between first and second label learning for exclusion than by direct

Table 1. Average percent of children correctly identifying the target object label learning task compared to chance.

	Direct Learning		Learning by Exclusion	
Age	1st Label	2nd Label	1st Label	2nd Label
12	.60† (.29)	.54 (.20)	.69* (.18)	.50 (.26)
16	.51 (.25)	.61* (.27)	.64* (.24)	.42† (.22)
20	.63* (.30)	.44 (.27)	.64** (.23)	.61* (.23)
24	.60 (.27)	.60* (.24)	.78** (.26)	.48 (.21)
28	.72** (.28)	.74** (.23)	.71** (.20)	.50 (.26)
All	.61** (.28)	.59** (.26)	.69** (.23)	.50 (.24

† p<.1, *p<.05, **p<.01

means was more pronounced for older than younger kids and somewhat reversed for 20-month-olds. No other main effects or interactions were significant.

Correlations Correlation analyses showed a significant correlation between learning a first label directly and age, r(120)=.22, p<.05, and a marginal correlation between learning a second label directly and age, r(120)=.16, p=.08. No correlations for leaning by exclusion were found.

Input Task

A series of one-way ANOVAs with age group as a between-subjects factor were conducted on each of the eight input measures. Results showed that all eight measures changed with age, all *p*'s<.05, with the exception of the proportion of unfamiliar objects labeled (See table 2 for means and SDs), *p>.05*. A series of correlations were also computed for each of the eight measures with age and vocabulary. Age was correlated with all eight measure, all *p*'s<.05, with the exception of the proportion of unfamiliar objects labeled, *p*>.05. Vocabulary was correlated with all measures except for the proportion of familiar and unfamiliar objects labeled, *p*>.05.

Generally speaking, the percent of familiar objects named, but not unfamiliar objects named, increased with age. The percent of both familiar and unfamiliar labeled objects that were given two or more labels also increased with age. The total number of labels used for familiar objects increased with age, whereas the total number of labels used for unfamiliar objects decreased. Finally, the percent of labeling instances that were second labels increased for both familiar and unfamiliar objects.

Factor Analysis on Relations between Labels A series of one-way ANOVAs with age were also conducted on the percentage of each of the eight label relations (NT, NR, etc…) used of the total relations used per participant. None of these types of relations changed with age, all *F*<.01, with the exception of the PP code, which decreased with age, F(4,115)=3.92, p<.01. Only one relationship type, NT, was correlated with age and vocabulary, r(120)=.19, *p*<.05 and r(120)=.18, *p*<.05, respectively.

Because it was likely that the seven codes in which parents provided relations for two or more labels (all but the NR code) were heavily interrelated, a factor analysis was conducted using PCA (principal components analysis) to look for relation types that loaded onto similar factors or components. The factor analysis passed several common criteria for use. First, with over 17 cases per factor, the factor analysis was reliable. Second, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .53, above the cutoff of .5. Third, Bartlett's test of sphericity was significant, $\chi^2(21)=46.28$, *p*<.01. Finally, the diagonals of the anti-image matrix and the commonalities between the relations were all at or above .5.

The principal components analysis produced three components with Eigen values above 1.0 that were retained in the model. The first component explained 23.79% of the variance, the second 17.30%, and the third 14.77%, for a total variance explained of 55.85%. Four other components had Eigen values less than 1.0 and were excluded from the model. Rotation of the solution was utilized to facilitate interpretation of the three components. For this rotation, the verimax solution was used, though no difference in interpretation was obtained using an oblimin solution. None of the relation types were eliminated from the analysis as all seven had loadings or cross-loadings of .6 or higher on one of the three components (see Table 3).

Upon inspection, using values at or greater than .6, it was clear that the first component (henceforth called Contrast Relations) represented greater use of the NT and LK relations as opposed to the AND relation. A higher score on this component is consistent with input that rejects second labels while a lower score is consistent with acceptance of second labels. The DK and OR codes loaded onto the second component (called Ambivalent Relations) with a higher score indicating a greater use of relations that are ambivalent towards rejecting or accepting second labels. The PP and SV codes loaded onto the third component (called Elaborative Relations) with a higher score indicated a greater use of relations in which one label is an elaboration

Table 3. Factor loading for principal components analysis of multiple-labels relationships.

Code	Contrast	Ambivalent	Elaborative
NT	**.72***	.06	-.01
LK	**.60***	-.12	-.27
AND	**-.83***	-.11	-.08
OR	.09	**.77***	.08
DK	-.03	**.75***	-.07
SV	-.11	-.06	**.74***
PP	.02	.06	**.71***

Table 2: Means and standard deviations for input variables. Standard deviations are in parentheses.

	% of Objects Labeled		% of 2+ Object Labels		# of Labeling Instances		% of 2+ Total Labels	
Age	Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar
12	50.8 (28.1)	56.3 (15.9)	14.7 (14.5)	20.2 (11.7)	26.5 (28.6)	58.0 (33.4)	25.6 (27.6)	35.7 (18.8)
16	66.8 (20.9)	54.1 (23.7)	22.9 (21.6)	23.4 (16.2)	40.0 (24.6)	50.5 (31.1)	29.3 (22.7)	41.0 (21.2)
20	72.7 (14.8)	56.9 (13.2)	25.7 (13.2)	30.7 (13.0)	57.2 (28.7)	44.0 (20.4)	38.5 (13.4)	52.9 (18.9)
24	69.7 (19.3)	57.4 (22.3)	29.2 (13.8)	32.4 (19.6)	50.8 (22.6)	33.8 (16.2)	45.7 (18.3)	54.4 (19.1)
28	66.6 (14.0)	55.2 (19.6)	35.9 (15.2)	28.8 (17.8)	63.5 (22.1)	26.8 (16.9)	51.9 (14.2)	48.7 (24.7)

(e.g. longer version) of the other label. It should be noted that adding age and vocabulary to the model did not change the qualitative conclusions except that a fourth component reached an Eigen value above 1.0 on which age and vocabulary, but none of the relations, loaded. Further analyses showed that none of these three components were significantly different by age group, nor were they correlated with age or vocabulary, all *p*'s>.05.

Relationship between Tasks

In order to evaluate any relationship between the input task and language learning task, a series of correlations were computed between the four language learning measures, the eight measures of label use by parents in the input task, and the three components identified for the label type relations.

Label Use and Label Learning The number of times that parents labeled unfamiliar objects was negatively correlated with children's ability to learn first labels directly, r(120)= -.22, p<.05, whereas the ability to learn first labels by exclusion was positively correlated with the proportion of unfamiliar objects given two or more labels, r(120)=.19, *p*<.05.The ability to learn second labels directly was negatively correlated with the number of times that parents labeled unfamiliar objects, r(120)=-.22, *p*<.05. None of the input measures were related to second label learning by exclusion.

If the two second label learning measures are pooled together to get an overall measure of second label learning, there is a significant negative correlation with the number of labels used for unfamiliar objects, r(120)=-.16, *p*<.05, and a positive correlation with the proportion of *familiar* objects given two or more labels, r(120)=.16, *p*<.05.

Multiple-labels Relations and Label Learning Parents use of contrast relations, the first component, was positively correlated with the ability to learn second labels by exclusion, r(120)=.19, *p*<.05, such that the more likely parents were to state that one label was correct and one was not, the more likely children were to learn second labels by exclusion. The second component, ambivalent relations, was negatively correlated with direct learning of second labels, r(120)=-.18, *p*=.05), such that the more ambivalent relations that parents use, the less likely children were to learn second labels directly. Finally, the elaborative relations component was related to the learning of first labels. It was positively correlated with learning by exclusion, r(120)=.15, *p*=.10, and negatively correlated with direct learning, r(120)=-.25, *p*<.01.

Discussion

At the outset of this paper, we asked whether parent use of second labels was related to second label learning. Several interesting relationships between parents' use of second labels and children's learning of first and second labels were found. In particular, parents who labeled unfamiliar objects more had children who were *less* likely to learn first labels directly. This suggests that direct learning of first labels is hindered by parents labeling unfamiliar objects. On the other hand, parents who gave unfamiliar objects two or more labels, had children that learned first labels by exclusion more easily. This suggests that while labeling unfamiliar objects in general disrupts first label learning, if those same unfamiliar objects are given more than one label, it helps children make inferences about first labels. In addition, the more likely parents were to give two or more labels to familiar objects, the easier it was for children to learn second labels (either directly or by exclusion), providing some evidence for a link between amount of second label use by parents and second label learning in children.

Further support for this relationship was found when looking at the types of relations that parents used to connect multiple labels. Parents who use less elaborative relations have children who learn first labels easier when learning is direct, possibly because input is less muddled. However, more elaborative relations are associated with *better* learning *by exclusion*, possibly because they support more complex language relations. Additionally, children learned second labels directly when input relations were less ambivalent. This relationship seems, intuitively, to suggest that using ambivalent relations such as stating that you don't know which label is correct hinders second label learning by direct means. On the other hand, parents who made clear contrasts between the two labels, stating that one of the two labels was correct and the other not, had children who found it easier to learn second labels by exclusion. Though this may seem unintuitive at first glance, it can be explained by thinking of learning labels by exclusion as needing to clearly understand which object should *not* have a new label. Parental input that rejects one label in favor of another helps children do the same when they reject a new label for an already familiar object in favor of an unfamiliar object.

Overall, these results suggest that learning both first and second labels is related to the contrasts that parents make between labels. First labels are easier to learn directly when the input is simple and less ambivalent, but easier to learn by inference with complex input. Second labels are easier to learn either directly or by exclusion when input is heavy on clear, less ambivalent, contrasts between labels.

In addition to the relationship between input and second label learning, we were also able to characterize both the input and the process of second label learning separately. First, in regards to second label learning, children easily learned first labels regardless of whether learning was direct or by exclusion. However, they had a much more difficult time when learning second labels by exclusion than by direct means, and this difference was greater as children got older. In other words, children rejected second labels more as they got older, which is consistent with previous literature (Merriman, Bowman, & MacWhinney, 1989).

Second, we asked whether the amount and type of parental input in regards to second labels varies and whether this was related to age. Parents gave both familiar and unfamiliar objects a higher percentage of second labels as children got older. In addition, a higher percentage of labels were used as a second label as children got older. More interesting, however, is the finding that, although the percent of second labeling changed with age, the types of relations that parents made between the two labels did not.

Together these results suggest that the manner in which parents label objects, not merely the amount, is related to children's processing of words. In particular, the types of contrasts that parents make can support or hurt children's word learning. However, it is not the case that providing children with more label contrasts will boost their word learning skills. Rather, whether elaborative contrasts with similar words or concrete contrasts of different words are better depends on the status of the word as a first or second label and the task demands.

In sum, not only does input relate to overall language variables such as vocabulary size, but it is also related to the way that children *process* language when presented with a new word. Several contextual influences, including previous experience, task and label type work together to determine children's responses at a given moment. More generally, these results suggest that parental input influences language biases in highly complex ways, something that should be carefully controlled and accounted for in future studies on linguistic biases.

Discussion

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