Different Kinds of Information Affect Word Learning in the Preschool Years: The Case of Part-Term Learning

Megan M. Saylor and Mark A. Sabbagh

Two studies investigated how preschool children’s interpretations of novel words as names for parts of objects were affected by 3 kinds of information: (a) whole object familiarity, (b) whole part juxtaposition, and (c) syntactic information indicating possession. Study 1 tested 3- to 4-year-olds and found that although there was evidence that all information affected children’s part-term interpretations to some extent, they were most systematic when provided with 2 or more kinds of information. Study 2 adapted the procedure for use with 2.5-year-olds and found the same general pattern of results. Variations across studies were found that may reflect changes in how different kinds of information affect word learning with development.

Preschool children learn words with remarkable speed, flexibility, and efficiency. For example, they are capable of learning words when they have minimal exposure (e.g., Carey & Bartlett, 1978), when information is offered in a novel way (e.g., Saylor, Sabbagh, & Baldwin, 2002), or when they simply overhear a novel word (Akhtar, Jipson, & Callanan, 2001). To account for children’s skill at word learning, researchers have focused on the kinds of information available to children during word learning, including object familiarity and syntactic and pragmatic information. A complementary focus of word-learning studies has been potential mechanisms supporting children’s use of information. Some proposed candidate mechanisms include word-learning biases (or constraints), pragmatic judgments, and syntactic bootstrapping (see Woodward & Markman, 1997, for a review).

Although word-learning researchers often focus on children’s use of a single kind of information or cognitive mechanism in isolation, most are careful to note that any one mechanism is unlikely to provide a full account of children’s word learning. Several recent theoretical reviews (e.g., Hollich, Hirsh-Pasek, & Golinkoff, 2000; Saylor, Baldwin, & Sabbagh, in press; Woodward, 2000; Woodward & Markman, 1997) have emphasized that when considered across situations, any single mechanism or source of information typically fails to provide children with sufficient basis for judgments about a word’s meaning. These recent critiques have led to the general consensus that silver bullet theories of word learning are fundamentally flawed (Golinkoff et al., 2000).

In an attempt to sketch an alternative approach, several researchers have suggested that children may benefit from capitalizing on multiple kinds of information (Golinkoff et al., 2000; Saylor et al., in press). Hollich et al. (2000) have offered the emergentist coalition model, which highlights that many kinds of information are important for children’s word learning and that children’s use of information may change with development. However, few studies have been devoted to investigating the questions that arise from this and other similar proposals (but see Hollich et al., 2000). For instance, when learning particular kinds of words, is the presence of one kind of information more important than another? Does having multiple kinds of information available during word learning have a positive effect on the strength of children’s hypotheses? Does children’s use of different kinds of information change with development?

In the present studies we addressed each of these questions by investigating preschool children’s learning of names for parts of objects (i.e., part terms), such as spigot for a part of a faucet. Part-term learning provides an excellent forum for studying how children might coordinate information to learn words. Previous studies suggest at least three kinds of information guide part-term learning: (a) the
familiarity of the whole object to which the part is attached, (b) the juxtaposition of the novel part label with the name of the whole object, and (c) the use of possessive syntax to provide the part label. Although there are undoubtedly other cues to part-term meaning (e.g., nonverbal cues such as fiddling with the part while labeling), we chose to focus on this set of cues because they are the most well established in the research literature. Before describing our studies, we provide a brief review of current literature on part-term learning with reference to each type of information and the associated cognitive mechanisms.

Three Kinds of Information in Part-Term Learning

Object Familiarity

The familiarity of the whole object is thought to play a role in children's part-term learning because of mutual exclusivity—the putative word-learning bias that impels children to resist interpreting novel labels as second names for already named objects (Markman, 1992, 1994). Although several alternatives to mutual exclusivity have been proposed (e.g., Golinkoff, Mervis, & Hirsh-Pasek, 1994; Merriman, 1999), all have made similar predictions with respect to how object familiarity might affect part-term learning. The biases typically lead children to reject a novel label as a name for a familiar whole object and to search instead for a plausible alternative referent (which may be a part).

Seminal work by Markman and Wachtel (1988) provides some support for the role of object familiarity in part-term learning. In their studies, children were offered a novel label in the presence of a familiar object with a salient part. For half the children, the label of the whole object (e.g., lung) was recently trained and thus familiar, and for the other half, no such pretraining was provided and therefore the label was novel. When children were asked to identify the trachea, children who received a name for the whole object during pretraining were more likely to select a salient part of the object than children who received no such pretraining. Thus, object familiarity was revealed to be an important factor guiding children's part-term learning.

Whole–Part Juxtaposition

Although object familiarity may trigger use of a word-learning bias such as mutual exclusivity, other studies suggest part-term learning benefits from information parents provide. In particular, naturalistic work by Masur (1997) showed that when parents label novel parts of familiar objects, they provide the name of a familiar whole object before the name of the part (e.g., “See the bird? There’s a beak.”). This pattern of whole–part juxtaposition may allow children to draw a pragmatic inference about speakers' labeling intentions (Saylor et al., 2002). Specifically, when a whole object and novel term are juxtaposed with one another, children may infer that the novel term refers to something other than the whole object. After all, if the speaker had intended to label the whole object again, he or she would have used the same label (e.g., Clark, 1987, 1993). In some contexts, the part of the object may be a reasonable interpretation of the novel term.

Recent research has shown preschool children's part interpretations are affected by the provision of whole–part juxtaposition. In particular, Saylor et al. (2002) presented children with an object constructed such that the whole object was one color and a salient part was another color (e.g., a blue fish with a yellow dorsal fin). Children were then offered a label in the presence (e.g., “See this fish? What color is the dorsal?”) or absence (e.g., “See this? What color is the dorsal?”) of whole–part juxtaposition. Children systematically made part-term interpretations only when whole–part juxtaposition was present. This finding clarifies that children treat whole–part juxtaposition as a powerful source of information when making inferences about part-term meaning.

Possessive Syntax

Another information source that reliably accompanies the everyday labeling of parts of objects is the use of the possessive construction (Masur, 1997; Ninio, 1980; Shipley, Kuhn, & Madden, 1983; e.g., “See the butterfly has a thorax?”). Children's skill at drawing on such regularities when learning part names has not yet been directly evaluated. The possibility that preschool children might also benefit from the provision of syntactic information during part-term learning is supported by previous work showing children use grammatical information to learn new words (e.g., Hall, Waxman, & Hurwitz, 1993; Mintz & Gleitman, 2002; Prasada, 1993; Taylor & Gelman, 1988).

Goals of the Present Study

The possibility that children's part-term learning can be affected by multiple sources of information raises questions that have the potential to tell us about word learning more generally. The first question
concerns whether some kinds of information have a greater independent impact on children's word learning than others. The second question concerns whether children's interpretations of novel words are more systematic in the presence of multiple, rather than single, sources of information. A primary goal of the present studies was to address these two questions directly by characterizing the effects of different kinds of information within the same experimental paradigm.

A third question concerns how children's use of word-learning information might change with development. We address this question in Study 2.

Study 1

To investigate the role of different kinds of information on 3- to 4-year-olds' part-term learning, we adopted a procedure for assessing children's part interpretations of novel words as first described by Saylor et al. (2002). In these studies, children were shown a picture of an object that was constructed so that the major portion of the object was one color and a salient part was another (e.g., a red butterfly with a green thorax). Children were then asked to identify the color of the novel part. We chose this established method because it allowed for an investigation of the effects of different kinds of information on children's part-term learning. Specifically, by modifying the phrase before the test question (i.e., “Do you see a __________? What color is it?”), we were able to assess the performance of children who were presented with either whole–part juxtaposition (e.g., “See this butterfly? See a thorax?”), possessive syntax (e.g., “See this? See it has a thorax?”), or a combination of the two (e.g., “See this butterfly? See it has a thorax?”). Children's performance in these conditions could be compared with a group of children who received no additional information in the phrase preceding the question (i.e., “See this? See a thorax?”).

We also assessed the effects of object familiarity by including both objects for which the whole-object label was known but the part was not (e.g., a butterfly with a thorax) and objects for which the whole object was novel (e.g., a blicket with a modi). By including these two types of items in each of the experimental conditions described earlier, we could characterize the effects of labeling information alone and in combination with each another and with object familiarity. The logic of the design is illustrated in Table 1.

Based on previous studies, we predicted that all three kinds of information would affect children's part-term interpretations. We also predicted that such interpretations would be more systematic when two or more kinds of information were presented than when a single type of information was presented.

Method

Participants

Ninety-six children (50 females, 46 males) ranging in age from 2 years, 11 months (2,11) to 4,9 (M = 3,11) were included in the final sample. Children were divided into two age groups for analysis (younger: M = 3,1; older: M = 4,1). All children were typically developing and came from monolingual, English-speaking families from a predominantly middle-class Caucasian community in the southern United States. Children who participated met two criteria. First, because color-term production was our dependent measure, only children who could produce the color terms used in the study (i.e., red, green, yellow, blue) during a pretest (described later) were included. Sixteen children were excluded for failure to produce the four color terms used in the present study (M age = 3,3; 8 males). Second, 6 children were excluded for failing to meet criterion on a control task that tapped basic understanding of the color-identification procedure (M age = 3,2; 3 males). An additional 11 children were excluded for non-compliance (9: M age = 3,4; 5 males) and experimenter error (2: M age = 3,8; 2 females). Participants were randomly assigned to one of four experimental conditions so that the mean ages of children across conditions were matched.

Materials

The stimuli were 16 pictures of familiar (12) and novel (4) items, each with a salient part. The familiar

<table>
<thead>
<tr>
<th>Condition</th>
<th>Object familiarity (within subjects)</th>
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<tr>
<td>Baseline</td>
<td>ME only</td>
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<tr>
<td>Juxtaposition</td>
<td>ME + pragmatics</td>
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<td>Possessive syntax</td>
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<td>Juxtaposition +</td>
<td>ME + pragmatics + syntax</td>
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<td>possessive</td>
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Note. Hypothesized mechanisms contributing to part-term learning are presented. ME = mutual exclusivity.
items used were modeled after those used in a previous study examining children’s acquisition of part labels (Saylor et al., 2002). The novel items were constructed for the purpose of the experiment and did not resemble objects known to preschool children (see Figure 1). Each item was presented in the center of a 8 ½ in. × 11 in. sheet of white paper. Of the familiar items, 8 were familiar whole objects with a familiar part (e.g., pig with an eye) and 4 were familiar whole objects with a novel part (e.g., butterfly with a thorax). All of the novel items included a novel whole object with a novel part (e.g., modi with a fep).

Half of the test items were animate creatures and half were inanimate. On the novel items, animacy was indicated with facial features (e.g., eyes), which have been found to signal animacy in other studies examining children’s word learning (e.g., Jones & Smith, 1998). Because preliminary analyses revealed that the animacy of the target did not affect children’s part responding, this manipulation is not discussed further.

All of the test items were constructed out of colored construction paper so that the major portion of whole object was one color (e.g., a red butterfly) and a salient part (e.g., a green thorax) was another color. A black felt-tipped marker was used to draw contour lines (e.g., line between wheel and base on the car) and facial features (e.g., eye center and mouth on butterfly). A white liquid correcting pen was used for the outer portion of the eyes on animate creatures.

Familiar labels (whole and part) were selected so that they would be in the productive and receptive repertoires of preschool children (Fenson et al., 1994). A posttest during which children were asked to point to black-and-white line drawings of the familiar test items confirmed that all children who participated in the study comprehended the whole-object label for each of the familiar items used in the study.

Novel labels were assigned to each of the four familiar whole-novel part items so that one label referred to the whole object and the other label referred to the part. The novel labels naming the items were (whole – part) dax–toma, riff–niddy, dawnoo–blicket, modi–fep. The labels used for the parts of familiar-novel items named parts of familiar items and were novel to children (i.e., whole-part: butterfly–thorax, spider–pedicel, boat–crank, key–groove).

The four color terms used (i.e., red, green, yellow, blue) were chosen on the basis of previous research indicating that they are within the productive repertoire of preschool children (Shatz, Behrend, Gelman, & Ebeling, 1996).

**Equipment**

The experimental sessions were videotaped, enabling later coding of children’s responses.

**Design**

We employed a mixed design with one between-subjects factor and one within-subjects factor. The between-subjects factor concerned how children were presented with labels for novel parts of objects. In all, there were four between-subjects conditions to which children were randomly assigned:

*Baseline.* This condition indexed children’s part-term responses when no information other than the novel part-term was provided (e.g., “Do you see this? See, a thorax. Wow! Look, a thorax! Do you see a thorax? What color is it?”).

*Juxtaposition.* This condition was also identical to baseline except that juxtaposition information was included when the part term was introduced (e.g., “Do you see this butterfly? See, a thorax! Wow, a butterfly! Look, a thorax! Do you see a thorax? What color is it?”).

*Possessive.* This condition was identical to baseline except that the possessive construction was used to introduce the part term (e.g., “Do you see this? See, it has a thorax! Wow! Look, it has a thorax. Do you see a thorax? What color is it?”).

*Juxtaposition + possessive.* In this condition, both possessive and juxtaposition information were used.
to introduce the novel term (e.g., “Do you see this butterfly? See, it has a thorax! Wow, a butterfly! Look, it has a thorax! Do you see a thorax? What color is it?”).

One of the primary goals of this study was to examine the effect of providing word-learning information in combination. As a result of this goal, our within-subjects condition concerned the familiarity of the whole object to which the novel part was attached. For half of the items, novel parts were attached to familiar whole objects (butterfly–thorax), and in the other half, novel parts were attached to novel whole objects (modi–fep). With familiarity as a within-subjects variable, we were able to examine the effects of each of the preceding sources of information in isolation (when the objects were novel) and in combination with familiarity (when the objects were familiar).

All participants also answered questions about control items for which both the whole object and its part were familiar. For half of these items, children were asked for the colors of familiar parts (e.g., “Do you see a nose? What color is it?”). For the other half, children were asked for the colors of familiar whole objects (e.g., “Do you see a bunny? What color is it?”). These control questions ensured that children could respond appropriately to our color-identification procedure by providing the color of the major portion of the object (i.e., blue for the bunny) when asked about the whole and the color of the part (i.e., yellow for the nose) when asked about the part. Only children who scored 75% correct or better on these control questions were included in the final sample.

All items were presented one at a time within a single picture book. The picture book was constructed such that it alternated between two control items (i.e., familiar whole–familiar part) and two test items (i.e., familiar whole–novel part or novel whole–novel part). The sequence in which the control items appeared was fixed (i.e., cat–tail and car–door, house–window and bunny–nose, pig–eye and cup–handle, horse–ear and shirt–pocket). Test pairs were presented between the pairs of control items. Three random orders for the placement of the novel-part items were generated with the constraint that no two novel-part items with the same color pairs came in a row (e.g., two green-and-red novel-part items did not come in immediate succession). Children were asked one comprehension test question for each item, for a total of 16 test questions: 8 control questions (4 about familiar wholes, 4 about familiar parts) and 8 questions about novel parts (4 about familiar whole–novel part items, and 4 about novel whole–novel part items).

**Procedure**

*Warm-up and pretesting.* After becoming acquainted with the researcher, children were seated at a small table facing her. Children were introduced to a puppet that wanted to learn his color words. They were told that the puppet was “silly and easily confused.” To help the puppet, children were asked to only give color names after he asked for them and to tell him one color when he asked for the color of something. Children were reminded of the instructions before viewing the test items and when needed (e.g., if they blurted out color names before the test question was asked). In pilot testing, we found that offering children such instructions helped them avoid producing the color of the items before the test question had been asked.

During the pretest, the puppet asked children to identify a color swatch matching the colors (i.e., red, green, yellow, blue) used on the test items (e.g., “What color is this one?”).

*Testing.* Following the pretest, the experimenter told children that they would be shown some pictures. The experimenter and child then went through the picture book with the control and test items. For each item, the experimenter provided the labeling information (e.g., “Do you see this? See, it has a thorax! Wow! Look, it has a thorax.”); then the puppet would ask the test question (e.g., “Do you see a thorax? What color is it?”). Children responded by providing a color term. If children did not respond to the test question the first time, it was repeated. If they did not respond the second time, the experimenter moved on to the next item but returned to the skipped item(s) at the end of the session. If children blurted out the color responses before the test question was asked, the experimenter reminded them to wait and then repeated the question.

**Coding**

Our dependent measure was whether children offered the color of the major portion of the whole object or the color of the part in response to our test question. When children offered the color of the whole object they were credited with giving a whole-object response and when they offered the color of the part they were credited with a part response. On occasion, children offered more than one color in response to the test question (e.g., whole-object color, color of eyes, part color). Multicolor responses were relatively rare (accounting for less than 5% of responses across Studies 1 and 2). These multicolor responses were of two types. The first, most common
type (92% of multicolor responses for Studies 1 and 2) included a list of two or more colors on the test item, as when children offered the color of the whole, part, and contour lines without a pause between each color offered (e.g., “red, green, and black” when asked about the red butterfly with the green thorax). Children giving this type of response were coded as giving a whole-object response. In the second type of multicolor response, children offered two colors with a clear pause between (e.g., “red the boat is green” in response to an inquiry about the red crank attached to the green boat). In these responses, the second color was offered well after the test question—almost as an afterthought—often as the experimenter was moving on the next object. These responses were coded with reference to the first response offered. The first color offered was a part color on six of the seven responses of this type (.3% of the total responses across Studies 1 and 2).

Children received a score of 1 for part responses and a score of 0 for whole-object responses. Thus, scores for the two novel-part items (i.e., familiar–novel and novel–novel) ranged between 0 and 4. A score near 4 indicated high part responding, and a score near 0 indicated high whole-object responding.

Results

The goal of this study was to characterize the influence of three kinds of information on children’s part-term learning: object familiarity, whole–part juxtaposition, and possessive syntax. In particular, we were interested both in the individual influence of these kinds of information and in how they worked in combination.

A 2 (age: older vs. younger) × 2 (familiarity: familiar vs. novel) × 4 (condition: possessive+juxtaposition, juxtaposition, possessive, and baseline) analysis of variance (ANOVA) with age and condition as between-subjects variables and familiarity as a within-subjects variable revealed main effects of familiarity, $F(1, 88) = 17.51$, $p < .01$, and condition, $F(3, 88) = 16.04$, $p < .01$. There were no significant interactions. The means and standard errors for these analyses are summarized in Figure 2. We further analyze the main effects of familiarity and condition in turn.

Familiarity

The main effect of familiarity in the omnibus ANOVA reflected that across conditions, children were more likely to make part-term interpretations when the whole object was familiar ($M = 2.27$, $SE = .17$) rather than novel ($M = 1.81$, $SE = .16$). This analysis reveals that, at least across conditions, object familiarity made a contribution to children’s part interpretations of novel words.

An important question in the present study was whether a familiarity alone, in the absence of juxtaposition or possessive information, would affect children’s word learning. Although there was no significant Familiarity × Condition interaction in the omnibus ANOVA to suggest that the main effect of familiarity differed across conditions, we tested this important question directly by characterizing the familiarity effect within each condition through a series of planned paired $t$ tests. The analyses revealed that children gave more part responses to familiar than novel items in the possessive and juxtaposition conditions, paired $t$s(23) $\geq 2.11$, $ps < .05$. However, there was not an analogous effect of familiarity in the baseline condition where familiarity was the only kind of information offered, paired $t$(23) = 1.23, $ns$. Taken together, these analyses suggest that although familiarity was an important factor affecting children’s part-term interpretations of words, the influence of familiarity was only detectable when combined with other information. When familiarity was offered alone, children failed to make reliable use of the information to learn words.

Juxtaposition, Possessive Syntax, and Their Combination

For the condition effect from the omnibus ANOVA, planned comparisons (Fisher’s least significant differences [LSDs], $ps < .05$) revealed that children’s part responding in the juxtaposition, possessive, and juxtaposition+possessive conditions was elevated over the baseline condition. Furthermore, children’s part responding in the juxtaposition+possessive
condition was higher than that in each of the other conditions, suggesting there may have been a particular advantage to having these kinds of information in combination. These findings demonstrate that when collapsing across the familiarity variable, children’s part-term responses were increased when juxtaposition and possessive syntax information were offered.

Although the omnibus ANOVA did not show a significant Condition × Familiarity interaction, it was of particular theoretical interest to determine whether juxtaposition, possessive information, and their combination had an effect even when the whole object was novel (i.e., independent of familiarity). To explore this question directly, we conducted a 2 (age) × 4 (condition) factorial ANOVA on children’s responses to items in which the whole object was novel. This analysis revealed a significant main effect of age, \( F(1, 88) = 3.89, p < .05 \), showing that part responses were more common overall for older children (\( M = 2.08, SE = .23 \)) than younger children (\( M = 1.54, SE = .23 \)). The analysis also revealed a significant main effect of condition, \( F(3, 88) = 12.97, p < .0001 \). The Age × Condition interaction was not significant. Planned comparisons (LSDs, \( ps < .05 \)) revealed a pattern identical to that shown in the omnibus ANOVA: Children’s part responding in the juxtaposition and possessive conditions was higher than that in the baseline condition. Also, part responding in the juxtaposition + possessive condition was higher than in either the juxtaposition or possessive condition alone. These findings demonstrate that even when children have no familiar label for the whole object, juxtaposition and possessive syntax alone lead to a greater likelihood of part responding than when these kinds of information are absent.

**Tests Against Chance**

The previous analyses evaluated how the different kinds of information increased children’s part-term learning relative to baseline levels (as measured by the baseline condition). These analyses are important because at baseline, children may have been systematically biased toward interpreting novel words as referring to whole objects. Although our study was not designed to test this question, some evidence for a whole-object bias comes from the fact that part-term interpretations were near floor in our baseline condition. Therefore, tests against baseline show that different kinds of information might move children away from an initial whole-object bias.

To characterize the strength of children’s part responding independent of baseline, we conducted a series of tests comparing children’s performance with what would be expected if they had responded randomly (\( \mu = 2 \)) in each of the eight experimental cells (one-sample \( t, p < .006 \), Bonferroni correction). The results are summarized in the annotations to Figure 2. The principal finding was that children’s part-term learning exceeded chance levels only when multiple kinds of information were present.

**Discussion**

Study 1 revealed that 3- and 4-year-old children’s part-term learning was affected by all three kinds of information provided. However, differences in children’s ability to use each information source in isolation emerged. Syntactic and pragmatic information operated effectively in isolation. That is, even when faced with novel whole objects, children provided part-term interpretations of new words when provided with syntactic or pragmatic information alone. In contrast, familiarity operated effectively only when it was presented in combination with syntactic and pragmatic information. In the baseline condition, in which familiarity was the only kind of information offered, children did not reliably make part interpretations of novel words.

The effects of combining information were straightforward—children’s part-term responding was also boosted when more than one kind of information was present. The importance of multiple kinds of information was revealed in the chance analyses: Children’s part-term responding only exceeded chance levels when multiple kinds of information were provided.

One important question concerns why familiarity, though clearly effective when presented in combination with other kinds of information, was not an effective elicitor of part-term responding in the baseline condition when it was presented on its own. Some insight may come from the mechanisms thought to underlie these different kinds of information. Recall that object familiarity was thought to be useful because of mutual exclusivity, which is valuable because of its efficiency. In the presence of the appropriate eliciting conditions (i.e., a novel label and a familiar object) children can use mutual exclusivity to arrive quickly at a candidate meaning of a novel word without effortful processing. Of course, as many researchers have noted, the use of mutual exclusivity is also unreliable with respect to adults’ probable labeling intentions; that is, sometimes parents really are intending to provide a second label for an object (Bloom, 1994). In contrast, pragmatic inference and syntactic bootstrapping skills rely on use.
of information (e.g., juxtaposition and possessive syntax) that is both more information rich and more reliable than constraints. However, use of such information may also be more processing intensive (e.g., Saylor et al., in press; Woodward, 2000).

For older preschool word learners, the additional processing required to support successful pragmatic inference of syntactic bootstrapping may be within their abilities. Accordingly, they may prefer interpretations of new words based on these more reliable kinds of information. This preference may coincide with a decreased use of the less reliable constraint option when learning words. This proposal raises a question: Would we observe these same patterns of recruitment of word-learning information with younger children who may be less skilled at interpreting juxtaposition and syntactic information? We addressed this question in Study 2 by testing 2.5-year-old children.

The question of how children’s attention to different aspects of the word-learning environment changes with development has received some attention with respect to the earliest stages of word learning. Previous research suggests that the mechanisms supporting word learning shift across the second year. For example, compared with older infants, 12-month-olds make less robust use of social information such as eye gaze; instead, they appear to be swayed by low-level attention-grabbing attributes that affect perceptual salience (Hollich et al., 2000). This previous work suggests, possibly as a result of still-developing social understanding, 12-month-olds are not yet able actively to recruit eye gaze as a source of information and must instead rely on the perceptually based cue of object salience. In contrast, 18- to 24-month-olds show a reversal of this pattern; as they become better able to use eye-gaze information, their use of salience information is diminished greatly (Moore, Angelopoulos, & Bennett, 1999). Our second study was aimed at determining whether a pattern that is similar in spirit might be present with respect to part-term learning. More specifically, we sought to determine whether younger children would show a pattern opposite to that shown with older children regarding their use of different kinds of information to support part-term interpretations of novel words (see Gelman & Raman, 2003, for related findings).

**Study 2**

In Study 2, younger children’s ability to draw on possessive syntax, whole–part juxtaposition, and familiarity when learning names for parts of objects was investigated. We predicted that, in contrast to the 3- and 4-year-olds in Study 1, 2.5-year-olds would rely on object familiarity to a greater extent than on either juxtaposition or possessive syntax information. It was less clear how multiple sources of information would improve children’s word learning. On the one hand, if children of this age truly did not appreciate juxtaposition or possessive syntax information, there was no reason to expect that the simultaneous presentation of this information would impel children toward part interpretations of novel words. On the other hand, if children’s abilities to use juxtaposition and possessive syntax information were fledgling or emergent, it seemed possible that these two kinds of information may support one another and be associated with higher levels of part-term learning.

**Method**

**Participants**

Forty-eight children (25 females, 23 males) ranging in age from 2.5 to 2.10 (M = 2.8) participated in Study 2. As in Study 1, children were typically developing, monolingual English speakers. Children were recruited and assigned to experimental conditions as in Study 1. For the pretest in Study 2, children were asked to identify the color of crayons, pens, or modeling clay (i.e., red, blue, yellow, green) that matched the test items in color during a warm-up session. Only children who could correctly label all four colors were included in the final sample. The mean ages of children and the distribution of males and females were roughly equal in each experimental condition. An additional 45 children participated but were not included in the final sample for failing to produce the four color terms used in the present study (31: M age = 2.8; 17 males), for not meeting criterion on the control task (8: M age 2.7; 6 females), for noncompliance (5: M age = 2.8; 4 females), and for experimenter error (1: age = 2; 7 females). The proportionally higher number of children excluded in Study 2 (relative to Study 1) may have been the result of 2.5-year-olds as a group being on average less linguistically skilled (and hence not as able to pass our inclusion tasks) than older preschoolers. We return to this issue in the general discussion.

**Materials**

The stimuli were the same as those used in Study 1 with the following exceptions. First, to make the
task more manageable for the younger children, there were only three, rather than four, of each of the familiar whole–novel part and novel whole–novel part test items. Second, all items and labels presented to children in Study 2 were the same as those in Study 1 except that a duck with a wing (Study 2) was substituted for the pig with an eye (Study 1), the pocket on the shirt (Study 1) was replaced with a button (Study 2), and the door on the car (Study 1) was replaced with a wheel (Study 2), as pilot testing revealed that the younger children were unable to reliably identify the eye, pocket, and door as familiar parts.

Equipment

All equipment was the same as in Study 1.

Design

The experimental design was the same as Study 1, with two exceptions. First, pilot testing revealed that a single book containing 14 pictures was difficult for 2.5-year-olds to complete. Thus, items were divided into four books that, when coupled with changes made to the overall procedure, served to break up the original procedure into more manageable sections. The first and third books contained the control items (i.e., familiar whole objects with familiar parts) and the second and fourth books contained a mixture of the experimental items (i.e., familiar and novel whole objects with novel parts). The order of presentation of the control items in the first book (kitty—tail, car—wheel, bunny—nose, house—window) and third book (duck—wing, cup—handle, horse—ear, shirt—button) was fixed. The experimental items were arranged in the two remaining books (three items in each) according to three random orders constrained as in Study 1.

Second, to shorten the procedure, children were asked a total of 14, rather than 16, comprehension test questions: 8 control questions (4 questions about wholes, 4 about parts) and 6 questions about novel parts (3 with familiar whole objects, 3 with novel whole objects).

Procedure

Several changes were made to the procedure for 2.5-year-olds. During the warm-up, children were seated (either at a table or on the floor) across from the researcher. Depending on their level of interest, they played with crayons, pens, or modeling clay that matched the four colors used on the test items. During play, the experimenter attempted to elicit color responses from children (e.g., “What color is this one?”).

Following the pretest, the experimenter invited children to help her “find some pictures” in an adjacent room. Each of the four books of test items was hidden at a different location in a large room (i.e., under a Winnie the Pooh chair, behind a star, under a ladybug rug, under a butterfly rug). Children were invited to locate and move to each hiding location in a set order (in order of the preceding; e.g., “Do you see a star? Can you show me?”). Once children had moved to each hiding place the experimenter retrieved the book of items and invited children to near the location. They were then shown the items in the book. For each picture, labeling proceeded as in Study 1 except that the comprehension question used for both control and experimental items was shortened into a one-part question (e.g., “What color is the thorax?”). This change was made because pilot testing revealed that the test question format used in Study 1 (e.g., “Do you see the thorax? What color is it?”) was confusing for the younger participants, even when their knowledge of familiar whole (e.g., bunny) and familiar part terms (e.g., nose) was queried.

One concern is that the change in test question may have altered children’s performance on our task. However, as in Study 1, children who were included in Study 2 passed control questions indexing their ability to answer test questions when the objects were familiar. Their performance on the control questions was comparable to that of children in Study 1, suggesting that the test question was analogous to the one used in Study 1.

Coding

Coding and scoring were the same as Study 1 except that children could score 0 to 3 (rather than 4) on questions about novel-part items.

Results

Because the goal of Study 2 was similar to that of Study 1, we followed the same analysis strategy. First, a 2 (familiarity) × 4 (condition) ANOVA with familiarity as a within-subjects variable and condition as a between-subjects variable revealed a significant main effect of whole object familiarity, $F(1, 44) = 12.05, p < .01$, and condition, $F(3, 44) = 8.60, p < .01$, but no interactions. The means and standard errors for this analysis are summarized in Figure 3.
We examine the main effects of familiarity and condition in turn.

**Familiarity**

The main effect of familiarity in the omnibus ANOVA reflected that when collapsed across conditions, children were more likely to make part interpretations of novel words when the whole object was familiar (\(M = 1.40, \text{SE} = .16\)) as opposed to novel (\(M = .90, \text{SE} = .17\)).

As with Study 1, a question of considerable theoretical import was whether object familiarity affected children’s word learning in the baseline condition where it was the only kind of information available to children about word meaning. To test this question directly, we conducted a series of planned paired \(t\) tests to test whether familiarity had an effect in each of the different conditions. These analyses revealed that there was an effect of familiarity in the baseline condition, \(t(11) = 2.16, p < .05\). This finding suggests that on its own, object familiarity was an important factor in 2.5-year-old children’s part-term learning. There was also a significant effect of familiarity in the juxtaposition condition, paired \(t(11) = 2.71, p < .05\), and a similar trend in the possessive condition, paired \(t(11) = 1.91, p = .08\).

Together, these findings show that familiarity, both on its own and in combination with other kinds of information, affected 2.5-year-old children’s part-term responding.

**Juxtaposition, Possessive Syntax, and Their Combination**

For the condition effect, planned comparisons (LSD, \(p < .05\)) revealed that, when collapsed across familiarity, children’s part responding in the possessive+juxtaposition condition exceeded that in all other experimental conditions. In addition, part responding in the juxtaposition condition was higher than that in the baseline condition. It is intriguing that we found no evidence to suggest that part-term responding in the possessive condition differed from baseline. These findings hint that for younger children, juxtaposition information may be more powerful than possessive construction information making part interpretations of novel terms.

As in Study 1, an important question was whether juxtaposition, possessive syntax, or their combination had an effect on their own (i.e., apart from possible additive effects due to whole object familiarity). To address this question directly, we conducted a one-way ANOVA with four levels of the condition variable (i.e., possessive+juxtaposition, possessive, juxtaposition, baseline). This analysis revealed that there were significant differences in children’s responding across the experimental conditions, \(F(3, 44) = 6.69, p < .01\). However, in contrast to the omnibus ANOVA, planned follow-up comparisons (LSD, \(p < .05\)) revealed that this main effect was largely due to the increase in part-term interpretations made by children in the juxtaposition+possessive condition; part-term responding was significantly higher than the other three conditions. That is, the post hoc comparisons provided no evidence that part-term responding in the juxtaposition or possessive conditions differed from baseline. Apparently, juxtaposition or possessive syntax information alone may not have been an important factor in children’s part interpretations of novel words. However, when these two kinds of information were combined, children’s part responses exceeded baseline levels.

**Tests Against Chance**

As in Study 1, an additional analysis was conducted to evaluate how systematic children’s part responding was when compared with chance levels (\(\mu = 1.5\)). The analyses revealed that it was only in the presence of all three cues to word meaning (possessive+juxtaposition for familiar items; e.g., butterfly with thorax) that 2.5-year-old children’s part responding reliably exceeded chance levels, \(t(11) = 3.45, p < .05\).

**Discussion**

The present findings contrast neatly with those from Study 1. Most important, 2.5-year-olds’ part responding was not greatly affected by either the presence of juxtaposition or possessive syntax.
information alone. Instead, we found object familiarity was a significant factor guiding 2.5-year-old children’s part-term interpretations of novel words, even when presented alone. This pattern of individual cue effectiveness is a reversal of the pattern shown with the older children from Study 1. One finding that was similar across studies, however, was that children clearly benefited from the simultaneous presentation of multiple kinds of information; children only responded at above chance levels when multiple sources of information were offered.

General Discussion

Three kinds of information have been shown to affect children’s part-term learning: object familiarity, whole–part juxtaposition, and possessive syntax. These kinds of information are likely supported by cognitive mechanisms proposed to guide word learning more generally: mutual exclusivity, pragmatic inference, and syntactic bootstrapping. In the present studies we investigated whether children coordinate these sources of information during word learning. A first question concerned whether each type of information operated effectively in isolation. A second question concerned whether simultaneous presentation of different kinds of information might facilitate word learning. We discuss each of these questions in turn with reference to a third question—how children’s use of different kinds of information might change with age.

Relative Efficacy of Information Sources: Developmental Differences

Our first goal was to characterize children’s use of word-learning information in isolation. Depending on children’s age, particular types of information were found to be more effective than others. In Study 1, although 3- and 4-year-olds made part-term interpretations when juxtaposition or possessive syntax was offered, they did not make such interpretations on the basis of the object familiarity alone. The opposite pattern was shown for the 2.5-year-olds in Study 2: Their part-term interpretations were affected by the familiarity of the whole object but not by juxtaposition or possessive syntax information.

There are at least three possible explanations for this finding. One can be directly ruled out. In particular, it is unlikely that these differences are the result of age differences in children’s facility with the procedure. All children who participated knew their color terms and passed a control task that assessed basic understanding of our procedure.

One drawback of using color-term production as a criterion for inclusion was that a larger proportion of 2.5-year-old children than 3- to 4-year-old children were excluded for an inability to produce color terms. As a result, we may have selected a subset of more advanced 2.5-year-olds and a more random sampling of the 3- and 4-year-olds. Although this concern must be kept in mind when interpreting our findings, it is interesting to note that our inclusion criterion may have provided an unintended control in our study. Specifically, the older and younger groups of participants may have been equally competent in at least the one area of language ability—color-term production. Although the extent to which color-term production is related to other language acquisition milestones is not well known (see Shatz et al., 1996), it is intriguing that even with this equivalence in place, differences between the age groups emerged.

A second possible explanation for changes in children’s use of information across development resides in the nature of the input. In particular, juxtaposition and possessive information are present only in the input and are not readable from environmental triggers such as object familiarity. To capitalize on this information, children must appreciate that the utterances surrounding a novel word are important with respect to the word’s meaning. One possibility is that 2.5-year-olds may not share this basic assumption to the same extent as the older children. This explanation is consistent with other studies that have found developmental differences in how children use language-driven sources of information (e.g., syntax; Gelman & Taylor, 1984; Soja, Carey, & Spelke, 1991).

A third possible explanation is that juxtaposition and possessive information require more processing resources and therefore may be more effectively used by older versus younger children. For pragmatic sensitivity, such as is necessary for using the juxtaposition information, children have to make quick, on-line judgments about speakers’ intentions based on language input alone. For using syntactic information, as they need to do to use the possessive construction, children need adequate experience with the syntax of possession and its association with part-term labeling. One possibility is that as compared with older children, 2.5-year-olds may not yet have the processing resources and requisite experience to use the pragmatic and syntactic information offered in the present study.

Finally, aspects of our design raise a potential caveat with respect to discussion of children’s use of individual kinds of information. Specifically, object
familiarity was treated as a within-subjects factor whereas juxtaposition and possessive information were treated as between-subjects factors. Treating these factors differently in the design may constrain our conclusions about the word-learning information. For example, within-subjects factors can be subject to potential carryover effects. It seems unlikely that our findings are compromised by these concerns. Our failure to find a familiarity effect for the baseline condition in Study 1 was probably not due to carryover effects because a familiarity effect was found in other conditions in Study 1 where carryover effects should have been operating as well. Nonetheless, more research is required to provide a finer grained quantitative characterization of the effects of a particular kind of information on children’s word learning.

Understanding the Role of Familiarity

An important question concerns why older children seemed to be less reliant on the familiarity cue than younger children. This finding appears counterintuitive because it seems at odds with Markman and Wachtel’s (1988, Study 3) demonstration that children’s part-term learning is strongly affected by familiarity. However, close investigation of their methods reveals that the experimenters actually reminded children of the whole object label before asking the test question (e.g., “Remember this lung? What’s a trachea?”). As a result, in the study with the most robust evidence of mutual exclusivity (higher part responding to familiar versus novel objects), object familiarity was combined with juxtaposition information (Markman & Wachtel, 1988, Study 3). In another study (Study 2) where no such reminder was provided, children were far less successful at inferring part meanings of novel words. Thus, our finding that object familiarity in isolation did not effectively guide older children’s part-term interpretations is consistent with previous research.

A larger question concerns why familiarity becomes less important with development. One possibility is that as children get older, they become accustomed to other speakers providing information relevant to word meaning (e.g., in the form of pragmatic or syntactic cues). As this sensitivity to the potential presence of word-learning information develops, children may be unwilling to adopt part interpretations of novel words when clarifying information they have come to expect is not present. The result would be decreasing use of constraints as children age (see also Markman, 1992, 1994). Our findings provide some initial direct support for this proposal. In particular, the older children did not make part interpretations in the absence of syntactic or pragmatic information even when object familiarity was available.

Importance of Multiple Kinds of Information

A clear finding from the present study was that both younger and older children were more likely to make part interpretations of novel words when two or more kinds of information were presented. Older children used juxtaposition and possessive syntax in isolation, but when these kinds of information were presented together or were presented in the presence of a familiar whole object, children’s part-term learning was increasingly systematic. For younger children, the pattern was more complex. Although they showed no evidence of using juxtaposition or possessive syntax information alone, the combination of the two kinds of information did motivate children to make part interpretations of novel words. This finding is compelling because it suggests that, at least to some degree, even 2.5-year-old children may possess some of the conceptual insights required to capitalize on juxtaposition or possessive syntax information.

Both younger and older children made more systematic part-term interpretations when all three kinds of information were available. Given that word-learning cues appear to work best in some combination, an interesting question is whether children are provided with language input that supports their use of multiple sources of information. This appears to be the case. Naturalistic and seminaturalistic work examining parents’ part-term labeling has revealed that child-directed speech is replete with multiple cues to part-term meaning.

Parents offer at least three types of regularities in their input that might support children’s inferences about the meaning of new part terms (e.g., see Masing, 1997; Ninio, 1980; Shipley et al., 1983). First, parents almost always offer novel part terms for familiar (e.g., bird) rather than novel (e.g., seal) objects. Such a labeling strategy supports the action of a default assumption such as mutual exclusivity. Second, when labeling a novel part of a familiar object, parents juxtapose the familiar whole and novel part labels (e.g., “See the bird? Look, a beak!”). This may support children’s use of pragmatic information for part-term learning. Third, parents provide syntactic regularities with variants of the English possessive construction when labeling novel parts of objects (e.g., “See. The bird has a beak”). When looking at parental input, it is easy to see how the different
sources of information come to layer on top of one another in the input—parents often juxtapose familiar and novel labels using the possessive construction. The present studies provide clear evidence that the coaction of these kinds of information benefits word learning.

Summary

Our findings clarify that children’s part-term learning is guided by at least three kinds of information: object familiarity, whole–part juxtaposition, and possessive syntax. For younger children, object familiarity operated effectively in isolation, whereas for older children, juxtaposition and possessive syntax information did so. Across both studies, part-term interpretations were more common when two or more kinds of information were present. Taken together, these findings highlight the importance of having multiple kinds of information available during word learning, thereby suggesting that no one skill is, nor has to be, responsible for preschool children’s remarkable ability to learn new words.

References


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