The Course of Children’s Naming Errors in Early Word Learning

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Young children sometimes use 1 word in the place of another when attempting to name an object. Previous research has suggested several reasons why children may call an object by another name, including faulty hypothesis testing concerning the meaning of words, limitations in vocabulary size, and difficulties in retrieving the desired word from lexical memory. This study examined children’s object naming in a longitudinal design. Ten children were tested at regular intervals from 16 to 24 months of age. Two tasks were presented: a picture book task used to elicit naming errors of known objects and a novel object task used to elicit word extensions to unknown referents. The results indicate that children are particularly prone to substitute 1 word for another during a narrow band of time, when they have between 50 and 150 words in their productive vocabularies. Moreover, the specific nature of the word substitutions suggests that they derive from common processes involving the activation and retrieval of words from a rapidly forming but still fragile lexicon.

Children begin spontaneously naming objects and events early in their second year. Whereas the majority of these first words are most often used correctly in production (Hattonlocher & Smiley, 1987), previous estimates indicate that up to one third of children’s initial 50 words are sometimes misapplied (Kucera, 1980; although for somewhat lower proportions, see Asplin, 1977; Barrett, 1978; Dromi, 1987; Gruendel, 1977). The naming errors children produce have generated much research and discussion as both overgeneralizations and as retrieval errors. What is unclear in previous discussions is the degree to which there is a single phenomenon

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underlying these early naming errors may be that two distinct albeit related phenomena (e.g., Kuczaj, 1986). The purpose of this article is to examine this issue.

Clark (1973) was among the first to discuss naming errors as overgeneralizations. She noted that children sometimes use a word to label a referent from a different lexical category as if they thought the word extended further than it did. For example, a child encountering a horse may mistakenly call it a dog, possibly because the child does not know that there are distinct words for the two kinds, horse and dog. This interpretation suggests an underlying category error deriving from the perceptual or conceptual similarity of the misnamed object to correct category members (Bowerman, 1978; Clark, 1973).

Although the existence of similarity-based errors has been well documented in diary studies, there is much debate as to whether such errors actually reflect mistaken beliefs about category membership—a belief, for example, that horses are dogs (see Dron, 1987, for a detailed discussion of this problem). Some have suggested instead that these overgeneralizations are not errors at all but are pragmatic solutions to a communication task given the child’s lack of knowledge of the correct word (Barrett, 1986; Bloom, 1977; Hook, Ingram, & Gibson, 1966). By this account, the child knows horses are not dogs but uses the word to comment on their appurtenant similarities. These explanations of overgeneralization, as either category errors or pragmatic solutions, concentrate on naming errors that consist of extending a known name to an object for which the word is yet unknown.

The second way in which children’s naming errors have been considered is as retrieval errors. Huttenlocher (1974) and others (Bloom, 1973; Hook et al., 1986; Naigles & Gelman, 1992) noted that many early naming errors may simply be retrieval errors; children may misname objects even when they have accurate category and lexical knowledge because of momentary difficulties in recalling the correct word. Recently, Gershkoff-Stowe and Smith (1997) found that children showed a marked increase in naming errors as productive vocabulary first accelerated, typically between 18 and 20 months of age. These errors involved children using a known word to name an object in which the name was also known to and formerly produced by the child. Furthermore, these errors appeared to result from the interference of a previously retrieved word. For example, a child may point to a picture of a duck and correctly label it “duck.” Shortly thereafter the child labels a second object, in this case, a shoe—an object also named correctly in the past. Now, however, the child points to the picture of the shoe but calls it a duck. The finding that children in the study knew the appropriate names of the objects is consistent with the idea that the errors are mistakes of retrieval—that is, they reflect momentary failures of accessing the correct word in the lexicon rather than failures of knowing the right word.

One line of evidence pertinent to the question of whether naming errors are overgeneralizations (albeit, perhaps pragmatically motivated ones) or retrieval errors is the lag between word comprehension and word production. Parents have
long noted that their children seem to understand many more words than they say. Although some researchers have argued that this more accurately reflects the child's reliance on general cognitive strategies for inferring the parent's intended meaning (Clark & Haight, 1983; Shatz, 1978), numerous studies have confirmed anecdotal reports that comprehension does, in fact, exceed production (Bates, Bretherton, & Snyder, 1988; Benedict, 1979; Gershkoff-Stowe, Hahn, & Smith, 2000; Goldin-Meadow, Seligman, & Gelman, 1976; Hutenlocher, 1974). Other studies, additionally, have found that children sometimes produce the wrong name for an object they have named correctly in the past or shown evidence of comprehension (Benedict, 1979; Fremgen & Fay, 1980; Grunfeld, 1977; Rescorla, 1980; Thomson & Chapman, 1977). For instance, a child who offers the word "dog" in naming a picture of a cat may accurately select a picture of a dog when presented with a choice of either a cat or a dog. Production errors, despite correct comprehension, lend support to the idea of naming errors that arise from performance difficulties, such as the incorrect retrieval of a word.1

In the research reported here, I seek a deeper understanding of early naming errors by closely studying their developmental progression. Specifically, I seek to understand the developmental relation between a known word selected to name an unknown object and a known word selected to name a known object—that is, one named correctly in the past. The former type of error fits the description of an overgeneralization; the latter type fits the description of a retrieval error. The research question is whether these errors are closely related developmentally and in the real-time processes of lexical retrieval that give rise to them. This empirical question is motivated by a larger theoretical idea (not directly tested) and by past findings on developmental changes in the frequency of naming errors and the circumstances that foster them.

THEORETICAL FRAMEWORK

The larger theoretical idea is one that considers both real-time and developmental time changes in children's knowledge of words. Past research has concentrated on developmental changes in semantic knowledge, with discussions centering on whether children have the concepts and words in question (Anglin, 1977; Barrett, 1978; Bloom, 1973; Bowerman, 1978; Clark, 1977; Dromi, 1987; Grunfeld, 1977; Kuczaj, 1982; Nelson, 1974; Rescorla, 1980). Figure 1 illustrates the issues by this

1Similar production errors are found also to arise from the selective constraints children impose on the words they attempt to use (Dickinson & Leonard, 1982). The influence of phonological factors on retrieval of word form can be distinguished from more temporary disruptions in memory by examination of the lexical repertoire of the child (see, e.g., Vihman, 1981).
view. In this example, a child mistakenly calls a horse "dog." The first column illustrates what may be termed a category error: The child does not yet know that a horse and a dog represent two distinct concepts and, therefore, does not have a separate word for referring to a horse. The child sees the horse but thinks of it as a member of the category dog and thus says the word "dog." The second column illustrates what may be termed a pragmatic error: The child recognizes the horse as a concept distinct from dog but does not yet have knowledge of the correct name and deliberately substitutes a semantically related word, in this case "dog." The third column illustrates a retrieval error: The child recognizes the horse and has knowledge of the word but unintentionally selects the word "dog." Errors of this kind may occur possibly because of disruptions in the selection, transfer, or maintenance of stored information from long-term to active memory (Bloom, 1993; Huttenlocher, 1974). All three examples illustrate different types of errors in production—each emergent from very different kinds of knowledge about the words and concepts in question.

Alternatively, children’s knowledge can be considered more graded and more dependent on the real-time processes through which words are selected and produced. From this perspective, the distinction among the three different types of naming errors illustrated in Figure 1 becomes blurred. Figure 2 illustrates this more graded, real-time process view. As shown at Time 1, the child encounters a novel object (horse) and on the basis of shared perceptual features, activates the previously established concept (dog). This, in turn, projects activation to the associated word "dog," and the child makes an error. Although subsequent feedback
concerning the correct use of the word (e.g., "that's not a dog; that's a horse") may encourage the formation of a distinct concept for horse, this may not be sufficient to override activation of the more well-established concept of dog at Time 1. Thus, the child, again, makes an error. At Time 3, however, the child has more experience distinguishing horses from dogs, and the connection between object and concept is sufficiently strengthened. However, because the link between concept and word is not well practiced in the sense that the child has not yet produced the word many times, the wrong word is again activated. At this point, the lag between comprehension and production becomes apparent. Eventually, in this hypothetical example, the child acquires ample experience naming the object at Time 50 so that the link between concept and word is firmly established. Now the child regularly says "horse" on seeing a horse and says "dog" on seeing a dog. In this view of children's naming errors, there is no easy split between knowledge and performance.

PREVIOUS FINDINGS

Past findings about interference effects in children's naming errors are consistent with both the graded process view of Figure 2 and the specific impetus for the study reported here. Gershkoff-Stowe and Smith (1997) reported a curvilinear trend in naming errors. Early in word learning, children rarely made naming errors, and then as productive vocabulary growth began to accelerate, they made many. As vocabulary continued to expand, naming errors again became infrequent. Gershkoff-Stowe and Smith interpreted these naming errors as retrieval errors on two counts. First, they involved attempts on the children's part to name objects that they had successfully named before, and second, they were often perseverative in nature—that

![Diagram](image_url)

**FIGURE 2** Changes in activation strength as a function of repeated opportunities for naming.

The arrows represent connecting links between levels of the language processing system. Brackets in bold indicate increased strength of activation.
is, they involved the repetition of a recently retreived word to name an inappropria-
tate target. For example, the child may correctly name a cup, "cup," and then look at
a dog and say, "cup." It is as if the previously-activated word interfered with the cur-
rrent retrieval (see, e.g., Viltovitch, Hoppophros, & Lloyd-Jones, 1993).

Ohtera have reported that overextensions also show a curvilinear trend (e.g.,
Gräudel, 1977; Rencorla, 1989). For example, in a detailed analysis of one child's
single-word extensions from 10 to 18 months of age. Dromi (1987) noted, "Most of
Keren's overextensions (74 percent) were recorded after an initial period of correct
application" (p. 142). This finding, Dromi concluded, "shows that before extending
a new word the child typically achieves a certain degree of familiarity with it."

This parallels brings us to two questions: What is the developmental relation be-
tween different kinds of naming errors, and how are these errors related to changes
in productive vocabulary growth, lexical perseveration, and object similarity? As a
first step in answering these questions, I conducted an 8-month longitudinal study
of naming errors in children 16 to 24 months of age. This is a time period when vo-
cabulary growth expands and naming errors of all kinds have been reported to be
frequent. Accordingly, the specific method used in this study builds on the con-
tinuous behavior of children in the midst of rapid vocabulary expansion. During this
time, children are eager to volunteer the names for things and often do so even
when they have limited or no experience with hearing or saying the correct word.
The purpose of this study was to document the development of vocabulary of chil-
dren's spontaneous naming using two laboratory tasks, presented at each session: a
picture book task examining children's naming errors of known objects and a
novel object task examining children's word extensions to objects for which they
have no name.

METHOD

Participants

Ten children (5 girls and 5 boys) from English-speaking, middle-class families were
recruited from newspaper announcements or by word of mouth. The mean age of the
children was 17 months (range = 16.1-18.0). Testing continued at 3-week intervals until chil-
dren were an average of 21 months of age (range = 18.9-22.5) and their productive
vocabulary had grown to a mean of 125 words (range = 88-152). Additionally, 3
children returned to the laboratory for one more visit at 24 months of age. The mean
number of days between the last session and the 24-month visit was 90.7 days.
A simple picture book, *Brown Bear* (Martin, 1983), was used for eliciting children's naming of known objects. On each page was a large, colorful picture of an object and a simple text that repeated the name of the object twice in a rhythmic fashion. Additionally, the last page contained pictures of all the objects in the book arranged in the order they first appeared. All 11 objects belonged to the same taxonomic category of animals—many of which were common to the experience of young children (e.g., dog). A list of the objects in the picture book is found in Appendix A. The pictures in the book were known to the children in three senses: (a) They are common, real-world objects that children are likely to encounter and hear named outside the laboratory; (b) the pictured objects were repeatedly named by the parent over the course of the experiment; and (c) the pictured objects were also named by the children over the course of the experiment, as reported in the Results section.

Children also were presented with three sets of objects containing three novel objects within each set. Different objects were used at each session and never repeated. Thus, children always saw one set of novel artificially constructed objects with eyes, one set of novel artificially constructed objects without eyes, and one set of novel real-world but unusual objects for which they were likely to have little experience (e.g., radish, tea strainer, and rubber stamp). These three sets were chosen to offer a diverse range of referents for children to name. Sample objects used in the experiment are presented in Appendix B. These objects are thus unknown in three senses: (a) They are either artificial or rarely encountered so that children are unlikely to have heard them named before, (b) they were presented at just one session and never named by the parent or experimenter; and (c) children (by parent report) had never named them before.

The reason for using picture books for the known objects and three-dimensional objects for the unknown ones was to vary the task to keep children interested in the long term and for ease of construction.

**Procedure**

*Measures of productive vocabulary growth.* Parents used the toddler version of the MacArthur Communicative Development Inventory (Fenson et al., 1993) to record the number of cumulative words in their child's vocabulary at the start of the study. In addition, parents used a traditional diary method to record additional words or phrases the child spontaneously produced at home each day. Parents also recorded nonce words, for the purpose of computing vocabulary growth, non-natural words (e.g., "gak" for duck) and onomatopoeia (e.g., "choo choo").
Laboratory tasks. Children were tested in the laboratory at 3-week intervals beginning when they had approximately 35 words in their productive vocabulary or when they reached the age of 18 months—whichever came first. The 35-word mark was selected to allow adequate opportunity to assess children’s errors before the onset of accelerated vocabulary growth. In particular, previous studies have suggested that the onset of the spur typically occurs around 18 months of age, when children have approximately 30 nouns in their productive lexicon (Benedict, 1979). However, because some children are late to begin talking but quickly catch up, testing was initiated for all children no later than 18 months of age.

Two tasks were presented to the children at each session. In the picture book task, children and their parents looked at and named common objects in a picture book. Parents were instructed to label and ask questions about the names of the pictured objects as they normally did at home and to correct their children’s errors when they occurred. The same book was used at each session. Children’s spontaneous naming in the laboratory and diary data were used as measures of whether or not an object name was known to the child; that is, whether the child had said the word correctly in previous naming episodes.

At each session, children’s responses were coded for the number of times they attempted to name an object in the picture book, either correctly or incorrectly. Nouns and other words that focused on specific details or referred to some property or attribute of the pictured object were included when analyzing the number of tokens children produced. For example, “whiskers” was coded as one response when looking at the picture of the cat, as was the word “pretty” when referring to the dog. Although children occasionally produced more than a single-word utterance in the picture-naming task, this did not occur often. One exception, however, was the production of color terms, which appears to be an artifact of the experimental setting. That is, children were told that the object on the page was a brown bear, red bird, or yellow duck. Thus, children sometimes used the same phrase to name an object. When this occurred, we counted the object word as a single utterance and did not treat the color word as a separate response. However, when children used the words “red” or “blue,” for example, as separate comments on the object, credit was given for having produced more than one utterance. Determining when to code a response as a single- or multiple-word utterance was based on pauses between items or individual points to an object. These coding decisions also applied to other phrases children produced. For example, “these frogs,” “duck quickly,” and “ride horse” were each counted as single naming responses, representing the objects frog, duck, and horse, respectively.

A naming attempt was considered incorrect if the child produced the name of one object but pointed to or looked unambiguously at another object. Additionally, an incorrect naming attempt was counted if the parent asked about one object while both were looking at the same picture but the child produced the wrong name. The vocabularies of individual children were taken into account when deter-
missing what constituted a naming error. For example, if “Fido” was the name the child used to refer to the family dog, then the word “Fido” was taken as a correct response to the picture of a dog but an incorrect response to the picture of a sheep. When in doubt, parents were queried about the child’s use of a word. For example, if the child used “hot” to refer to stove, then the word was treated as a nominal and counted as a naming error when used to refer to cat.

Following the picture book task, children played with three individual sets of objects, with each set containing three novel objects. The sets were presented one at a time for 2 min and were counterbalanced across session. Thus, a limit was set on the amount of time children had in the novel object task but not in the picture book task. Parents in the novel object task were instructed not to label or comment on the objects and not to direct their children’s play with the objects in any way. Children’s verbal responses were coded for the number of times they offered an English word as a name for a stimulus object, for example, saying “hat” for a tea strainer. Nonreferential utterances, such as “no,” “more,” and “look,” and adjectives such as “hot” or “pretty,” were also included as part of a measure of children’s total talking but not naming. As in the picture book task, phrases such as “all done” and “I want it” were counted as a single unit.

On rare occasions, children said a word that was functionally related to the experimental object in the novel object task. For example, one child said “fly” as he gleefully attacked the table with the fly swatter. On these occasions, the response was counted as an instance of total laboratory talking but not as a word extension.

Reliability was assessed in both tasks by calculating the percentage of agreements between two coders in scoring the naming responses of 2 of the 10 children across all sessions. Collectively, the 2 children produced a total of 306 object names in the picture book task and 92 names in the novel object task. Inter-rater reliability was 87% and 90% for total talking in each task, respectively. Additionally, reliability between the two coders on a total of 64 naming errors in the picture book task was 85%.

RESULTS

Preliminary Issues

Previous findings suggest the critical developmental time for a rise in naming errors occurs when children have between 30 and 150 words in their cumulative productive vocabulary (Gershkoff-Stowe & Smith, 1997). In the study reported here, children’s data were aligned by the number of words in their productive lexicon, as reported by parent questionnaires, and developments in naming were compared across four ranges that span the period just before, during, and just after this critical time: 0 to 50 words, 51 to 100 words, 101 to 150 words, and over 150 words.
The average number of times children visited the laboratory prior to their 24-month visit was 6.8 (range = 4–10). Because the rate of vocabulary growth varied considerably across children in the study (as it does across children generally), the number of sessions they participated in each vocabulary range differed. Children averaged 4.2 visits in the under-50 word period, 3.0 visits in the 51 to 100 word period, and 1.7 visits in the 101 to 150 word period. Children in the over-150 word period visited the laboratory only one time at 24 months. Thus, the data reported here are analyzed in terms of responses per session.

Preliminary analyses, using a one-way analysis of variance (ANOVA), indicate the time children spent in the picture book task (which was child determined) did not vary as a function of session, $F(3, 35) = .654, p = .59$. Time in the novel object task was fixed by the experimenter and thus did not vary across sessions.

**Total Talking in the Laboratory**

Early in the experiment, when children had few words in their productive vocabulary, they spoke little in the laboratory. As vocabulary size increased, however, and children became more familiar with the testing situation, they generated the names of objects, in both the picture book task and the novel object task, with greater frequency. Figure 3 shows children's total talking in both tasks as a function of vocabulary development. A 4 x 2 repeated-measures ANOVA on these data revealed no main effect of task (picture book vs. novel object), $F(1, 72) = 1.44$, but a highly robust effect of vocabulary size, $F(3, 72) = 11.38, p < .001$. In addition, there was a significant interaction between the two factors, $F(3, 72) = 3.89, p < .01$. Tukey's HSD post hoc analyses ($p < .05$) indicate that children spoke reliably more in the novel object task than in the picture book task when they had over 150 words. This difference is likely reflects differences in the way the two tasks were structured. That is, the novelty of stimuli in the novel object task seems to have continued to capture the children's comments at 24 months in a way that repeated presentations of the same stimuli in the picture book task did not.

**Developmental Timing of Naming Errors and Word Extensions**

The central aim of this study is to provide evidence on the correspondence between the developmental trajectories of naming errors that involve known and unknown objects. Accordingly, I first describe the frequency with which children misnamed the familiar objects in the picture book task and the frequency with which they spontaneously offered names for the unfamiliar objects in the novel object task.
A word was counted as an error in the picture book task if the name supplied by the child did not correctly identify the pictured object to which the child was attending, as indicated either by gesture or gaze. Each error was assessed for whether the target word (i.e., the one not offered by the child) had been appropriately used in the past. Both laboratory talking and parent diaries were used to assess familiarity. By this measure, 78% of all naming errors in the picture book task involved objects with names known to the children.

In the novel object task, parent reports indicate that none of the children was familiar with the names of the experimental objects. All the children’s naming attempts were, thus, errors in a sense or at least pragmatic extensions of known names to unusual things. To stay neutral on this issue, I call naming attempts in the novel object task extensions. Thus, for my purposes, an extension was defined as using a real English word to identify an experimental object (e.g., calling a tea strainer “hat”). This definition included any kind of extension, independent of the conceptual, pragmatic, or associative basis for the word (e.g., Rescorla, 1980). A list of the word extension and naming error types produced at each session by each representative child is listed in Appendix C.

Figure 4 presents the mean frequency of naming errors in the picture book task and extensions in the novel object task at each vocabulary range. As can be seen, both types of responses follow a similar rise and fall pattern. This result was confirmed by a 4 (vocabulary range) × 2 (task) ANOVA that yielded a significant
The main effect of vocabulary range, $F(3, 72) = 5.43, p < .002$; no effect of task, $F(1, 72) = 3.05, p = .08$; and no interaction, $F(3, 72) = 1.16, p = .32$. A Tukey HSD test $(a = .05)$ reveals that the vocabulary effect was due to a rise in naming errors and word extensions from the 15 to 100 word range and the 101 to 150 word range and a subsequent decline in both kinds of responses from the 101 to 150 range and the over-150 word range. Thus, despite differences in the structure of the two tasks—the apparent knowledge children have for the names of the objects and the decrease in overall talking in the picture book task but not the novel object task—children show a common rise and fall trajectory for both naming errors and word extensions. This finding seems to suggest a common mechanism may underlie the two behaviors. This possibility is considered in the analyses that follow by examining the essential character of children’s naming responses.

Character of Naming Errors and Word Extensions

Previous research (Merley & Barn, 1976; Pratt & Shallott, 1993; Scarborough, Cestate, & Scarborough, 1977; Vitekovich & Humphreys, 1991) has suggested two possible influences, in particular, that may affect the accuracy of children’s naming: (a) perseverative effects involving a word set previously retrieved by the child and (b) similarity effects between the incorrectly named object and the object the child intended to name.
Perseveration effects. To test for the effects of interference from a previously retrieved word, the time frame that spanned for last three utterances said by the child prior to each naming error and word extension in the picture book and novel object task, respectively, was examined. For example, if the child saw a picture of a bird and said, "cuc," I asked how often that response had been preceded by the child's production of the same word. This is the same time span that was used previously to assess perseverative effects in children's object naming (Gershkoff-Stowe & Smith, 1997).

As shown in Figure 5, perseverations were most evident in the picture book task, particularly during the two middle vocabulary ranges (50-150 words). These data were analyzed using a 4 × 2 ANOVA, with vocabulary range and experimental task (i.e., picture book, novel object) as factors. Significant main effects, but no interactions, were found for both vocabulary range, F(3, 72) = 3.28, p < .03 and task, F(1, 72) = 9.59, p < .002. Post hoc analyses (Tukey's HSD; q = .05) indicate that perseverative responses rise reliably between the 0 to 50 and 101 to 150 levels of productive vocabulary development and decline reliably between the 101 to 150 and over-150 levels as a function of task. This finding that both naming errors, when the target word is known, and word extensions, when the target word is unknown, are influenced by the words the child has just uttered is potentially of considerable importance. It suggests that as vocabulary first expands, the processes that activate a word are generally vulnerable to the influence of a recently retrieved

FIGURE 5. Mean proportion of responses that were perseverative in the picture book and novel-object tasks.
word. This fact suggests similar mechanisms underlie both curvilinear trends. The hint that this vulnerability first emerges when the child attempts to retrieve a name for a more familiar object is intriguing and is considered in the Discussion section.

Additional analysis was conducted to determine whether the familiar words from the picture book task influenced perseverative responding in the novel object task. Examination of each word extension for possible repetition effects reveals that only 8% of the naming responses in the novel object task involved words previously spoken in the picture book task. Two possibilities for this small effect are suggested. First, the amount of time that passed between the two tasks was relatively long (M = 45 sec) and, thus, extended beyond the testoral properties normally associated with short-term repetition (see Forster, 1990). Second, these appear to have been little perceptual similarity between the experimental objects themselves. This idea is considered in further detail in the next section.

Similarity effects. The selection of a word also may depend on similarity and, as suggested by adult lexical access studies, interference in word retrieval is often due to such effects (Meyer & Schvaneveldt, 1971; Scarborough et al., 1977; Vitkovitch et al., 1993). Thus, it is possible that in the picture book task, children misnamed offered a wrong word when attempting to name a familiar object because of overlapping visual or semantic features between the target and mismatched object. Such overlap could cause the wrong word to be activated and retrieved. Analogously, when children selected a known name to label an unknown object in the novel object task, it is likely that they did so on the basis of similarity of the novel object to a thing for which they knew a name.

To what extent, then, did children produce naming errors in the picture book task and word extensions in the novel object task that involved similar objects? To answer this question, each naming error and word extension was classified as perceptually or conceptually related if the object the child intended to name and instances of the supplied name were roughly alike in shape (e.g., apple and sap) or if they belonged to the same taxonomic category (e.g., mommy and baby). Two independent judges rated similarity for 25% of the naming errors and word extensions, and interrater reliability was high at 93%.

By these criteria, just over one-half of all errors in the picture book task (54%) consisted of mismapped objects that were related in appearance or meaning to the intended object. Importantly, 60% of these similarity-based errors were, in addition, perseverations. The remaining proportion of errors—those not classified as perceptually or conceptually similar—were identified as either unrelated perseverations (20%), phonologically related (e.g., bear and baby, 12%), or unrelated (14%). In contrast, when children were presented with the experimental objects in the novel object task, they selected a word that was perceptually similar in shape to the target in virtually every case (range = 93%–100%). From an adult per-
spective, the similarities in this task were compelling and often seemed to be based on more than just shape. For example, children called a metal shoehorn “spoon,” an object sharing the same shape, material, and color.

Substituting these data to a 4 x 2 ANOVA revealed a significant interaction between Vocabulary Size X Experimental Task, $F(3, 72) = 3.4, p < .02$. As it is evident in Figure 6, the proportion of word extensions that were similarity based in the novel object task differed little across vocabulary period. This result is perhaps not surprising because all word extensions are spontaneously produced, with no direct demand on the child to try to name the novel objects. Therefore, it is likely that children attempted to say a name only when the object was sufficiently similar to prompt retrieval of a related word. In contrast, the rate of similarity-based retrieval errors in the picture book task rose reliably from the 101 to 150 word levels to the over-150 word levels (Tukey’s HSD; $p < .05$). That is, in the last session, when children misnamed the same pictured objects they had encountered several times before, the word they selected was a name for an object that was more often perceptually or conceptually similar to the object erroneously named.

In summary, the results suggest that children’s activations of words in lexical memory change over the course of early vocabulary growth, from being vulnerable to perseveration to not being vulnerable. Moreover, this is true both when the target word to be activated is the name of a known object and when it is the name of an unknown but perceptually similar object. In both cases, errors rise and are par-
ticularly susceptible to influence from a recently spoken word. In the discussion that follows, the nature of these processes, the link between concept and word, and the developments that lead children to increasingly successful naming are all considered.

DISCUSSION

In the course of early word learning, children sometimes incorrectly apply the name of one object to members of a different object category. Findings from this experiment indicate that this is particularly true of children during a narrow band of time—when they have between 50 and 150 words in their productive lexicon. This brief period is a time of rapid vocabulary growth and is often characterized by a sudden spurt in naming (Benedict, 1979; Bloom, 1973; Corregan, 1978; Dromi, 1987; Goldfield & Reznick, 1990; Gopnik & Meltzoff, 1987; Nelson, 1973). Previous studies have suggested several reasons why children may call an object by another name, including faulty hypotheses concerning the meaning of words, limitations in vocabulary size coupled with a desire to communicate, and difficulties in retrieving the desired word from lexical memory. As revealed in the experiment presented here, the specific nature of children’s word extensions and naming errors suggests that they derive from common processes involving the activation and retrieval of words from a newly forming and rapidly expanding lexicon.

This conclusion is based on the finding that the selection of words for naming, for both known and unknown objects, follows a common developmental trajectory—one that rises and falls with increased vocabulary growth. Several factors associated with accelerated vocabulary growth may contribute to this curvilinear pattern. Children have more words to choose from, are talking more often, and are increasingly retrieving successive words close together in time. These developmental factors, combined with the real-time processes involved in perceiving an object and naming it, are likely to increase the probability of an error. In particular, increased lexical interference may result from objects that are perceptually or conceptually related to the target, as suggested by the high rate of word extensions in the novel object task. Additionally, interference from just a previously said word appears related to the rise in errors, as indicated by the high rate of perseverative naming in both the picture book task and novel object task during the time of the vocabulary spurt (see also, Gershkoff-Stowe & Smith, 1997).

These results fit the idea that errors occur when the appropriate word for labeling an object is currently inaccessible to the child. This may happen because the word is too weakly represented, as was the case when a word was newly learned, or because it is not represented at all, as when the child attempts to name a completely novel object. These are developmental issues relevant to children’s increasing knowledge of words. Additionally, a word may be momentarily inaccessible to the child because a competing word, one just spoken—perhaps, inter-
fers with current attempts to retrieve a word. Hence, accessibility of a word depends on both developmental processes and real-time processes. The results suggest that it may be useful to consider these processes jointly.

Retrieval Competition as a Mechanism for Children’s Naming Errors

Two sets of factors, in particular, are important for interpreting the results: first, those factors concerned with the circumstances of the presentation of a word and, second, those concerned with the properties of the words themselves. The most important of this first set of factors are repetition effects. Previous work indicates that adults recognize words faster when they have been presented previously in an experiment (Scarborough et al., 1977). This result suggests that items in the lexicon retain some degree of activation after initial access. In the study presented here, children produced a high rate of perseverative naming errors in the picture book task and novel object task at a time of accelerated vocabulary growth. This pattern of perseverative naming suggests a temporary disruption in word-retrieval processes—a disruption in the ability to override lingering activation from a previously said word.

An additional effect related to the repetition of a word is the priming effect. Adult speakers recognize words faster when they are preceded by a semantically (or less consistently, phonologically) related word (Meyer & Schvaneveldt, 1971). Adults also demonstrate priming effects under speeded naming conditions for objects that are visually but not semantically related (Vitkovic et al., 1993). Much less is known about priming effects in early development, however. One exception is recent work by Staley and Smith (1999), who investigated whether young children are sensitive to the effects of visual priming by examining the word extensions children produced when presented with a novel object. Children first were asked to name three pictures of familiar objects (two distractors and a target) and then to name a picture of a novel object that had the same overall shape as the target. Staley and Smith compared the naming responses of 2-year-old and 4-year-old children with age-matched controls who were not primed. The results offered clear evidence for the effects of shape-related priming for children at both ages in the experimental but not the control condition.

These results are consistent with findings in the novel object task in which similarity of shape was a potent source of influence on the word extensions children produced. More importantly, however, the results in the novel object task, and those of Staley and Smith (1999), suggest a model of children’s word learning in which knowledge of a word is affected by on-line processes that are highly context specific. The general feature of this model is the simultaneous activation of multiple representations that compete for lexical access (as depicted in Figure 2). This competitive process begins at the conceptual level in which multiple representa-
tions become activated in response to a target object. The degree of activation associated with a concept depends on its visual or semantic overlap with the target object. These concepts in turn project activation to the lexical level in which the word that accumulates the most activation is accessed for production. Several sources of activation determine the strength of a word. One important source is the semantic unit itself. The transfer of activation from concept to word will be greatest for those concepts that most closely resemble the current input. Additionally, repeated mappings between concept and word will strengthen the connection weights that link the conceptual to the lexical level. In most instances of naming in the real world, these processes lead to the correct selection of a word. When faced with a novel object for which the young child has no name, however, the word the child selects will be most directly affected by the visual properties of the target itself and, in particular, its overall shape.

Although perceptual similarity is a potent source of activation in the word-retrieval process, data from both tasks suggest that lingering activation from a preceding response has a significant effect on the occurrence of the errors children produce at the time they have 50 to 150 words in their productive lexicons. As suggested by previous research, this vocabulary range marks a period of accelerated growth known as the vocabulary spurt (Gershkoff-Stowe & Smith, 1997). In the picture book task, approximately one half of the errors produced by children in this middle vocabulary range were perceptually or conceptually related to the target object. In the postspurt period, however, when children had more than 150 words, the proportion of similarity-based errors increased significantly. These results thus suggest that during the time of the vocabulary spurt, the residual activation from a just previously said word overrides competing activation from the perceptual or conceptual similarity of the target object. As these perseverative effects diminish with increased vocabulary size, similarity assumes greater activation value. This raises two important questions: First, what could cause the effects of repetition to first increase and then decrease in strength and, second, how may these causes be related to the developmental course of overextensions in the period beyond the spurt?

Changes in Memory Retrieval Processes as a Function of Repeated Use

Key to understanding the time course of children’s naming errors before, during, and after the vocabulary spurt is a second set of factors concerned with the properties of individual words. Most critical are the effects of word frequency. The frequency with which a word occurs in language has been shown to have powerful effects on the accessibility of words in memory (Foster, 1990). Such effects are encoded in the processing system in terms of strength of activation. Thus, high-fre-
quency words may be conceptualized as having higher activation at resting level and as passing more activation to connected levels than low-frequency words. Consequently, high-frequency words are less susceptible to error and may be accessed faster than low-frequency words (Dell, 1990). Given this, it is reasonable to expect that the properties of word retrieval will be particularly vulnerable as children begin to produce many new words—most of which are low-frequency words in the sense of the individual child's experience. As children insistently practice the words they know, those words should become stronger and more resistant to interference from lexical competitors. This prediction was recently confirmed in an experimen
tal training study examining the effects of practice on the naming errors children produce (Gershkoff-Stowe, 2001).

By this hypothesis, then, the changing pattern of overextensions and retrieval errors may be related to changes in the absolute activation strength of words that will occur as children learn and repeatedly use those words in production. More specifically, retrieval errors may rise at the start of accelerated vocabulary growth because activation levels are too weak to resist the interference that results from the lingering activation of a previously said word. Errors then may fall as children gain practice hearing and saying individual words. This assumption is based on the notion that each experienced occurrence of a word produces a change, or strength
ing, of connecting weights that determines the level of activation for that word. By this account, the decline in overextensions involves similar increases in activation strength that will accrue for most common words as children practice those words by talking more.

Recent work by Dapento and Bjork (2000) on children's naming before and af
ter the spur in productive vocabulary supports this general account. They hypoth
esized that the gap between early receptive and productive abilities may reflect difficulties in the processes of retrieving words from lexical memory. To test this, they compared children's ability to recall familiar object labels to their ability to recall the location of the objects. Although both groups of children had the names of the test objects in their productive vocabularies at the time of the experiment, Dapento and Bjork found that the children who had demonstrated a lexical, spur were more successful at recalling the familiar object labels than the children who had not. In contrast, both groups were equally successful in recalling the object lo
cations. This difference suggests that the word-retrieval operations of young chil
dren may be less well established than the nonverbal retrieval operations occurring more generally.

CONCLUSIONS

The development literature offers numerous examples of studies in which chil
dren exhibit temporary dips in performance with increasing age (Alibali & Goldin-
Meadow, 1993; Church & Goldin-Meadow, 1986; Gershkoff-Stowe & Smith, 1997; Marcus, 1995; Smith, Thelen, Tzitter, & McLin, 1999). These U-shaped curves are often characterized by behaviors that are rigid, repetitive, and tightly coupled to initial learning conditions. For example, in the domain of early word learning, Nelson and Nelson (1978) observed that children generally move from an initial stage of open and broad word extensions to a narrow and rigid use of underextension and then finally back to a more flexible and adult-like application of words. Importantly, they noted the following: “Paradoxically, the period of overlearning, repetition, and even rigidity that rightly are called ‘closed’ establish the best basis for new periods of flexibility” (p. 277). The study reported here supports this view and, furthermore, suggests that the causal mechanism underlying the shift in children’s naming errors just before and after the onset of the vocabulary spurt resides in the processes that occur at children learn and repeatedly retrieve individual words for production.

The focus of this study, like most studies of early language learning, is on what children say rather than on what they know. Considerable debate exists concerning the extent to which children’s word extensions occur in comprehension as well as production (Chaitman & Thomson, 1980; Frequent & Fay, 1980; Marvin & Casada, 1983). According to the account proposed here, word extensions should be found in both modalities. This prediction is based on the assumption that the same activation processes operating in production also operate in comprehension. What differs is the directional link between concept and word: in comprehension, children must retrieve stored information about an object in response to hearing a word. In production, children must retrieve information about a word in response to perceiving an object. Recent findings by Gelman, Croft, Fu, Clausner, and Gottfried (1998) support this prediction. Specifically, they found that 2- and 4-year-olds demonstrated word extensions in comprehension, based on similarities of shape and taxonomy, that were much like the word extensions produced by younger children in the novel object task.

In conclusion, this study is a strong replication of a temporary instability in children’s spontaneous naming in two different task contexts. The results suggest that the processes that activate a word for naming are similar, regardless of whether a known word is selected to name an unknown object or a known word is selected to name a known object. In experimental situations that encourage children to name objects, the data indicate that early in development, both kinds of retrieval are vulnerable to influence from previously activated words. Later in development, however, word retrieval becomes less vulnerable to such influence. Thus, finding of a temporary instability in the processes that underlie lexical access and naming is intriguing and suggests new directions for studying the ways conceptual knowledge changes with increased opportunities for naming—by increasing connection strengths between concept and word and by providing the context for competitive learning.
ACKNOWLEDGMENTS

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REFERENCES


APPENDIX A
Objects Presented in the Experimental Picture Book:

1. brown bear
2. red bird
3. yellow duck
4. blue horse
5. green frog
6. purple rat
7. white dog
8. black sheep
9. gold fish
10. mother
11. children
APPENDIX B
Sample Objects Presented in the Novel Object Task
### Course of Errors

#### Appendix C

**Naming Errors and Word Extensions (Types) for One Child by Savill**

<table>
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<th>Target</th>
<th>Response</th>
<th>Word Extension</th>
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<td>duck</td>
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<td>2</td>
<td>home</td>
<td>bear</td>
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<td></td>
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