

## Retrieval Mechanisms in the Development of Instance and Superordinate Naming of Pictures

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Children's use of superordinate names lags behind their use of instance names, and production lags behind comprehension. The hypothesis that both of these developmental delays reflect underlying retrieval difficulties predicts an interaction between name generality (instance vs. superordinate) and task (comprehension vs. production). Specifically, production of superordinate names should be more difficult for children than the separate name generality and task effects would predict. To examine this hypothesis, 32 junior kindergarten and 32 Grade 1 children in Experiment 1 performed an instance and superordinate name comprehension task for 96 single-exemplar pictures from 12 categories, and 32 junior kindergarten and 32 Grade 1 children in Experiment 2 produced instance or superordinate names for the same pictures. As predicted, the combination of superordinate names and language production was particularly difficult, especially for junior kindergarten children. High rates of instance name intrusions and other findings suggest that superordinate name production may be interfered with by more readily available instance names. Weak inhibition of competing instance

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This research was supported by a Natural Sciences and Engineering Research Council of Canada (NSERC) Postgraduate Scholarship and an Ontario Ministry of Health Fellowship to C. J. Johnson, and by NSERC Grants OGP0042736 to J. M. Clark, OGP0121509 to C. J. Johnson, and A0087 to A. Paivio. Conclusions expressed herein are those of the authors, and no official endorsement by the funding agencies is intended or should be inferred. For their assistance with this project, we thank Allan Paivio, the administration and teachers of the London Board of Education and the University of Western Ontario preschool, parents and children who participated in the studies, and teachers who volunteered their time for the ratings. Portions of this research were presented at the 1989 biennial meeting of the Society for Research in Child Development in Kansas City, Missouri. Address correspondence and reprint requests to James M. Clark, Department of Psychology, University of Winnipeg, Winnipeg, Manitoba, Canada, R3B 2E9. E-mail: CLARK@UWPG02.UWINNIPEG.CA.

names and other mechanistic explanations for the effects are considered. © 1994  
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Mature speakers can name single objects or pictures at various levels of generality (Brown, 1958), producing instance (basic level) or superordinate names as appropriate (e.g., chair or furniture, dog or animal). However, children typically comprehend and produce instance or basic-level names for objects at an earlier age than superordinate category names for those same objects (Anglin, 1977; Clark, 1983; Gelman & Baillargeon, 1983; Mervis, 1980; Mervis & Rosch, 1981; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). The later emergence of superordinate knowledge is also demonstrated by developmental increases in the effects of taxonomic relations on such cognitive tasks as perceptual set (Reese & Lipsitt, 1970), free recall (Kobasigawa, 1977; Moely, 1977), picture name interference (Guttentag, 1984), matching to sample (Tager-Flusberg, 1985), word association (Ervin, 1961), and some semantic priming tasks (McCauley, Weil, & Sperber, 1976).

This delayed superordinate production may reflect some fundamental constraint on the retrieval of superordinate names. Although response failures disappear, the difficulty of superordinate naming is not a transient developmental phenomenon. Adults continue to be slower at superordinate than instance naming (Clark, 1988; Irwin & Lupker, 1983; Jolicoeur, Gluck, & Kosslyn, 1984; Smith & Magee, 1980; Wingfield, 1967). The lasting advantage for the retrieval of instance names may result from the manner in which knowledge about instance and superordinate names is organized and accessed in semantic memory, and these same mechanisms may contribute to the late emergence of superordinate naming in children. The present studies examined the retrieval processes involved in instance and superordinate naming, and related these processes to other developmental changes during mid childhood.

#### A COGNITIVE MODEL OF PICTURE NAMING AND ITS DEVELOPMENT

We assume a cognitive model in which pictures and words are represented by object-like and word-like mental codes (cf. Clark, 1987; Clark & Paivio, 1987; Paivio, 1971, 1986; Paivio, Clark, Digdon, & Bons, 1989), with referential connections between corresponding object and word codes. When names for objects or pictures must be produced, the non-verbal stimulus activates the appropriate object code. Activation then spreads along referential connections to verbal representations for instance names, superordinate names, and other words that have been associated with that object in the past. Selection processes determine which name occurs as a response, depending upon such factors as the familiarity of

the names, the strength of the referential connections, recency of priming, and instructions (e.g., to give an object's instance or superordinate name).

Superordinate names and their connections to object representations are acquired later than instance names because of various developmental and conceptual factors (Markman, 1989; Mervis & Rosch, 1981; Nelson, 1985). Labeling practices of parents play a major role (Blewitt, 1983; Shipley, Kuhn, & Madden, 1983; Wales, Colman, & Pattison, 1983; White, 1982). For example, parents use instance names more often than superordinate names, even when teaching superordinate concepts (Callanan, 1985), and use superordinate names primarily with multiple exemplars from the same category (Callanan, 1989). Moreover, superordinate naming requires mature metalinguistic skills, such as the understanding that objects can have more than one name (e.g., Benelli, 1988; Clark, 1983). Acquisition of superordinate names may also be delayed because exemplars from the same superordinate category vary more in appearance than do objects representing the same instance category (Rosch et al., 1976). Instance and superordinate names can also differ in age of acquisition because of length, frequency, difficulty of pronunciation, or other properties of the words, although control of such factors does not eliminate name generality effects (e.g., Murphy & Smith, 1982). Markman (1989, especially chapter 4) presents a thorough analysis of these and other developmental and conceptual factors that contribute to the late emergence of superordinate naming.

The overall effect of such factors is that superordinate words and their referential links to object codes are generally acquired at a later age than instance names and their links. One consequence of successive acquisition and differential use is that superordinate names and their links will typically be weaker than instance names and their links, even after both have been acquired. The earlier-acquired instance names could even mediate access to superordinate names, such that activation spreads from the object code to the instance name and subsequently to the superordinate name code.

According to such models, instance names would usually be more available, in and of themselves, and also more strongly or more directly connected to object codes than are superordinate codes. The greater availability and accessibility of instance names confers an advantage on them in naming tasks, although exceptions would exist (e.g., the superordinate *food* would generally be more available and accessible than the instance-name *broccoli*).

But if instance names are more available and more accessible than superordinate names early in development, then children must eventually develop special retrieval mechanisms to overcome the relative weakness of superordinate names and permit their generation. We hypothesize that superordinate naming requires the development or maturation of addi-

tional retrieval processes that compensate for the relative unavailability of superordinate names. Compensating mechanisms could include additional excitation of the weaker superordinate names (e.g., converging activation from other members of the category or from instructions to give superordinate names), suppression of the dominant and therefore interfering instance names, or both excitation and suppression. Selective excitation of appropriate responses and inhibition of inappropriate responses presumably play lesser roles in retrieval of the dominant instance names.

In name production tasks, the hypothesized retrieval mechanisms confer a clear advantage on instance names relative to superordinate names. Differences between instance and superordinate names should be less pronounced on comprehension tasks, however, because the spoken names directly activate their respective name codes and autonomous retrieval of the appropriate names is not required. Direct activation will reduce and perhaps even eliminate benefits from the easier access to instance than superordinate names.

We have not found any direct tests of this hypothesized interaction between task (comprehension vs. production) and name generality (instance vs. superordinate). Considerable literature does demonstrate that young children comprehend many words that they fail to produce (Bates, Bretherton, & Snyder, 1988; Goldin-Meadow, Seligman, & Gelman, 1976). The difference between comprehension and production also varies across language attributes; for example, the difference is less for nouns than verbs (Goldin-Meadow et al., 1976, Table 2). In addition, we have unpublished evidence that the superiority of instance items may be less for the Peabody Picture Vocabulary Test-Revised (a comprehension test) than for the Expressive One Word Picture Vocabulary Test (a production test; Johnson & Clark, 1988).

Indirect evidence for the retrieval deficit hypothesis includes findings that young children and even infants demonstrate some sensitivity to superordinate relations when only comprehension is required (Bauer & Mandler, 1989; Fenson, Vella, & Kennedy, 1989; Perlmutter & Myers, 1979; Ross, 1980; Sherman, 1985; Younger, 1985). Direct presentation of a superordinate name, as on comprehension tasks, also helps younger children more than older children on a category judgment task involving two pictures of different instances (Duncan & Kellas, 1978). As well, providing superordinate organization cues in memory studies is of particular benefit to young children who fail to generate the cues themselves (e.g., Melkman, Tversky, & Baratz, 1981).

Such findings suggest that the capacity to independently generate superordinate names is delayed by cognitive demands not present in comprehension tasks, and retrieval difficulties seem a likely candidate. Dapretto, Bjork, and Gelman (1991) have specifically argued that word

production errors result from retrieval failures in young children. Consistent with this view, Johnson and Clark (1988) found that multiple-instance superordinate items on a picture naming test were more difficult than instance names of equivalent age of acquisition and that children were more likely than adults to wrongly generate instance names for superordinate items, but not more likely to make noninstance errors. That instance naming continues to be faster than superordinate naming even in adulthood indirectly supports the hypothesis that retrieval processes contribute to the relatively late emergence of superordinate name production.

More generally, the retrieval deficit hypothesis can be derived from current theories of self-regulation, especially the hypothesis that the capacity to suppress impulsive responses is a late maturing process (see Bjorklund & Harnishfeger, 1990; Dempster, 1992; White, 1965). If the ability to suppress competing responses during semantic retrieval develops late, then young children (i.e., less than 5 years or so of age) could find it extremely difficult to inhibit interfering instance names during superordinate name production. One reflection of this regulatory weakness would be a greater difference between instance and superordinate name performance for younger children than for older children, an interaction that should be more pronounced for production than for comprehension according to the proposed model.

Various empirical and theoretical considerations suggest that the hypothesized changes will be particularly apparent between junior kindergarten (4–5 years) and Grade 1 (6–7 years). This is a time when both categorization and vocabulary skills undergo dramatic changes (Anglin, 1977; Markman, 1989). This period is also important in Piagetian and other theories of cognitive development, in models of self-regulation, and in hypotheses about the maturation of inhibitory mechanisms (e.g., White, 1965).

The present studies measured developmental differences in the comprehension and production of instance and superordinate names across this critical time period. We predicted that superordinate name production would be particularly difficult because of its increased retrieval demands, which would especially challenge young children. Moreover, analyses of errors (e.g., instance name intrusions) and item attribute effects (e.g., name familiarity) in the production tasks of Experiment 2 were expected to provide additional evidence on the developmental role of competition from instance names.

### EXPERIMENT 1: COMPREHENSION

Experiment 1 measured children's comprehension of instance and superordinate names for pictures, which served as a baseline for production (naming) performance in Experiment 2. Junior kindergarten and Grade

1 children simultaneously saw a picture and heard its spoken name (either instance or superordinate) and then indicated whether or not the name was correct for the pictured object. Correct responses and reaction times (RT) were measured. We used relatively familiar instance and superordinate names and hence expected that junior kindergarten and Grade 1 children should both do well on the comprehension tasks, and that differences between instance and superordinate performance should be modest because of weak retrieval demands. In theory, oral presentation of names directly activates the corresponding verbal codes, thereby reducing competition that interferes with retrieval of superordinate names.

### Method

#### *Subjects*

Thirty-two junior kindergarten children (16 girls) from 4 years, 1 month to 5 years, 2 months of age ( $M = 4$  years, 7 months) and 32 Grade 1 children (17 girls) from 6 years, 2 months to 7 years, 2 months of age ( $M = 6$  years, 7 months) participated. English was the primary language for all subjects, who came from a university preschool (6 subjects) or a local public school (58 subjects). Data from one additional Grade 1 subject were replaced due to experimenter error.

#### *Materials*

The stimuli were slides of 96 black-on-white line drawings of 8 single objects from each of 12 common superordinate categories (e.g., animals, clothes, tools, toys). The mean prototypicality rating for the 81 items that appeared in the Uyeda and Mandler (1980) norms was 2.50 on a 7-point scale, with one corresponding to highly prototypical ( $S = .88$ ). Single-exemplar pictures were used in both the instance and superordinate tasks and were chosen primarily from available picture norms (Snodgrass & Vanderwart, 1980; Paivio et al., 1989). The Appendix provides instance names, superordinate names, prototypicality ratings for instance names, children's instance generation ranks from Posnansky (1978), word familiarity ratings, and sources for the stimulus pictures. Practice slides involved two additional exemplars from each of seven superordinate categories not used for target items.

Children's instance generation norms (Posnansky, 1978) or experimenter judgment were used to rank the items from most common (rank of 1) to least common (rank of 8) within each category. One exemplar per category was randomly assigned to each of 8 sets of 12 items such that all item sets had mean generation ranks between 4.0 and 5.0. The order of the sets was randomized using a latin square so that across eight stimulus lists each set of items appeared once in each of eight possible blocks. The order of items within sets was randomly determined and the same for all subjects.

For each of the eight list orders, half of the items were paired with their appropriate instance and superordinate names ("yes" responses), whereas the other half were paired with incorrect instance and superordinate names ("no" responses). Incorrect names were based on 8 random matchings of pictures with incorrect instance and superordinate labels. Mismatched labels came from a different superordinate category and from a different block of 12 items to reduce the proximity of correct labels for mismatched pictures. Each instance name occurred once as a label in a list, and across lists each picture occurred with several different instance and superordinate names. To eliminate runs of more than three matches or mismatches, several items were reordered after the random matching.

For each of the 8 list orders and for each grade, two subjects saw mismatched pictures for half the items and correctly matched pictures for the other half; two other subjects received complementary lists with mismatched and matched pictures switched. One subject from each such pair of subjects was tested first for instance name comprehension; the other subject was tested first for superordinate name comprehension.

### *Procedure*

Each child viewed the list of 96 stimulus pictures twice, once for instance name comprehension and once for superordinate name comprehension. For each item, the experimenter used the paired (correct or incorrect) instance or superordinate name (whichever was appropriate to the task) to complete an orally presented question of the form "Is this \_\_\_\_?". Pronunciation of the name occurred simultaneously with presentation of the picture on a rear projection screen situated approximately 2 feet from the subject. The child judged whether the spoken name matched the picture and was to say "yes" for correct matches and "no" for incorrect matches as quickly as possible. The experimenter advanced the slides with a remote control, and slide changes and naming responses were tape recorded. A short pause between sets of items allowed the experimenter to move the slide tray.

The 14 single-exemplar practice slides were presented in the same order to all subjects. For the first seven items, the experimenter asked a question ("Is this \_\_\_\_?") about each picture's "own" (instance) name and its "group"(superordinate) name, emphasizing that each picture had both types of names. The questions for the final seven practice items involved the same level of name generality as the first comprehension task, either instance or superordinate names. Feedback on the correctness of the "yes" or "no" judgements was given for practice items. The instance or superordinate names of test pictures were never presented during the instructions or the practice trials.

The subject then completed the first comprehension task, as described above. After the first task, the "own" versus "group" name distinction

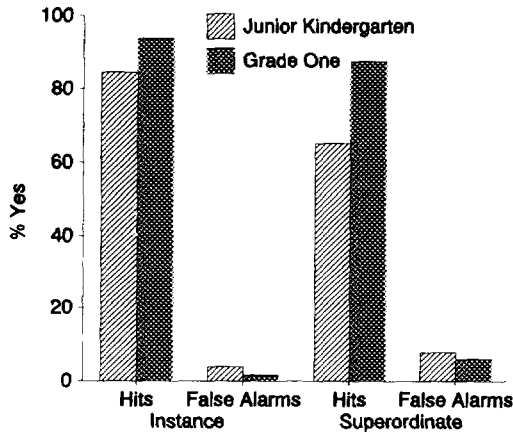


FIG. 1. Percent yes responses on instance and superordinate name comprehension tasks.

was reviewed and the final seven practice pictures were reshown with instance or superordinate name questions, as appropriate for the second task. Feedback was provided during practice and the second comprehension task was then completed.

*Timing and scoring of responses.* The RT for each trial was measured from the tape recordings. The experimenter pressed one key on a computer to start timing when the slide clicked into place and another key to stop timing at the initiation of the subject's response. The computer stored the RT (accurate to 1/60 of a second) for each item. One experienced experimenter timed the responses of all 64 subjects to ensure that similar criteria were used throughout. Verbal responses were scored for the percent of correct picture-name matches that were answered "yes" (hit rate), the percent of incorrect picture-name matches that were answered "yes" (false alarm rate), and an adjusted correct score (hits minus false alarms). No RTs were lost or excessively slow. Mean RTs were calculated for each subject and task separately for hits and correct rejections (i.e., incorrect picture-name matches that were answered "no").

### Results and Discussion

Preliminary analyses indicated no significant main effects or interactions for the order in which tasks were performed, and order was therefore ignored. The children performed well on both comprehension tasks as shown by the hit and false alarm rates presented in Fig. 1. False alarms occurred on only 4.92% of the mismatched trials and did not differ significantly between junior kindergarten and Grade 1 ( $M_s = 5.96$  and  $3.87\%$ ),  $F = 2.37$ ,  $MS_e = 58.63$ ,  $p = .129$  (unless stated otherwise,  $df = 1, 62$  for all  $F_s$ ). False alarms were slightly, but significantly, higher

for the superordinate names ( $M = 7.00\%$ ) than for the instance names ( $M = 2.83\%$ ),  $F = 33.96$ ,  $MS_e = 16.36$ ,  $p < .001$ . There was no interaction between grade and name generality for false alarms,  $F = .07$ . In principle, chance performance on the mismatched items is 50% false "yes" responses, but the junior kindergarten and Grade 1 children were both well below that level and approached the 0% minimum on this measure. Even very young children recognized that incorrect instance and superordinate names were inappropriate. Because of the low false alarm rate and lack of interaction, only analyses of hit rates are reported here. Adjusted scores corrected for false alarms showed identical patterns to those presented below.

Hit rates revealed a high level of performance and varied as a function of name generality, grade, and their interaction. Correct yes responses averaged 82.81%; that is, children failed to recognize correct names on only 17.19% of trials. Scores were higher for instance names than for superordinate names ( $M_s = 89.16\%$  and  $76.45\%$ ),  $F = 124.32$ ,  $MS_e = 41.48$ ,  $p < .001$ , but the difference was a modest 12.71%. Junior kindergarten children obtained lower scores than Grade 1 children ( $M_s = 74.90\%$  and  $90.72\%$ ),  $F = 61.68$ ,  $MS_e = 129.84$ ,  $p < .001$ , and also showed a somewhat greater difference between instance and superordinate performance,  $84.57-65.23\% = 19.34\%$  for junior kindergarten, versus  $93.75-87.70\% = 6.05\%$  for Grade 1,  $F = 34.02$ ,  $p < .001$ , for the interaction. Ceiling effects may have contributed to this interaction inasmuch as the Grade 1 mean for instance names was over 90%.

Traditional analysis of variance measures the absolute differences between instance and superordinate scores. Relative measures are also appropriate, especially when dramatically different levels of performance occur in different conditions. For each child, we calculated superordinate name comprehension as a percentage of instance name comprehension. The mean percent ratio of superordinate to instance comprehension was 76.90% for junior kindergarten and 93.66% for Grade 1. These percentages demonstrate good relative performance at both grades and are compared to analogous statistics for production in Experiment 2.

RTs provided additional data on the ease of instance and superordinate name comprehension. Mean RTs are presented in Table 1 as a function of grade, name generality, and item type (hit or correct rejection). RTs were fast overall, averaging less than 2 s. RTs were faster for instance than superordinate names ( $M_s = 1.59$  and  $1.72$ ),  $F = 12.70$ ,  $MS_e = .09$ ,  $p = .001$ ; slower for junior kindergarten than for Grade 1 ( $M_s = 1.79$  and  $1.53$ ),  $F = 14.72$ ,  $MS_e = .31$ ,  $p < .001$ ; and equivalent for hits and correct rejections ( $M_s = 1.66$  and  $1.66$ ),  $F = .05$ ,  $MS_e = .03$ , ns. A significant three-way interaction involving grade, name generality, and item type,  $F = 6.27$ ,  $MS_e = .02$ ,  $p = .015$ , accounted for several lower-order interactions. The triple interaction occurred because RTs for in-

TABLE 1  
 COMPREHENSION RTs (SECONDS) FOR JUNIOR KINDERGARTEN (JK) AND GRADE 1 (G1) CHILDREN BY NAME GENERALITY AND ITEM TYPE

	Grade	
	JK	G1
Instance name		
Hit	1.68	1.47
Correct rejection	1.72	1.51
Superordinate name		
Hit	1.95	1.53
Correct rejection	1.82	1.59

stance and superordinate names differed more for junior kindergarten hits ( $M$  difference = .27) than for junior kindergarten correct-rejections, Grade 1 hits, and Grade 1 correct-rejections ( $M$  differences = .10, .06, and .08, respectively). Superordinate hits in junior kindergarten were slower than other conditions, which differed from one another by 1/10th of a second or less.

Experiment 1 demonstrated that junior kindergarten and Grade 1 children have moderate to high levels of comprehension for both instance and superordinate names, as measured by picture-name matching. Hit rates were much higher than false-alarm rates for both instance and superordinate names and at both grade levels. Even junior kindergarten children comprehended superordinate names for over 70% of the items for which they understood instance names. RTs averaged under 2 s and also indicated that instance and superordinate name comprehension are both relatively good, although junior kindergarten children were somewhat slower for superordinate name comprehension. This respectable comprehension performance provides a baseline for assessing superordinate name production in Experiment 2.

## EXPERIMENT 2: NAME PRODUCTION

Because name production is hypothesized to involve more demanding retrieval processes than comprehension, differences in performance between instance and superordinate names should be exaggerated in production. The response competition hypothesis also predicted that instance name intrusions would be particularly common errors in the superordinate production task, especially for the younger children (Johnson & Clark, 1988) and especially in cases where instance names were highly familiar. Moreover, the hypothesis that a late-developing mechanism overcomes the greater availability of instance names predicts that superordinate name

production should be especially difficult for junior kindergarten children, even when age differences in comprehension are considered. These predictions were examined in Experiment 2.

## Method

### *Subjects*

Data were collected from 32 junior kindergarten children (19 girls) from 4 years, 5 months to 5 years, 3 months in age ( $M = 4$  years, 11 months) and 32 Grade 1 children (16 girls) from 6 years, 6 months, to 8 years, 0 months in age ( $M = 7$  years, 2 months). Children were recruited from a university preschool (5 subjects), two local public schools (58 subjects), and a colleague with a child in a third public school (1 replacement subject). No subject had participated in Experiment 1. Data for four students who spoke English as a second language were replaced because the omissions in instance naming were excessive relative to other children at their grade level. Data for 4 other subjects were replaced due to equipment problems or experimenter error. Thirty-four primary school teachers rated word and picture attributes for use in item analyses that tested hypotheses concerning competition between instance and superordinate names.

### *Materials and Procedures*

The stimulus pictures, practice items, lists, and presentation apparatus were the same as for the comprehension task in Experiment 1. An additional multiple instance picture was created for each target and practice superordinate category by mounting pictures of two different instances side-by-side on an index card. Four subjects at each age level received each of the 8 stimulus lists. Time constraints prevented presentation of all items twice; hence, two subjects completed instance naming (i.e., "own" name) for the first half of each list and superordinate naming (i.e., "group" name) for the second half; two subjects did the reverse. The orders ensured that every item appeared equally often in both conditions.

The 14 single-exemplar practice slides were presented in the same order to all subjects. For the first four practice items, the experimenter demonstrated that each picture had two names, its "own" name and its "group" name. For the next three practice items, the experimenter also asked the child to produce these names in response to the questions, "What is its own name?" and "What is its group name?" In addition to verbal modeling, the multiple exemplar picture for the appropriate practice category was presented with each practice slide to help the children understand what was meant by "group" names. The final seven practice items depended on whether the child was assigned to do instance or superordinate naming first, as in Experiment 1. During practice, the ex-

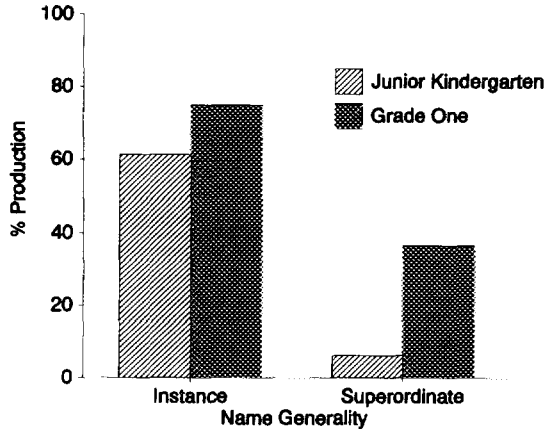


FIG. 2. Percent correct responses on instance and superordinate name production tasks.

perimenter provided feedback on the correctness of responses and tried to ensure that the distinction between "own" and "group" names was understood. Instance and superordinate names of the critical test items were never presented during the instructions or the practice trials.

The subject then completed the first naming task (instance or superordinate naming) for four sets of 12 items each. If necessary, subjects in the superordinate naming task were reminded after the first set of items to "give the picture's group name, not its own name." Subjects were also reminded about the required response ("own" or "group") during slide changes between blocks, but no additional feedback was given.

After the first naming task was completed, the distinction between "own" and "group" names was reviewed, and the subject received seven instance or superordinate naming practice trials, whichever was appropriate to task two. Feedback was provided as in the initial instructions. The second naming task was then presented for the final 48 items.

Following the timed, single-instance naming tasks, the experimenter presented the multiple instance card for each target category and attempted to elicit the superordinate name with a variety of prompts such as "Here are some \_\_\_\_\_," "These are both \_\_\_\_\_," or "Look at these \_\_\_\_\_." Cards were randomly shuffled for each subject and the multiple instance task was not timed.

*Timing and scoring of responses.* The RT for each trial was measured from the tape recordings in the same manner as for Experiment 1. To reduce the influence of extreme values, 120 RTs (1.95%) were truncated at 15 s. Five additional RTs were lost due to equipment problems, and were replaced by the mean truncated RTs for those subjects. Subjects sometimes gave more than one response to a picture, but only the first

response was scored. Each first response was classified as an instance, superordinate, omission, or other response.

*Teacher ratings.* To evaluate competition between instance and superordinate names and to examine a word familiarity explanation for name generality effects, we asked primary school teachers to rate 180 words (the 96 instance names, the 12 superordinate names, and 72 other frequent responses in the naming tasks) on 7-point scales of word familiarity (Cronbach's  $\alpha = .93$ ;  $n = 9$ ) or object familiarity ( $\alpha = .96$ ;  $n = 16$ ). Other raters estimated to the nearest whole year the age at which children could produce or use the words correctly ( $\alpha = .93$ ;  $n = 9$ ). Across 180 items, mean word familiarity correlated .94 with object familiarity, and estimated age of production correlated  $-.90$  and  $-.89$  with word and object familiarity. Given the agreement of these measures, only the results for mean word familiarity are reported.

### Results and Discussion

We first describe the effects of grade and name generality on correct responses, errors, and RTs in the timed naming tasks; where appropriate, comparisons are made to the results from Experiment 1. Supplementary results related to alternative explanations for the findings are then examined.

#### *Analyses of Correct Naming Responses*

Preliminary analyses indicated no significant main effects or interactions for the order in which tasks were performed, and order was thereafter ignored. Unless stated otherwise, the effects involve 1 and 62 degrees of freedom. Mean percentages correct are shown in Fig. 2 as a function of grade and task. As expected, instance naming ( $M = 68.13\%$ ) was much easier than superordinate naming ( $M = 21.39\%$ ),  $F = 479.32$ ,  $MS_e = 145.88$ ,  $p < .001$ , and the absolute difference was quite substantial (46.74%). Grade 1 children ( $M = 55.76\%$ ) gave over 20% more correct responses than did junior kindergarten children ( $M = 33.76\%$ ),  $F = 44.95$ ,  $MS_e = 344.69$ ,  $p < .001$ .

The expected interaction between grade and name generality was significant,  $F = 15.47$ ,  $p < .001$ , reflecting the fact that the difference in correct responding between instance and superordinate naming was greater in junior kindergarten ( $M$  difference =  $61.33 - 6.19 = 55.14\%$ ) than in Grade 1 ( $M$  difference =  $74.94 - 36.59 = 38.35\%$ ),  $F_s = 333.51$  and  $161.27$ , respectively, for the simple effects of task. This interaction is apparent in Fig. 2. Using relative measures of correct superordinate naming as a percentage of correct instance naming, the difference between junior kindergarten ( $M = 9.63\%$ ) and Grade 1 ( $M = 46.53\%$ ) was also highly significant,  $F = 37.54$ ,  $MS_e = 580.09$ ,  $p < .001$ . Junior kinder-

garten children performed only 10% as well on the superordinate production task as on the instance production task.

### *Naming RTs*

In general, analyses of naming RTs paralleled those for the accuracy measures. Individual mean RTs were calculated for correct instance and superordinate naming responses. The few correct superordinate responses resulted in missing means for 7 junior kindergarten children and scores based on very few items for most others. The mean for superordinate naming in junior kindergarten ( $M = 3.34$  s) therefore involves excessive item and subject selection (presumably the easiest items and most advanced children). Because of the questionable status of this cell and missing data, factorial analyses of RTs are not presented.

For Grade 1 children, the mean RT for instance naming ( $M = 1.89$ ) was significantly faster than for superordinate naming ( $M = 3.42$ ),  $F = 88.08$ ,  $MS_e = .43$ ,  $p < .001$ ). The mean difference would have been even larger without differential item selection that favored the superordinate condition. For the 25 junior kindergarten children who had both instance and superordinate RTs, correct instance naming was also faster than correct superordinate naming ( $M_s = 2.00$  and  $3.34$ ),  $F(1, 24) = 24.79$ ,  $MS_e = .90$ ,  $p < .001$ . However, the superordinate naming RTs for junior kindergarten are grossly underestimated and need to be interpreted cautiously. The results agree with adult research showing that superordinate naming is slower than instance naming.

Mean RTs on the instance naming task did not differ significantly for junior kindergarten ( $M = 2.00$ ) and Grade 1 ( $M = 1.89$ ) children,  $F = 1.59$ ,  $MS_e = .13$ ,  $p = .213$ . The latter result suggests that children in both grades performed the instance naming task equally well, but again item selection may mask some difference because Grade 1 children correctly named more items. Overall, the RT data are consistent with the modest differences between grades on the percent correct instance production scores, in contrast to the substantial age effects for superordinate name production.

### *Comparison of Correct Production and Comprehension*

Comparisons of the two studies are complicated by several factors. Correct guessing was possible for comprehension and not production, although false alarm rates were low in Experiment 1. In favor of production, subjects were 5.5 months older than comprehension subjects because of the time of year at which testing was performed, and alternative superordinate names were accepted in production (e.g., "bugs"), whereas only the nominally correct superordinate names were scored correct in comprehension (e.g., "insect"). Production subjects also saw individual items only once for either instance or superordinate naming, which might

be less prone to interference than seeing each item in both instance and superordinate conditions, as was the case for comprehension. Between-experiment comparisons were further complicated by the different overall levels of performance because interactions in traditional analysis of variance are only sensitive to absolute differences between conditions. Ratios of superordinate to instance performance were also compared.

As expected theoretically and on the basis of much previous research, comprehension hit rates were much higher than name production scores ( $M_s = 82.81\%$  vs.  $44.76\%$ ),  $F(1, 124) = 390.60$ ,  $MS_e = 237.27$ ,  $p < .001$ . Of more theoretical interest was the significant interaction between name generality and study,  $F = 198.01$ ,  $MS_e = 93.68$ ,  $p < .001$ , reflecting the fact that the difference between instance and superordinate names was almost three times as high for production ( $68.13-21.39\% = 46.75\%$ ) as for comprehension ( $86.33-69.47\% = 16.86\%$ ).

The interaction between task and name generality was also demonstrated strongly with relative scores; superordinate performance was 85.28% of instance performance for comprehension and only 28.08% for production,  $F = 300.15$ ,  $MS_e = 348.85$ ,  $p < .001$ . These findings are consistent with the hypothesis that production of superordinate names involves additional retrieval mechanisms beyond those required for production of instance names or for comprehension of either instance or superordinate names.

Comparisons between comprehension and production are even more problematic for the RT results than for percent correct. Errors led to more lost RTs in production than in comprehension, especially for junior kindergarten production of superordinates. Production subjects also had to articulate different words on each trial, whereas comprehension subjects said "yes" or "no." With these caveats in mind, mean Grade 1 RTs for instance and superordinate name production were 1.89 and 3.42 (difference of 1.53 s), respectively, versus 1.47 and 1.53 (difference of only .06 s) for comprehension. A similar pattern was observed for junior kindergarten children, who had mean instance and superordinate RTs of 2.00 and 3.34 (difference of 1.34 s) for production, versus 1.68 and 1.95 (difference of only .27 s) for comprehension. Even though RTs for superordinate production are probably low estimates of difficulty, especially for junior kindergarten, the differences between instance and superordinate RTs are considerably larger for production than comprehension.

Theoretically, the production task should have exacerbated retrieval interference more for junior kindergarten than Grade 1 children. For the absolute difference scores, the largest difference between instance and superordinate performance did occur for junior kindergarten children in the production study, but the triple interaction of task, name generality, and grade was not significant,  $F = .53$ . In contrast, the comparable analysis using the ratio of superordinate to instance scores produced a

TABLE 2  
PERCENT CORRECT RESPONSES AND VARIOUS ERRORS ON SUPERORDINATE NAME PRODUCTION TASK

	Junior kindergarten	Grade 1
Correct	6.19	36.59
Errors		
Instance	53.26	29.30
Omission	7.55	4.75
Other	33.01	29.36

significant interaction between grade and task,  $F = 9.30$ ,  $MS_e = 348.85$ ,  $p = .003$ . Ratio measures of superordinate naming difficulty resulted in a larger difference between comprehension and production for junior kindergarten (76.90–9.63% = 67.27%) than for Grade 1 (93.66–46.53% = 47.13). Superordinate name production by junior kindergarten children was exceptionally low relative to their own performance in the other three conditions, and to Grade 1 performance in all four conditions.

#### *Analyses of Errors*

One explanation for the low superordinate production is instance name competition, which should reveal itself as intrusions of instance names. Mean percent instance names, response omissions, and other incorrect responses in the superordinate condition are shown in Table 2. A grade by error-type analysis of variance produced a significant interaction,  $F(2, 124) = 5.88$ ,  $MS_e = 390.64$ ,  $p < .01$ . One-way analyses demonstrated that junior kindergarten children gave more instance responses in superordinate naming ( $M = 53.26\%$ ) than did Grade 1 children ( $M = 29.30\%$ ),  $F = 19.09$ ,  $p < .001$ , but did not produce significantly more incorrect noninstance responses ( $Ms = 33.01\%$  and  $29.36\%$ ),  $F = .55$ ,  $p = .46$ , or omissions ( $Ms = 7.55\%$  and  $4.75\%$ ),  $F = 3.10$ ,  $p = .08$ . In fact, junior kindergarten children gave only 10% fewer instance responses in superordinate naming than in instance naming ( $Ms = 53.26\%$  vs.  $61.33\%$ ), a significant difference,  $F = 5.68$ ,  $p = .023$ , but small relative to the robust difference of over 45% between the instance and superordinate naming tasks for Grade 1 children ( $Ms = 29.30\%$  vs.  $74.94\%$ ),  $F = 69.79$ ,  $p < .001$ .

RTs for instance intrusions in superordinate naming were consistent with the hypothesis that instance names are strongly activated in young children. Instance name intrusions for junior kindergarten were significantly *faster* than for Grade 1 ( $Ms = 2.50$  and  $4.57$  s),  $F = 11.80$ ,  $MS_e = 5.84$ ,  $p = .001$ . Junior kindergarten children actually generated instance names (2.50 s) only a half second slower in superordinate naming than

in instance naming (2.00 s), a modest but significant difference,  $F = 7.25$ ,  $MS_e = .54$ ,  $p = .011$ ). These findings implicate failure to suppress competing instance names in the lower superordinate performance of junior kindergarten children.

The hypothesized negative relation between instance intrusions and superordinate name production was further supported by correlational analyses. In junior kindergarten, superordinate name production correlated negatively with instance intrusions ( $r = -.42$ ,  $p = .008$ , one-tailed), but not with non-instance intrusions ( $r = -.21$ ,  $p = .125$ ) or omissions ( $r = .10$ ,  $p = .292$ ). These correlations need to be interpreted cautiously, however, because of the restricted range in superordinate naming in junior kindergarten and dependencies among the mutually exclusive response types. The dependencies also make it impossible to use partial correlation methods because total errors account completely for correct responses. For Grade 1 children, superordinate naming still correlated most strongly with instance intrusions ( $r = -.71$ ,  $p < .001$ ), but correlations with non-instance responses ( $r = -.29$ ,  $p = .056$ ) and omissions ( $r = -.43$ ,  $p = .007$ ) also approached or reached significance.

To further document the special status of instance intrusions, three analyses of covariance were performed with correct superordinate performance as the dependent variable, grade as the independent variable, and each error type entered alone as a covariate. The sum of squares for grade (junior kindergarten vs. Grade 1) was reduced by 75.32% with instance intrusions as the covariate, but was reduced by only 6.45 and 14.06% with non-instance intrusions or omissions as the covariate.

### *Name Familiarity*

Word familiarity ratings were used to test the prediction that instance name familiarity would be positively related to instance name production and *negatively* related to superordinate name production because familiar instance names should be more difficult to suppress than unfamiliar names. Percent correct scores for items were regressed on teacher ratings of children's familiarity with the instance and superordinate names (see Table 3). Although instance name familiarity was a strong positive predictor of correct instance name production in both junior kindergarten and Grade 1, instance name familiarity also demonstrated the expected negative relationship with superordinate name production. The negative effect was significant in junior kindergarten ( $p = .01$ ) and marginal in Grade 1 ( $p = .10$ ). Superordinate name familiarity correlated positively with superordinate name production for Grade 1 children, but not for junior kindergarten children, and had a weak negative effect on correct instance name production, although the effect approached significance only in junior kindergarten. As predicted, instance name familiarity had negative effects on superordinate name production and junior kindergarten children were

TABLE 3  
 PERCENT CORRECT NAMING SCORES REGRESSED ON INSTANCE AND SUPERORDINATE NAME  
 FAMILIARITY ACROSS THE 96 ITEMS

	$\beta$ ( $p$ ) for name familiarity		$R$	$p$
	Instance	Superordinate		
Instance naming				
Junior kindergarten	.709 (.00)	-.146 (.07)	.681	.000
Grade 1	.742 (.00)	-.064 (.40)	.726	.000
Superordinate naming				
Junior kindergarten	-.285 (.01)	-.037 (.72)	.298	.013
Grade 1	-.173 (.10)	.242 (.02)	.253	.046

somewhat more susceptible than Grade 1 children to competing incorrect names of high familiarity.

#### *Other Factors That Contribute to Category Naming Difficulty*

The preceding findings are consistent with the interference hypothesis, but it is unlikely that the extremely low superordinate naming performance of junior kindergarten children is completely due to retrieval difficulties and interference from instance names. Undoubtedly, many conceptual, linguistic, and other factors contribute to the development and use of knowledge about instance and superordinate names (see Introduction). There are several indications in our own data that other factors contributed to naming success, but also that they failed, individually at least, to account for the extremely low superordinate naming performance observed in junior kindergarten.

One possible contributing factor is that young children do not have the appropriate superordinate names stored in semantic memory. This word failure hypothesis is insufficient to explain the very low superordinate naming performance in junior kindergarten (6.19%). Experiment 1 demonstrated that junior kindergarten children comprehended the superordinate names and their correctness as labels for over 60% of the instance pictures used in Experiment 2, yet superordinate production was only 10% of that level. Moreover, many of the superordinate names were rated as highly familiar to children this age (e.g., animal 6.00, clothes 6.22, toys 6.67), and very familiar names were acceptable alternatives for some categories (e.g., "food" was accepted for both fruits and vegetables). Junior kindergarten children could have scored higher than 6.19% if they

TABLE 4  
WORD FAMILIARITY RATINGS (7 = HIGH) AND PERCENT CORRECT INSTANCE AND SUPERORDINATE NAME PRODUCTION

	Name familiarity	Name production	
		Junior kindergarten	Grade 1
Instance items			
Generation rank			
1	6.01	84.89	91.14
2	5.79	79.17	90.63
3	5.42	70.83	88.02
4	5.07	56.77	76.04
5	4.65	54.69	72.92
6	4.69	55.21	70.83
7	3.91	50.52	64.58
8	3.88	38.54	45.31
Average	4.93	61.33%	74.93%
Superordinate items	4.31	6.18%	36.59%

had responded correctly to all four items in just one of these categories (4/48 = 8.33%).

The familiarity ratings for instance and superordinate names permitted us to examine the word failure hypothesis more closely. The mean rated familiarity for the nominally correct superordinate names was 4.31, which is indeed lower than the average familiarity rating of 4.93 for all instance names. But as shown in Table 4, the mean familiarity of instance names generally declined as a function of instance generation rank (See Method of Experiment 1), and instance name familiarity was rated higher than superordinate name familiarity only for ranks 1 to 6.

The critical finding in Table 4 is that instance names at ranks 7 and 8 were rated as *less* familiar than the superordinate names (i.e., 3.91 and 3.88 versus 4.31), but instance name production for ranks 7 and 8 was still much higher than the average superordinate name production, especially in junior kindergarten (50.52% and 38.54% vs. 6.19%), and less so in Grade 1 (64.58% and 45.31% vs. 36.59%). That junior kindergarten children were five to six times more likely to retrieve less familiar instance names than more familiar superordinate names suggests that the poor superordinate production of junior kindergarten children is due to cognitive demands beyond differential word familiarity.

The multiple exemplar superordinate naming post-test also indicated that children knew more superordinate names than they produced in the single-exemplar task. The mean percent correct on the multiple-exemplar task (based on 12 categories) was 29.69% for junior kindergarten and

66.15% for Grade 1. Both values were higher than the level correct on the timed single-instance, superordinate naming task ( $M_s = 6.19\%$  and  $36.59\%$  for junior kindergarten and Grade 1). Ratios of correct single-instance to multiple-instance superordinate performance (not computable for 7 junior kindergarten children who scored 0 on the multiple task) demonstrated that in the timed task junior kindergarten children retrieved only 28.92% of the names they retrieved in the multiple instance task, whereas Grade 1 children retrieved 49.69%,  $F(1, 55) = 5.69$ ,  $MS_e = 1063.95$ ,  $p = .021$ . Note that multiple-instance performance provides a conservative estimate of superordinate name knowledge, especially for young children, since the task is also susceptible to instance-name interference.

Another factor that might have contributed to the poor superordinate performance of junior kindergarten children is failure to understand the superordinate naming task. Although junior kindergarten children undoubtedly did not understand the superordinate task as well as Grade 1 children, this explanation also seems inadequate to account fully for the very low performance. Experiment 1 demonstrated that both junior kindergarten and Grade 1 children understand that a superordinate name is a legitimate name for a single object. Junior kindergarten children also generally performed appropriately toward the end of the instruction phase of Experiment 2, after receiving corrective feedback on earlier trials. Also, as just noted, junior kindergarten children produced superordinate names for multiple instance pictures at a much higher level than in the single-instance task.

The performance of junior kindergarten children during superordinate name production also suggested that they knew something different was required of them than in instance naming. Although they did not delay instance names as long as Grade 1 children, junior kindergarten children did produce instance names in the superordinate condition more slowly than in the instance condition ( $M_s = 2.50$  and  $2.00$  s). Moreover, the children often indicated superordinate-like processing by: (a) naming a superordinate as a second response; (b) pluralizing the instance names (e.g., saying "apples" instead of "apple"); (c) including relevant phrases or qualifiers (e.g., "a kind of apple", "apple family"); or (d) stating superordinate properties or functions (e.g., "something you eat"). Such superordinate indicators occurred rarely in instance naming (1.63 and .84% for junior kindergarten and Grade 1 children), but were relatively common in superordinate naming (15.10 and 30.60% for junior kindergarten and Grade 1 children).

Poor performance might also result in part from the fact that children performed both instance and superordinate tasks (i.e., a within-subject design was used for the name generality variable). That is, exposure to both conditions could aggravate interference between instance and superordinate names. This hypothesis is weakened by the absence of order

effects in either study, indicating that the first naming task did not interfere with performance on the second task. Moreover, any unmeasured between-task interference that did occur would presumably work against our finding of smaller differences between instance and superordinate performance for comprehension than for production. Comprehension children saw all pictures twice, once in each condition, whereas production children saw individual pictures in either the instance or superordinate condition but not both. Exposure to both names for each picture should, if anything, intensify interference between instance and superordinate names.

In summary, the difficulty of superordinate names relative to instance names was much greater for name production than for name comprehension, and junior kindergarten children had particular difficulty with superordinate naming. Supplementary analyses indicated that ignorance of superordinate names and failure to understand the superordinate naming instructions were not the entire story, although such factors undoubtedly contributed to the observed effects. Nonetheless, it appears that many junior kindergarten children understood the superordinate names and the task, but lacked the retrieval skills or mechanisms necessary to generate correct superordinate names. Various findings indicate that one difficulty was interference from competing instance names.

### GENERAL DISCUSSION

Our results support the following conclusions: (a) production of superordinate names involves additional retrieval mechanisms not involved in the production of instance names and the comprehension of either instance or superordinate names, (b) a limiting factor for retrieval of superordinate names may be interference from instance names that are more available than the correct superordinate names, and (c) the additional retrieval mechanisms involved in superordinate naming are weaker in younger children. These conclusions are compatible with the cognitive model described in the introduction, according to which name production involves spreading activation from an object representation to multiple verbal representations (including instance and superordinate names), and selection of an ultimate response from among competing responses. Variation in the strength of instance and superordinate names and of their referential connections to objects results from parent labelling practices and other developmental or cognitive factors.

#### Instance vs. Superordinate Naming

Both accuracy and speed measures confirmed earlier research showing that superordinate naming is more difficult than instance naming and that production is more demanding than comprehension. The expected interaction between name generality and task was also confirmed, with the

difference between instance and superordinate performance being more pronounced for production than for comprehension. The model that predicted this interaction assumes that developmental factors (e.g., parent labelling practices, basic differences between instance and superordinate concepts, order of word acquisition) result in differential strengths for instance and superordinate name representations and for their connections to object representations. The stronger mental codes and connections for instance names have an advantage over the relatively weak codes and connections for superordinate names, but this advantage is less noticeable in comprehension tasks that directly activate the name codes than in production tasks that require unsupported retrieval of name codes from object codes in semantic memory.

The model led to the related prediction that the generation of correct superordinate names would be hampered by interference from the stronger instance names. Findings consistent with the hypothesized role of instance-name competition included: high levels of instance name intrusions in the superordinate naming task, relatively fast RTs for instance name intrusions in junior kindergarten, a negative relation across subjects between instance intrusions and correct superordinate name performance, and negative correlations across items between instance name familiarity and correct superordinate name production for junior kindergarten children. These effects support the hypothesis that superordinate naming requires retrieval mechanisms to control competing instance names.

One possible retrieval mechanism is suppression of the competing instance names, perhaps in conjunction with extra activation of superordinate name codes. That is, incorrect instance names could be suppressed by some associative mechanism that prevents their being produced as responses under inappropriate circumstances (e.g., multiple instances from a superordinate category, instructions to give "group names"). Such inhibitory mechanisms have been invoked to explain a variety of related cognitive findings, such as inhibition of to-be-ignored stimuli in selective attention (e.g., Dalrymple-Alford & Budayr, 1966; Neill, 1977; Tipper, 1985), and suppression of competing responses in semantic retrieval and number processing tasks (e.g., Campbell & Clark, 1989; Clark, 1992).

### Developmental Changes

Both junior kindergarten and Grade 1 children demonstrated less than perfect performance, especially on the superordinate production task. In unpublished research, adults show virtually perfect performance for both instance and superordinate name production for the same pictures, and we would expect similar perfect performance on comprehension. The production of superordinate names, therefore, appears to constitute a particular difficulty for children. This conclusion also receives support from the fact that the ratio of superordinate to instance name performance

was lower for junior kindergarten in the production task than expected given the main effects of grade and task (comprehension versus production). Junior kindergarten children produced superordinate names for only 9.63% of the objects for which they produced instance names, whereas the corresponding values were 70.55, 46.53, and 88.67% for junior kindergarten comprehension, Grade 1 production, and Grade 1 comprehension, respectively. These results suggest that superordinate name production was particularly difficult for pre-school children.

The effect of age on the critical interaction between name generality and task suggests that developmental factors contribute to whatever retrieval mechanism is required for the accurate production of superordinate names. If the hypothesis that superordinate naming entails suppression of competing instance names is correct, then weak inhibitory mechanisms could explain the observed grade effect and the inferred difference between children and adults. That is, improvements in performance with age may reflect the increased capacity of older children to suppress and hence control competition from inappropriate responses. Differences between children and adults would reflect continued development of these inhibitory competencies. Ricco (1989) has similarly suggested that inhibition of distinct figurative properties of objects may be an important factor in the development of taxonomic thinking.

Although inferential in the present picture naming study, the general hypothesis that inhibitory mechanisms strengthen during childhood is consistent with many findings in diverse areas of developmental psychology (e.g., Bjorkland & Harnishfeger, 1990; Clark, 1991; Clark & Johnson, 1990; Dempster, 1992; Dustman, Emmerson, & Shearer, 1990; White, 1965). Age correlates with changes in the capacity to ignore interfering stimuli in selective attention tasks (Enns & Girgus, 1985; Maccoby & Hagen, 1965; Hale, Taweel, Green, & Flaughner, 1978; Tipper, Bourque, Anderson, & Brehaut, 1989), suppression of conditioned evoked potentials (Freedman, Adler, & Waldo, 1987), delay of gratification (Mischel & Metzner, 1962), impulsivity (Messer, 1976), measures of attention deficit and hyperactivity disorder (Goyette, Conners, & Ulrich, 1978), and the capacity to inhibit motor acts (Bem, 1967; Luria, 1961; Strommen, 1973). The hypothesis of increased inhibition is also consistent with such physiological evidence as a decreased susceptibility to seizures during childhood (Hauser & Hesdorffer, 1990), and with several major theoretical orientations in developmental psychology. Maccoby (1980), for example, describes various ways in which strengthened inhibition contributes to the development of metacognitive control and self-regulation, and such Piagetian constructs as decentration and reversibility implicate suppression of one perceptual or cognitive state for another (e.g., Ricco, 1989).

A second general consideration favoring the inhibition hypothesis is that non-inhibitory mechanisms are deficient by themselves to explain the

capacity to generate superordinate names, given the well-documented availability of instance names. One possible hypothesis, for example, is that mental codes for superordinate aspects of the instructions (e.g., "group name") selectively activate codes for superordinate names, raising their activation levels above the levels for instance name codes. When the superordinate names finally achieve a sufficiently high level of activation, they occur as a response. But this model fails to explain why the instance names are not emitted prior to the superordinate names achieving their critical level of excitation. That is, it would seem that the quickly available instance names would be produced before the superordinate names had time to accumulate sufficient additional activation. The correction for this deficiency in the model is some inhibitory mechanism to postpone output of the instance name, as proposed here.

#### Implications for Other Work

The present paper contributes to the continuing debate over the taxonomic competencies of young children. Nelson and her colleagues (e.g., Lucariello, Kyratzis, & Nelson, 1992) have proposed that taxonomic knowledge in young children is restricted to certain types and that purported demonstrations with toddlers fail to adequately assess vertical taxonomic knowledge using tests of understanding or production of superordinate terms. The late emergence of vertical taxonomic knowledge based on superordinate labels has been challenged by others; for example, Blewitt and Krackow (1992) observed no effect of superordinate label familiarity on several tests of superordinate relations.

Our findings demonstrate that the level of superordinate knowledge shown by young children depends critically on the task used to assess knowledge, with retrieval demands being particularly important. Preschoolers demonstrated extremely low production of superordinate names, but in conjunction with quite high comprehension of the same names. Whether poor production of superordinate names reflects a fundamental limitation in taxonomic thinking of young children will be difficult to determine until we understand more fully the role of interference in masking retrieval of superordinate names and the cognitive mechanisms required to cope with that interference.

In addition to explaining superordinate and instance naming, retrieval processes analogous to those discussed here may shed light on the general superiority of comprehension over production. Presumably, young children have less difficulty with comprehension because direct activation of a specific name code avoids response retrieval demands that may be especially critical for the production of superordinate names, parts (Rochford & Williams, 1962), and other nondominant responses.

Response interference and the hypothesized retrieval mechanisms are also relevant to many normal and dysfunctional naming phenomena. Com-

petition among alternative labels may underlie the negative effects of name uncertainty (i.e., number of different labels for a picture) on correct naming and naming RT, both in children and adults (Johnson, 1992; Johnson & Clark, 1988; Lachman, 1973; Mitchell, 1989; Paivio et al., 1989). These effects of name uncertainty are exaggerated in aphasics (Mills, Knox, Juola, & Salmon, 1979), suggesting that brain insults may selectively injure the capacity to suppress interfering responses. Consistent with this suggestion, inhibitory neurons appear more susceptible to damage from hypoxia than excitatory neurons (Dunwiddie, 1981; Roberts, 1987). Thus, investigation of the role of retrieval mechanisms in child language may enhance our understanding not only of normal development, but also of language dysfunction associated with brain insult and aging (Wolf, 1982).

Although the interference and weak inhibition hypotheses provide a plausible explanation for our developmental findings and those of other researchers, the available findings do not yet compel acceptance of inhibitory mechanisms. Future research must test directly the inhibition hypothesis for superordinate naming, perhaps with methods that have been used to examine developmental changes in inhibitory processes on other tasks (e.g., Tipper et al., 1989).

In conclusion, the present results suggest that special retrieval mechanisms, perhaps involving inhibition of competing instance names, are required for the production of superordinate category names. Developmental changes in the acquisition of skilled superordinate naming reflect the maturation of these underlying retrieval processes and add to the growing number of phenomena that implicate inhibitory mechanisms in semantic retrieval and cognitive development.

## APPENDIX

### Stimuli and Selected Attributes

Superordinate instance <sup>a</sup>	Fam <sup>b</sup>	Prot <sup>c</sup>	Source <sup>d</sup>
Animals	6.00		
Dog	6.78	1.50	S
Horse	6.11	1.94	S
Pig	6.00	3.38	S
Elephant	5.89	3.34	S
Tiger	5.44	2.46	S
Goat	4.22	2.68	S
Camel	3.00	3.66	S
Rhinoceros	2.67	4.12	S
Body (parts)	5.11		
Leg	6.44	1.66	S
Hand	6.78	1.66	S

## APPENDIX—Continued

Superordinate instance <sup>a</sup>	Fam <sup>b</sup>	Prot <sup>c</sup>	Source <sup>d</sup>
Eye	6.56	1.88	S
Nose	6.78	2.12	S
Hair	6.67	3.66	S
Finger	6.56	2.34	S
Brain	3.00	2.90	P
Lips	6.44	— <sup>e</sup>	S
Clothing	6.22		
Pants	5.33	1.20	S
Shirt	5.89	1.36	S
Socks	6.56	2.60	S
Skirt	5.22	1.92	S
Shorts	6.00	2.44	P
Coat	6.44	2.12	S
Tie	4.22	4.14	S
Vest	3.67	3.68	S
Fruit	5.11		
Apple	6.67	1.18	S
Grapes	5.00	2.10	S
Banana	6.22	1.70	S
Pear	4.78	1.64	S
Pineapple	3.22	2.60	S
Lemon	3.89	2.58	S
Watermelon	4.33	3.12	S
Strawberry	5.11	2.02	S
Furniture	4.22		
Chair	6.56	1.24	S
Table	6.22	1.26	S
Bed	6.67	2.04	S
Desk	5.44	1.96	S
Dresser	3.56	2.08	S
Lamp	5.33	2.98	S
Stool	3.56	3.32	S
Cot	2.00	—	P
Insects	3.67		
Fly	5.33	—	S
Bee	5.89	—	S
Ant	5.11	—	P
Butterfly	6.00	—	S
Ladybug	4.56	—	P
Spider	5.89	—	S
Grasshopper	4.11	—	S
Caterpillar	5.11	—	S
Tools	3.56		
Hammer	5.67	1.52	S
Saw	4.67	1.28	S
Screwdriver	3.78	1.98	S

APPENDIX — *Continued*

Superordinate instance <sup>a</sup>	Fam <sup>b</sup>	Prot <sup>c</sup>	Source <sup>d</sup>
Wrench	2.67	4.40	S
Pliers	2.78	3.42	S
Chisel	1.50	3.64	S
Axe	3.89	4.74	S
Paintbrush	6.00	—	P
Toys	6.67		
Doll	6.44	1.46	P
Ball	6.89	1.88	S
Top	4.11	2.04	S
Teddybear	7.00	2.12	O
Rollerskate	4.33	—	S
Block	6.11	2.42	O
Balloon	6.44	3.84	S
Tricycle	5.89	3.10	P
Utensils	2.25		
Pot	4.89	2.18	S
Knife	5.44	1.78	S
Bowl	5.11	3.18	S
Mixer	3.11	2.80	P
Cup	6.00	3.40	S
Toaster	5.44	3.48	S
Rollingpin	2.89	3.00	S
Ladle	2.22	2.80	O
Vegetables	3.56		
Carrot	6.00	1.60	S
Corn	5.22	2.16	S
Potato	5.22	3.06	S
Lettuce	4.56	2.16	S
Celery	4.67	2.38	S
Asparagus	2.00	2.44	S
Onion	4.33	3.36	S
Mushroom	3.11	—	S
Vehicles	2.22		
Car	6.78	1.12	S
Bus	5.78	1.84	S
Train	6.11	3.06	S
Airplane	6.33	3.26	S
Motorcycle	5.67	2.20	S
Helicopter	4.56	4.30	S
Sailboat	5.11	—	P
Stagecoach	2.00	—	P
Instruments	3.11		
Piano	5.22	1.48	S
Drum	5.56	2.74	S
Trumpet	3.56	1.82	S
Violin	3.11	2.02	S

## APPENDIX—Continued

Superordinate instance <sup>a</sup>	Fam <sup>b</sup>	Prot <sup>c</sup>	Source <sup>d</sup>
Flute	2.89	1.68	S
Guitar	4.33	1.54	S
Harp	2.00	3.14	S
Accordion	2.38	3.84	S

<sup>a</sup> Ranked by Posnansky (1978) instance production norms or (when unavailable) experimenter judgement.

<sup>b</sup> Rated word familiarity (7 = highly familiar).

<sup>c</sup> Uyeda and Mandler (1980) prototypicality ratings (1 = highly prototypical).

<sup>d</sup> Picture source (S, Snodgrass & Vanderwart 1980; P, Paivio et al., 1989; O, Other).

<sup>e</sup> Not available.

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RECEIVED: September 18, 1992; REVISED: November 12, 1993