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Children's picture naming difficulty and errors: Effects of age of acquisition, uncertainty, and name generality

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ABSTRACT
On the basis of prior research and a theoretical analysis of picture naming, we examined three correlates of child picture naming difficulty: age of name acquisition, picture-to-name uncertainty, and name generality (instance or category names). Study 1 demonstrated that late age of acquisition and high adult name uncertainty were associated with increased naming difficulty for both single instance and category items from the Expressive One-Word Picture Vocabulary Test (EOWPVT) (Gardner, 1979). Age of acquisition was a particularly strong predictor for instance items. Moreover, category pictures were more difficult to name than single instance pictures with names of comparable age of acquisition. In Study 2, analysis of incorrect responses to category pictures demonstrated that children made more instance errors than adults, but not more errors of other kinds. Study 2 also showed that a child uncertainty measure correlated more strongly with EOWPVT item difficulty than the adult measure of Study 1. The findings suggest that picture naming scores reflect both the availability of the names in lexical memory and their accessibility, which, in turn, partly depend on the amount of interference from competing responses. Some implications for the interpretation and remediation of picture naming deficits are suggested.

Accuracy measures of picture naming competence have been used to identify children with language impairment and/or learning disabilities (Fried-Oken, 1987; German, 1984; Rudel, Denckla, & Broman, 1981; Wiig & Becker-Caplan, 1984), to predict early reading problems (Jansky & DeHirsch, 1972; Wolf, Bally, & Morris, 1986), and to diagnose adults with acquired aphasia (Geschwind, 1967; Kohn & Goodglass, 1985; Newcombe, Oldfield, Ratcliff, & Wingfield, 1971; Rochford, 1971; Williams & Canter, 1982). Improved understanding of the cognitive mechanisms that underlie picture naming would permit more refined interpretation and use of naming test results for children and special populations. The present studies shed some light on those mechanisms by examining the effects of three item attributes on the picture naming accuracy of children.

Picture naming is a complex cognitive operation that can be described in terms of several basic mental structures and processes (Lachman & Lachman, 1980; Paivio, Clark, Digdon, & Bons, in press; Wolf, 1982). Successful picture naming requires first that representations of the pictured object and its name(s) be available and interconnected in permanent memory. These structures do not guarantee successful naming, however, because naming also depends on processes that access the various representations and connections. An initial phase of naming is perceptual processing that activates the representation of the pictured object, which leads in turn to activation of referential connections to one or more corresponding verbal representations (names). Because more than one name can be activated and some candidate names may be inappropriate (e.g., instance names in a category naming task), additional processing may be required to isolate a single name prior to overt responding.

This analysis of picture naming as a complex operation leads one to expect effects of various item attributes on picture naming difficulty. Consistent with this expectation, latency of picture naming correlates with picture or object familiarity (Lachman & Lachman, 1980; Paivio et al., in press; Snodgrass & Vanderwart, 1980); picture-to-name uncertainty (essentially, number of different names for each picture) (Lachman, 1973a, 1973b; Lachman, Schaffer, & Hennrikus, 1974; Paivio et al., in press); word frequency or familiarity (Oldfield & Wingfield, 1964, 1965; Paivio et al., in press; Rochford & Williams, 1965); and age of name acquisition (Carroll & White, 1973a, 1973b; Lachman et al., 1974; Paivio et al., in press). Name generality (cf. Brown, 1958; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976) also affects the ease of picture naming, with basic level or instance names (e.g., *chair*) being emitted faster than superordinate or category names (e.g., *furniture*) (Irwin & Lupker, 1983).

The relevance of these findings to children's picture naming performance is not certain, because few of these correlates of naming difficulty have been investigated at younger age levels. Children are similar to adults in producing high-frequency names more quickly than low-frequency names (Leonard, Nippold, Kail, & Hale, 1983; Milianti & Cullinan, 1974; Rudel, Denckla, Broman, & Hirsch, 1980), but the effects of other item variables on children's picture naming have not been widely studied. In addition, research has not systematically examined whether item attributes that influence latency have similar effects on accuracy scores, a typical measure for picture naming tests used with children. Positive correlations between latency and accuracy have been reported for naming of single stimulus pictures by adults (Goodglass, Theurkauf, & Wingfield, 1984) and for rapid serial naming of familiar pictured objects by dyslexics (Denckla, Rudel, & Broman, 1981). Such findings suggest that latency and accuracy reflect the complexity of similar underlying structures and processes. If this inference is correct, then variables that correlate with latency should also correlate with children's accuracy on picture naming tests. In Study 1, we investigated the effects on children's picture naming accuracy of three variables that affect adult naming latency: age of name acquisition, name uncertainty, and name generality. Study 2 examined further implications of the name uncertainty and generality effects.

STUDY 1

The picture-name pairs for our studies came from the Expressive One-Word Picture Vocabulary Test (EOWPVT; Gardner, 1979), a naming test designed for children 2 to 12 years of age. The 110 EOWPVT pictures are normatively ordered according to increasing naming difficulty, and this difficulty rank was the principal dependent variable. The ranking is based on the responses of 1,249 children to a preliminary version of the test that included the final 110 items. Although not reported for the version of the test used in the present study, the correlation between rank order and actual naming difficulty is .99 for an upper extension of the test designed for older children (Gardner, 1983). We hypothesized that naming difficulty as represented by the ordering of the items resulted from multiple factors, including word knowledge (age of name acquisition), response competition (uncertainty), and generality of the target name (instance or category).

Age of acquisition indicates the relative likelihood that a word will be known by children at certain ages and should be particularly relevant to the naming success of children. We asked adults in Study 1 to rate the age at which they had learned the words that name the pictures of the EOWPVT. Such ratings correlate highly with more objective indices of word availability for children at different ages (Carroll & White, 1973a) and are strong predictors of adult naming latencies (Carroll & White, 1973a, 1973b; Lachman et al., 1974; Paivio et al., in press). Specifically, pictures whose names were learned early in life are named more rapidly than pictures with names that were learned at later ages. We expected that increases in age of word acquisition would also be associated with increases in picture naming difficulty, but naming difficulty and age of acquisition are not redundant measures because other factors, such as uncertainty and name generality, can also affect naming difficulty. One explanation for age of acquisition effects on children's picture naming is differential availability of verbal representations for individual words in lexical memory.

Picture-to-name uncertainty, our second variable, refers to the number of different or competing names available for a picture and also has powerful effects on adult naming latencies (Lachman, 1973a, 1973b; Paivio et al., in press). Low-uncertainty pictures with few names are named faster than high-uncertainty pictures with many names. Relevant to the present study, uncertainty has been implicated in children's picture naming (Denckla & Rudel, 1974; Morin & Forrin, 1965; Rochford & Williams, 1962) and in the picture naming difficulties of aphasics (e.g., Mills, Knox, Juola, & Salmon, 1979; Rochford & Williams, 1962). Uncertainty was operationally defined in our paper as the number of different names (both correct and incorrect) given to each picture by a group of subjects (adults in Study 1 and children in Study 2). Interference among competing verbal representations provides one possible mechanism for the effects of uncertainty on child picture naming accuracy. That is, children may have difficulty inhibiting incorrect responses associated with the picture, or mutual inhibition among competing responses may prevent any name from becoming sufficiently activated to produce a response. That nontarget names often share

semantic or phonological characteristics with the target name is consistent with this hypothesis, but perceptual misidentifications of pictures can also contribute to name uncertainty (cf. Katz, 1986; Wiig & Becker-Caplan, 1984; Wolf & Goodglass, 1986).

The final variable, name generality, concerns the level of abstraction of the correct name for a particular picture. Category names tend to be emitted more slowly than specific instance names (Irwin & Lupker, 1983) and to be used appropriately at a later age (e.g., Anglin, 1977; MacNamara, 1982; Nelson, 1985). Name generality was a dichotomous variable in our study and involved a contrast between single-instance pictures that tend to elicit instance names and multiple-instance pictures that tend to elicit superordinate category names (Wales, Colman, & Pattison, 1983; White, 1982). The EOWPVT contains 86 pictures that depict objects for which instance names are correct. The remaining 24 pictures are category pictures that include several objects from the same category (e.g., car, boat, train) with superordinate names (e.g., vehicles) as the correct responses. We expected that category items would be more difficult to name than single-instance pictures even when equated for age of word acquisition. One mechanism that could contribute to the difficulty of category naming is the need to inhibit the names of the specific instances shown in category pictures.

The major questions examined in Study 1 were: (a) Is picture naming on the EOWPVT more difficult as age of name acquisition, picture-to-name uncertainty, and name generality increase? (b) Do these variables contribute independently to prediction of item difficulty? In particular, are category pictures more difficult to name than single-instance pictures with target names of comparable age of acquisition? (c) Do the variables interact with one another? Specifically, do age of name acquisition and uncertainty show different effects for single-instance and category stimuli?

Method

Subjects. Age of acquisition ratings were obtained from 58 introductory psychology students (30 female), and adult uncertainty measures from 40 introductory psychology students (21 female). Subjects participated for course credit and all spoke English as their first language.

Materials and procedure. The age of acquisition rating booklets contained 300 words, including the 130 acceptable names for the 110 pictures from the EOWPVT (Gardner, 1979). Other items were target words from the Peabody Picture Vocabulary Test–Revised (Dunn & Dunn, 1981) and the Boston Naming Test (Goodglass & Kaplan, 1983). Five random orders were constructed with the restriction that each word appeared once in each of the first through fifth blocks of 60 positions. Twenty-nine subjects (15 females) rated age of acquisition for comprehension (AgeC), while 29 subjects (15 females) rated age of acquisition for production (AgeP). Subjects estimated to the nearest whole year either the age at which they could understand the spoken word but not necessarily produce it (AgeC), or the age at which they could actually use the spoken word (AgeP).

The names for our adult uncertainty measure were obtained from subjects

tested in five small groups of 7 to 9 students each. Transparencies of the 110 pictures from the EOWPVT were shown one at a time with an overhead projector. Each picture remained in view for 20 seconds and subjects wrote the first appropriate, single-word name that came to mind for each picture. Subjects then wrote down any additional appropriate names in the order they occurred. A different random order of the pictures was used for each of the five groups.

Results

Considering only the 110 dominant names for the EOWPVT (i.e., the most frequent response for each picture), mean AgeC and AgeP estimates were highly correlated, $r(df = 108) = .97$, $p < .001$, so they were averaged to determine one mean age of acquisition estimate (AgeA) for each word. AgeA values for the 110 items ranged from 3.41 to 10.62 ($M = 6.07$, $SD = 1.62$). We do not assume that these averages reflect subjects' actual memories of when they learned the words, but simply that subjects could infer reliably the relative age at which words were learned. This assumption was supported by the fact that AgeP estimates exceeded AgeC estimates for 102 of the 110 items (93%) and by the remarkable consistency of the estimates across subjects. Specifically, AgeC and AgeP estimates were highly correlated, both yielded Cronbach's alpha reliability coefficients of .97 (300 items), and our AgeA values correlated well with age of acquisition ratings from Carroll and White (1973a) ($r = .93$, $p < .001$) (55 items), and Paivio et al. (in press) ($r = .96$, $p < .001$) (63 items). Similar reliabilities were observed for the 110 items of the EOWPVT when examined alone.

Our adult picture naming responses yielded two measures of uncertainty for each picture: the number of different names given as first responses and the total number of different names given. Plural and singular forms of the same name were considered equivalent. The number of different first responses given to the EOWPVT items ranged from 1 to 18 ($M = 4.17$, $SD = 2.94$). The total number of different responses for each item ranged from 1 to 25 ($M = 7.99$, $SD = 3.83$). The two uncertainty measures were highly correlated ($r(108) = .85$, $p < .001$) and yielded similar results in subsequent analyses. Therefore, we report only the analyses using the number of different first responses.

The primary purpose of Study 1 was to use age of acquisition, adult uncertainty, and name generality to predict item difficulty. EOWPVT items are ordered from easiest (rank = 1) to most difficult (rank = 110) based on the performance of normative samples of children, and this rank order served as our index of item difficulty. Correlations, means, and standard deviations appear in Table 1. As expected, mean age of name acquisition and adult uncertainty correlated significantly with item difficulty for both single instance and category pictures, and category pictures were significantly more difficult to name ($M = 77.58$) than single instance pictures ($M = 49.34$), $t(108) = 4.11$, $p < .001$. The correlation between AgeA and item difficulty was significantly higher for single instance pictures (.85) than for category pictures (.54) ($z = 2.67$, $p < .05$), accounting for 72% of the total variance in the single instance case and 29% in the category case. The correlations between uncertainty and item difficulty were somewhat

Table 1. *Descriptive statistics and correlations for variables in Study 1*

	AgeA	Adult	*M*	*SD*
Single-instance pictures (86 items)				
Item difficulty	.85**	.36**	49.34	31.76
Age of acquisition		.28*	5.98	1.60
Adult uncertainty			3.66	2.38
Category pictures (24 items)				
Item difficulty	.54*	.52*	77.58	21.04
Age of acquisition		.52*	6.40	1.71
Adult uncertainty			6.00	3.95

*$p < .01$.
**$p < .001$.

higher for category pictures (.52) than for single instance pictures (.36), but not significantly so ($z = .82$, $p > .05$). Mean AgeA was similar for instance and category items (Ms = 5.98 and 6.40), $t(108) = 1.12$, $p > .05$, but adult uncertainty was significantly lower for instance items (Ms = 3.66 and 6.00), $t(108) = 3.63$, $p < .001$.

To determine whether age of acquisition and uncertainty contributed independently to item difficulty for single instance and category items, we regressed naming difficulty on both predictors. A multiple R of .86 accounted for approximately 74% of the variance in single instance naming difficulty. Inclusion of uncertainty increased prediction significantly, $F(1, 83) = 5.01$, $p = .028$, but added only 1.6% to the explained variance. The multiple R for category items was .61, but neither age of acquisition, $F(1, 21) = 3.21$, $p = .088$, nor uncertainty, $F(1, 21) = 2.54$, $p = .126$, made a unique, significant contribution once the other variable had entered the equation.

A multiple regression analysis confirmed that category items were more difficult to name than single instance items of comparable age of acquisition. The three predictors were: name generality (effect coded as -1 for single instance items and 1 for category items), age of acquisition deviation scores (AgeD = AgeA $-$ 6.07, the mean for AgeA), and their interaction (i.e., the product of generality and AgeD). The deviation scores have a mean of zero, which ensures that differences in the intercepts of single instance and category items correspond to differences in naming difficulty for average AgeA items. The main effects of AgeD and generality as well as their interaction, were significant (see Table 2). The interaction between generality and age of acquisition indicates that the slope relating item difficulty to AgeD differed for instance and category pictures. For single instance pictures, the regression equation was: Difficulty = 50.88 + 16.91(AgeD). For category pictures, the equation was: Difficulty = 75.28 + 6.60(AgeD). A unit change in age of acquisition had a significantly greater impact on single instance item difficulty (slope = 16.91) than on category item difficulty (slope = 6.60).

Table 2. *Multiple regression of EOWPVT item difficulty on AgeD, name generality, and their interaction*

Variable	Simple *r*	Beta	R^2	Change	*F*
AgeD	.77	11.76	.59	.59	96.65*
Name generality[a]	.37	12.28	.67	.08	37.38*
AgeD × Name generality	−.55	−5.16	.72	.05	18.60*

[a]Effect coded as −1 = single instance; 1 = category.
*$p < .001$.

The significant main effect for name generality arose from the difference between the intercepts of the two regression equations: 50.88 for single instance items and 75.28 for category items. This finding demonstrates that category items were more difficult than single instance items when compared at the mean age of acquisition (0 AgeD or 6.07 AgeA), that is, when equated statistically for age of acquisition. Given the interaction between name generality and age of acquisition, the difference between the difficulty of category and instance pictures is larger for words rated below average on age of acquisition than for words rated above average.

Discussion

Variables known to correlate with adult picture naming latencies successfully predicted the normative difficulty of children's picture naming on the EOWPVT, although somewhat differently for instance and category pictures. For single instance pictures, the relationship of AgeA to item difficulty was particularly strong. We verified the generality of this effect by correlating AgeA ratings with the naming difficulty (i.e., normative ordering) of the 60 items of the Boston Naming Test ($r = .91$), which contains only single instance pictures. These results suggest that the naming difficulty of single instance pictures may be largely determined by name availability. That is, the later the age at which a word is normally learned, the less likely it is to be available in lexical memory.

The naming difficulty of single instance items also correlated with uncertainty, but in comparison to AgeA, adult uncertainty accounted for relatively little unique variance. This weak effect was somewhat surprising in light of the strength of uncertainty as a predictor of adult picture naming reaction times (e.g., Lachman, 1973b; Lachman et al., 1974; Paivio et al., in press). Naming accuracy for children may be governed by different factors (for example word knowledge) than reaction time for adults. Another possibility, however, is that our adult uncertainty measure does not accurately reflect name uncertainty for children, and therefore underestimated the actual contribution of uncertainty to child naming difficulty. We tested this hypothesis in Study 2.

Category pictures that contained multiple objects were more difficult to name than single instance pictures, even when their target names were comparable in

age of acquisition. Category pictures also differed from single instance pictures in that the relationship between age of acquisition and naming difficulty, although significant, was weaker for category than for instance pictures, and neither age of acquisition nor uncertainty accounted significantly for unique variance in the difficulty of category items. These findings suggest that factors other than word knowledge, as indexed by age of acquisition, play an important role in category naming. One possible factor is failure to inhibit competing responses. Category pictures presumably activate the names of the individual objects as well as the appropriate category name, and such competing instance names may be a strong source of interference. This hypothesis was examined in Study 2.

STUDY 2

Study 2 explored two issues raised by Study 1. One issue concerned the appropriateness of adult measures of name uncertainty, which may not correspond to child uncertainty. Previous research suggests that child picture naming performance only gradually approaches the degree of consensus shown by adults (Butterfield & Butterfield, 1977). Therefore, a measure of uncertainty derived from child naming responses might reveal a stronger relation between uncertainty and EOWPVT item difficulty than was shown by the adult measure. In Study 2, the availability of both adult and child uncertainty measures allowed us to test this hypothesis and also to assess directly the degree of agreement between child and adult uncertainty.

In addition, we analyzed child and adult naming errors for category pictures to test the hypothesis that the greater naming difficulty of category items was due to interference from competing instance names. Naming errors presumably represent candidate names that were activated in addition to or instead of the target name. Although we cannot always be certain at what stage of processing erroneous responses originate (i.e., perceptual misidentification, and so on), category pictures are perhaps less likely to result in perceptual errors because they contain multiple instances. Moreover, if correct identification activates single instance names that provide strong competition for the superordinate label when children name category pictures, then we would expect single instance names to account for a large proportion of children's naming errors for these items. Conversely, if skilled category picture naming entails successful inhibition of strongly activated instance names, then instance names should occur infrequently as errors for adults. Consistent with this analysis of developing skill in category picture naming, Wales et al. (1983) found that two-year-olds used instance names for both category and single instance pictures and that four-year-olds, who occasionally used superordinate names correctly, made predominantly instance name errors for category pictures.

Study 2 examined two questions: (a) Does a measure of child naming uncertainty predict children's picture naming difficulty better than the adult uncertainty measure used in Study 1? (b) When naming errors are made for category

pictures, do children give single instance names proportionately more often than adults do?

Method

Subjects. The child uncertainty measure was based on the EOWPVT responses of 105 subjects, 25 kindergarten children (11 girls) and 80 grade 1 children (41 girls). Their ages ranged from 65 to 96 months ($M = 79.58$, $SD = 6.54$). The error analysis was based on the responses of these 105 children and those of the 40 adults who contributed to the adult uncertainty measure in Study 1.

Procedure. The EOWPVT was originally administered according to the standardized procedure (Gardner, 1979) to 167 English-speaking kindergarten and grade 1 children as part of another investigation (Johnson, 1986). Children were instructed to name each picture and received two practice items. For each item, the examiner recorded the first response or its spontaneous correction. Because children started at items determined by their age (item 40 for most subjects) and testing was discontinued when six consecutive pictures were incorrectly named, subjects saw varying numbers of pictures. To obtain comparable measures across items, we calculated child uncertainty for a core set of 49 items (numbers 40 through 88) that had been seen by all 105 of the subjects described above. Fifteen of these core items were category pictures and 34 were instance pictures. Uncertainty for each item was operationally defined as the number of different naming responses given by the group of children. Children gave more varied responses than adults, so words or phrases differing in only inflection (e.g., singular–plural, verb ending) or order were treated as equivalent responses.

For the error analysis, the naming responses of the 105 children and the 40 adults to the 49 core items were coded as correct or incorrect. It should be noted that, while our subject selection procedure has the advantage of confining the analysis to the responses of the same children for each item, the responses of children in the lower range of performance on the EOWPVT were excluded by this criterion. This exclusion would most likely work against our hypothesis of differences in the nature of child and adult errors, and therefore was considered a conservative approach to the initial problem of unequal numbers of respondents for each picture.

Each error response to the 15 core set EOWPVT category items was classified into one of three mutually exclusive categories: superordinate name, instance name, or other response. Superordinate names were single names or definitions that could collectively apply to all the objects shown in the target category picture, for example, "group" for the picture of children or "things you eat" for food. Instance names were single names (e.g., "girls" for children or "cake" for food) or lists of single names (e.g., "boys and girls" for children or "cake, turkey" for food) that referred to one or more of the objects present in the picture. The category of other responses included any errors that did not fit the definitions for superordinate or instance names, (e.g., "play" for children or "stuffings" for food). Omissions were also classified as other responses. There

Table 3. *Descriptive statistics and correlations for Study 2 variables in core set of 49 EOWPVT items*

	AgeA	Child	Adult	*M*	*SD*
Single-instance pictures (34 items)					
Item difficulty	.63**	.61**	.01	64.21	15.29
Age of acquisition		.52**	.01	6.45	1.13
Child uncertainty			.17	12.15	7.27
Adult uncertainty				3.44	1.86
Category pictures (15 items)					
Item difficulty	.15	.44*	.07	63.53	12.19
Age of acquisition		.28	.24	5.66	1.40
Child uncertainty			.25	10.93	5.56
Adult uncertainty				4.53	2.70

*$p < .05$.
**$p < .001$.

were a total of 175 different error responses and two independent judges agreed on all but 9 items, which were subsequently classified in consultation.

Results and discussion

Child uncertainty and item difficulty. Table 3 presents descriptive statistics and intercorrelations for the core items. As hypothesized, child uncertainty was a better predictor of naming difficulty than was adult uncertainty. For single instance pictures, naming difficulty was more highly correlated with child uncertainty ($r = .61$) than with adult uncertainty ($r = .01$), $t(31) = 3.30, p < .01$, for the difference between the correlations. Multiple regression demonstrated that the percentages of variation in item difficulty predicted uniquely by age of acquisition and child uncertainty were similar, 12.9% and 11.2% respectively. The remaining 26.3% of variation accounted for by the equation ($R = .71$) could not be specifically allocated to either variable. For category pictures, item difficulty again correlated significantly with child uncertainty ($r(13) = .44, p = .05$) and not with adult uncertainty ($r = .07$), but these correlations did not differ significantly, $t(12) = 1.17, p > .05$. The distinct natures of the adult and child uncertainty measures were also shown by their nonsignificant correlations with one another for both instance and category pictures.

These findings indicate that child and adult uncertainty measures are not equivalent, with the former being a better predictor of children's picture naming accuracy, at least for single instance pictures. Moreover, child uncertainty explained variation in instance naming difficulty that could not be accounted for by age of acquisition. The results for category items were weaker, perhaps because of the small number of category items in the core set (15), and therefore require verification with a larger set of pictures.

Some results described in Study 1 were changed in Study 2 because selection

Table 4. *Mean percentage of naming errors on category items*

Error type	Children	Adults
Instance	11.24	1.17
Superordinate	11.49	11.17
Other	3.62	2.33
Total	26.35	14.67

of the 49 core items excluded the more difficult and retained the easier category items, but excluded many easy instance items along with difficult ones. Removing extreme items resulted in lower AgeA values for category items than for single instance items, $t(47) = 2.09$, $p < .05$, and artificially equated the naming difficulty of instance and category items, $t(47) < 1$, $p > .05$.

Naming errors on category pictures. Table 4 shows the mean percentage of the three types of category picture naming errors (instance, superordinate, other) separately for child and adult subjects. The mean total incidence of errors was higher for children (26.35%) than for adults (14.67%), $t(143) = 4.31$, $p < .01$. Consistent with the hypothesis that competition from instance names makes the category items more difficult, the poorer performance by children was due almost entirely to their instance errors. The percentage of instance errors was 11.24% for children (42.9% of errors) and only 1.17% for adults (8.0% of errors), $t(143) = 4.42$, $p < .01$. Children and adults did not differ significantly on the superordinate errors, $t < 1$, or the other errors, $t = 1.56$, $p > .05$.

These results and those of Wales et al. (1983) support the hypothesis that the development of category naming skill involves, at least in part, learning to inhibit instance names so that appropriate superordinate terms emerge. Instance names for one or more of the single objects shown in a category picture are the dominant type of naming error for category pictures at early developmental stages, but decline in favor of superordinate errors (nonstandard names that still apply collectively to all the depicted objects) at later ages. These findings are consistent with the hypothesis that the need to suppress strongly activated instance names contributes to the greater difficulty of EOWPVT category items relative to single instance pictures of comparable age of name acquisition.

GENERAL DISCUSSION

The results suggest that age of name acquisition, uncertainty, and name generality are important determinants of the difficulty of picture naming in children. Although the usual limitations of correlational research apply to the present study, all three variables are amenable to experimental manipulation, which could shed further light on the processes involved in picture naming.

The effect of age of name acquisition was particularly robust for single in-

stance items, although Study 2 showed that age of acquisition and child uncertainty accounted for some of the same variability in naming difficulty. The relation between uncertainty and age of acquisition suggests that children may sometimes generate idiosyncratic responses when they do not know the proper names for pictures. Theoretically, age of acquisition maps directly onto the availability of a relevant word in lexical memory with late age of acquisition words being stored later, perhaps especially by children with limited opportunity or capacity to learn words. Other loci for the effects of age of acquisition are possible, however, and further research is needed. For example, Paivio et al. (in press) found that age of acquisition correlated with such variables as word familiarity, word complexity, picture familiarity, and ease of imagery. These relations suggest that age of acquisition could affect other components of picture naming than response availability, for example, picture encoding. Detailed study of children's naming errors with questioning or comprehension testing on omission trials might make it possible to localize more precisely errors due to these different phases of naming.

The child uncertainty measure predicted the accuracy of children's naming responses more strongly than adult uncertainty, and produced effects more similar to those found for adult naming reaction times. This result has clear methodological implications for investigations of uncertainty effects on children's picture naming and invites further comparisons of developmental changes in picture naming responses. The specific mechanism by which number of different names (i.e., uncertainty) affects picture naming is not known, but one possibility is that competing responses must be inhibited before a correct response can be emitted. The latency and difficulty of this operation would increase with the number of names to be suppressed, consistent with the present findings on children's picture naming difficulties and prior research on naming latency. Whatever mechanism underlies uncertainty effects also appears to be relevant to clinical populations such as aphasics or the learning disabled. For example, Mills et al. (1979) found that mild to moderate aphasics had longer naming reaction times than nonaphasics for high uncertainty pictures but not for low uncertainty pictures.

Category pictures were more difficult to name than single instance pictures even when age of name acquisition was equated, and the naming difficulty of category pictures was less affected by age of acquisition than the difficulty of single instance pictures. The analysis of category naming errors indicated that competing instance names were particularly problematic for children. Multiple instance pictures activate instance names that interfere with the correct category name, perhaps because of an underlying mechanism similar to that proposed for uncertainty effects. That is, successful category naming may depend on inhibition of strongly activated instance names. Additional support for this suggestion comes from an early study on naming parts of objects, which may similarly require suppression of object names. Systematic replication is needed, but Rochford and Williams (1962) reported that naming parts of objects was particularly difficult for children and aphasics. A further developmental implication of our analysis is that children's capacity to suppress competing name responses should increase with age, as does their capacity to inhibit irrelevant events in

selective attention paradigms (e.g., Hale, Taweel, Green, & Flaugher, 1978).

If replicated with other normal and special populations, our findings would have practical implications, including potential improvements in the diagnostic use of picture naming scores. We have suggested that poor performance on picture naming tests may reflect lack of word availability and/or failure to inhibit competing responses. Tests that permit systematic comparisons between naming of instance versus category pictures or low versus high uncertainty items may be especially useful in differentiating word availability and response competition dysfunctions. Existing tests would need to be changed or supplemented to permit such differential assessment, since some tests include only single instance items (e.g., the Boston Naming Test) and test pictures vary in unknown ways with respect to name uncertainty. Until more differentiated tests are available, clinicians might consider such indicators as the specific items that clients make errors on, the incidence of omissions and different kinds of intrusions (e.g., instance names for category pictures), evidence for interference problems on rapid naming tests (e.g., perseverative errors), and even indications of attentional deficits.

Improved differential diagnosis could lead in turn to more appropriate remediation. Children who score poorly on age-appropriate, low uncertainty instance pictures may especially benefit from training in vocabulary and word learning skills (e.g., Fey, 1986; McKeown & Curtis, 1987; Pressley, Johnson, & Symons, 1987). Poor performance on high uncertainty and category pictures may be improved by self-control techniques similar to those that work for children with attentional deficits (e.g., Kneedler & Hallahan, 1984). That is, when failure to inhibit inappropriate responses is a problem, cognitive self-statements that postpone quick responding may improve performance on naming tasks and correlated measures.

In conclusion, naming accuracy in children is responsive to several item attributes that affect picture naming reaction times for adults. The variables of age of acquisition, picture-to-name uncertainty, and name generality suggested different possible mechanisms that can underlie dysfunctional picture naming, specifically word availability and response competition. Further investigations of the determinants of item difficulty on picture naming tests should lead eventually to precise classification of naming failures by children and special populations, and to focussed treatments designed to strengthen the underlying components of proficient picture naming and related cognitive performance.

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