

# Categorization and Naming: Basic-Level Sorting in Eighteen-Month-Olds and Its Relation to Language

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GOPNIK, ALISON, and MELTZOFF, ANDREW N. *Categorization and Naming: Basic-Level Sorting in Eighteen-Month-Olds and Its Relation to Language*. CHILD DEVELOPMENT, 1992, 63, 1091–1103. 2 studies investigate whether 18-month-old children spontaneously sort objects into basic-level categories, and how this ability is related to naming. In Study 1, 18-month-old children were given spontaneous sorting tasks, involving both identical objects and objects with basic-level intracategory variation. Children were scored as having passed the tasks if they produced “exhaustive grouping,” that is, physically grouped all the objects of one kind into one location and the objects of the other kind into a different location. The children also received means-ends and object-permanence tasks. Children’s parents received a checklist of early names. Children who produced exhaustive grouping used significantly more names than those who did not, in both identical and basic-level cases. There was no such relation between object-permanence and naming or between means-ends performance and naming. In Study 2, children received arrays of the same objects, with either identical objects or objects with basic-level variation in each group. No significant differences were found between the identical and basic-level tasks. However, as in the previous task, performance on both types of categorization was related to naming. Children who produced exhaustive grouping were reported to produce more names than those who did not. There appears to be a close relation between object categorization and naming in young children. The theoretical implications of this empirical association are discussed.

These studies address two central questions: (1) What is the nature of the 18-month-old child’s categorization abilities? In particular, will infants of this age spontaneously and actively sort objects into basic-level categories? (2) Is there a relation between such abilities and early language development?

## *The Development of Categorization*

Somewhere between 15 and 21 months of age there are striking changes in the ways that children sort objects into categories (Gopnik & Meltzoff, 1987a, 1987b; Langer, 1982; Nelson, 1973b; Ricciuti, 1965; Starkey, 1981; Sugarman, 1983). In these studies, children have been given mixed arrays of objects and their spontaneous sorting behavior has been observed. For example, a child might be presented with an array of

four identical clay balls and four identical pillboxes. By about 1 year of age children can begin to group objects from a single category, for example, they may place all the balls in a single pile (Ricciuti, 1965; Starkey, 1981; Sugarman, 1983). By 15 months or so they may show what Mandler and Bauer (1988) call “exhaustive serial touching,” that is, they touch all the objects in one category followed by all the objects in the other category (Gopnik & Meltzoff, 1987a; Nelson, 1973b; Ricciuti, 1965; Sugarman, 1983). Only at 18 months, however, do children begin to form multicategory groupings of all the objects in an array. It is only at this point that children will, for example, place all the boxes in one pile and all the balls in the other (Gopnik & Meltzoff, 1987a; Nelson, 1973b; Ricciuti, 1965; Sugarman, 1983). We

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might coin the term "exhaustive grouping" to describe these more sophisticated behaviors. In exhaustive grouping children displace the objects to form separate spatially defined groups, each composed of objects from a different category.

All these studies have presented children with objects that were identical within each category. In contrast, it has long been thought that children would not spontaneously sort objects with within-category variation until later in their development. In the classical "Vygotsky blocks" tasks (Vygotsky, 1962), for example, children were given objects that varied on several different dimensions, such as a set of blocks of different colors, sizes, and shapes. They tended to sort those objects "complexively" rather than sorting them according to properties. They might make a group of a red square block, followed by a red circular block, followed by a blue circular block rather than placing all the square blocks in one pile and the circular blocks in another pile. These tasks, however, require that the children pick out one particular property of objects, among many possible properties, and sort them according to that single property. They test the children's ability to understand the logical relations between objects and object properties.

Neither of these arrays—identical objects nor objects that simultaneously vary on many dimensions—capture the type of categorization that is involved in early naming and that many psychologists believe is cognitively primary. Rosch proposed that human beings naturally categorize objects into what she called "basic-level" categories. The members of such categories are not identical but they do share many similar within-category properties. These shared properties overlap rather little with the properties of the members of other basic-level categories (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976).<sup>1</sup>

There are a few studies of basic-level categorization in infancy using different paradigms. Roberts has shown that by 9 months of age children can recognize a single basic-level category in a habituation paradigm

(Roberts, 1988; Roberts & Horowitz, 1986). Mandler and Bauer (1988) also suggest that, by 18 months, children may exhaustively serially touch objects from two basic-level categories. The first aim of this study was to investigate whether 18-month-old children would spontaneously sort objects into basic-level categories. Would they actually place objects of different types in different locations? In addition, we wanted to explore how this ability was related to the ability to sort identical objects and to other significant cognitive abilities of this period.

#### *Categorization and Naming*

Basic-level categorization is particularly interesting because of its possible relation to naming. One theoretical reason we might expect to find relations between these two areas of development, in particular, is that both basic-level categorization and naming involve similar conceptual domains. There have been few demonstrated relations between general aspects of language, such as the ability to use words or combine them, and general cognitive skills or abilities. There have, however, been a number of studies that demonstrated specific relations between the emergence of words that encode particular types of concepts and problem-solving abilities that require those concepts. For example, there appear to be relations between words like "gone" that encode disappearance and the development of object-permanence abilities. Similarly, there appear to be relations between the development of words for the success and failure of plans, like "there" and "uh-oh," and means-ends abilities (Gopnik & Meltzoff, 1986b). Since names encode basic-level categories, a relation between naming and basic-level sorting would be another instance of such a specific relation.

A second reason for predicting such a relation is that there are significant changes in naming at about the same time as the changes in sorting we have outlined. Between 15 and 21 months, children often develop a marked interest in naming objects. This interest may take the form of a "naming spurt"—a sudden sharp increase in naming (Bates et al., 1979; Bloom, 1973; Corrigan,

<sup>1</sup> We have used the term "basic-level" here to indicate simply categories that have prototype-based within-category variation and are similar to those encoded in early language. Some of these categories might be described as "superordinate" or "subordinate" in the adult system. There is evidence that the child's system may be structured somewhat differently from the adult's in this respect (see Mandler & Bauer, 1988, and Mervis, 1987, on "child-basic" categories). The important contrast here is to sets of identical objects on the one hand and objects that differ on many dimensions on the other.

1978; Goldfield & Reznick, 1990; Gopnik & Meltzoff, 1987a; Halliday, 1975; McShane, 1980; Nelson, 1973a). There is much evidence to suggest that early names, acquired both before and after the naming spurt, encode basic-level, prototype-based categories (Bowerman, 1978; Kuczaj, 1982; Mervis, 1987).

Some investigators have seen the development of early naming and the emergence of the naming spurt as essentially linguistic developments. For these theorists, the naming spurt occurs as a result of a "nominal insight" or a new "referential capacity" or even the activation of a linguistic constraint (Halliday, 1975; Markman, 1989; McShane, 1980). However, we might also think of the use of names as a kind of categorization behavior. A name places some of the objects in the world into a particular group. From this perspective, changes in naming may not be purely linguistic phenomena. Instead, they may also be related to nonlinguistic cognitive developments.

Very young infants, perhaps those as young as 9 months of age, can comprehend names, and so recognize that a name picks out a category of objects (Bates et al., 1979; Benedict, 1979). At least some infants can also spontaneously and actively use a few names to indicate objects in a category at a very early age, approximately 1 year, particularly if that category is salient or significant (Gopnik, 1988; Harris, Barrett, Jones, & Brookes, 1988; Huttenlocher & Smiley, 1987).

At around 18 months, however, many children begin to name many different objects, often, it seems, every object they see, not just salient or significant ones. A sharp increase in vocabulary results. This naming spurt can also be thought of as a kind of categorization behavior. However, it involves a rather different kind of categorization than the categorization involved in the very earliest uses of names. When children comprehend early names and when they produce a few names for salient objects, they seem to use the names to detect or mark single categories. During the naming spurt, children begin to comprehensively assign all the objects they see to different categories by giving them different names. The naming spurt is often described by saying that the child discovers that every object has a name. We might also see it as the discovery that every object belongs in some category.

The idea of a conceptual side to the

naming spurt may be supported by the fact that, as described above, there are similar changes in children's nonlinguistic sorting abilities (Gopnik & Meltzoff, 1987a, 1987b; Nelson, 1973b; Ricciuti, 1965; Sugarman, 1983). These changes take place at about the same time that naming spurts are typically reported. These "exhaustive grouping" behaviors are similar in some respects to the behaviors of the naming spurt. In both cases, children seem intent on sorting collections of objects systematically into several categories, rather than on selecting out a single category. In both, the children spontaneously and actively divide the world into "natural kinds." A number of authors have suggested, on this basis, that there might be a particular relation between increases in naming at 18 months and the development of spontaneous sorting (Gopnik & Meltzoff, 1986a, 1987a, 1987b; Nelson & Lucariello, 1985).

However, there is also an interesting difference between the kind of categorization involved in the cognitive tasks used to date and in early naming. All the previous studies that have measured exhaustive sorting have used objects that were identical within each category, while early names encode categories with basic-level intracategory variation. What remains to be tested is the relation between the naming spurt and the ability to sort objects into basic-level categories.

A third reason for predicting that basic-level sorting might be related to naming is that there are already studies suggesting such relations between other types of sorting behaviors and naming. In a longitudinal study of 12 children, Gopnik and Meltzoff (Gopnik & Meltzoff, 1987a) found a specific empirical relation between the emergence of a naming spurt and the development of spontaneous exhaustive grouping of identical objects. In Gopnik and Meltzoff's study, children developed a naming spurt at the same time or shortly after they first displayed exhaustive grouping. In addition, there were strong correlations between the age at which children showed such behavior and the age at which they developed a naming spurt. Children who developed a spurt early also were likely to develop exhaustive grouping early. Similarly, though with different measures, Lifter and Bloom (1989) discovered a relation between spontaneous classificatory object play and the naming spurt.

Gopnik and Meltzoff's study, like the

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other earlier cognitive studies, used identical objects, rather than objects with intracategory variation. Early words encode basic-level categories, not identical ones, and so *prima facie* we might expect to find close relations between basic-level categorization abilities and the naming spurt. The Gopnik and Meltzoff result might reflect a more general change in sorting that applied to all types of categorization, both basic-level and identical, and this might explain its relation to language. Or it might be that, in fact, only identical sorting was related to naming and basic-level sorting was not. Or perhaps the two types of sorting are related to naming in different ways.

The current studies then were designed to investigate (1) whether 18-month-old children would exhaustively group objects into basic-level categories, (2) how basic-level grouping might be related to identical grouping and to other areas of cognitive development such as object-permanence and means-ends development, (3) whether relations between grouping and naming would emerge when basic-level grouping was used as a measure as well as identical grouping, and (4) whether the Gopnik and Meltzoff (1987a) finding of a relation between identical grouping and naming would be replicated using different materials and a cross-sectional design.

### Study 1

#### METHOD

##### *Subjects*

Subjects were 32 children from the Berkeley area. Subjects included 15 boys and 17 girls. Children came from a variety of socioeconomic and ethnic backgrounds, though most were Caucasian and middle class. At the time of testing, children's ages ranged from 511 days (16.8 months) to 574 days (18.8 months), with a mean of 540.03 days (17.8 months).

##### *Materials*

The materials in the object-permanence and means-ends tasks (see below) included several different-colored cloths and small toys for hiding, a toy turtle tied to a string, a giraffe and a plastic rake, a string of beads and a bottle, and a set of stacking rings with one ring taped over.

In the categorization tasks (see below), the objects in the identical-objects tasks were the same as those employed by Gopnik and Meltzoff (1987a) and were similar

to those used by Ricciuti (1965), Starkey (1981), and Sugarman (1983). In the first task, the objects were four yellow "slabs" (small, flat rectangles) and four small, stylized, Fisher-Price "people." In the second task, the objects were four yellow plasticine balls and four green square pillboxes. In the third task the objects were four Raggedy Andy figures and four small toy trains.

The objects in the basic-level tasks were chosen to be relatively small, to be familiar to the child, and to have salient within-category variation on several dimensions. In the first task, the stimuli were four toy horses, of different breeds, colors, and shapes, and four pencils of different lengths, colors, and shapes. In the second task, the stimuli were four toy cars, again of roughly similar size but different shapes, models, and colors, and four different keychains, each with a differently shaped key. In the third task, children were presented with four finger rings of different colors with different ornaments, and four different rocks—two agates, a quartz, and a tiger's eye—again of different colors and shapes. Objects in both the identical and the basic-level tasks were small enough so that four of them could fit comfortably in an adult's open hand.

##### *Procedure*

*Cognitive testing.*—Children were tested in a small laboratory room. During testing children sat on their parent's lap opposite a small table from the female experimenter. Parents were told to encourage the children to play with the objects but not to tell or show them what to do. A concealed overhead camera videotaped the sessions for subsequent analysis.

Children received six cognitive tasks adapted from the Uzgis and Hunt (1975) scales. These included two object-permanence tasks and four means-ends tasks. The two object-permanence tasks were: finding a simply invisibly displaced object (Task 13) and finding a serially invisibly displaced object (Task 14). The four means-ends tasks were: using a string to obtain an object, using a stick to obtain an object, placing a necklace in a bottle, and avoiding placing a solid ring on a post (Tasks 9–12). These same tasks were used in earlier studies relating infant cognitive and linguistic behavior (Gopnik & Meltzoff, 1986b, 1987a). Children also received six categorization tasks, three using sets of objects with basic-level variation and three using sets of identical objects (see above). All the tasks were pre-



sented in a different randomly determined order within each session, with the proviso that children never received two categorization tasks in a row to alleviate boredom. In pilot testing, children who received two categorization tasks in a row often became bored and ceased manipulating the objects.

Pilot testing also indicated that children of this age were unable to complete all six categorization tasks and the six other cognitive tasks in a single testing session; the session was simply too long. Therefore, the cognitive tasks were administered in two separate sessions, approximately 1 week apart. Children received all the object-permanence and means-ends tasks in each session. The three identical categorization tasks were administered in one session, and the three basic categorization tasks in the other session. Half the children received the basic-level tasks in the first session and half received the identical tasks. Two children completed only the basic-level session and one completed only the identical session. Data from these children were used only for the tasks they completed.

The procedure in all six categorization tasks was identical. The experimenter presented the eight to-be-sorted objects in a random array on the table. In Gopnik and Meltzoff (1987a), 15–21-month-old children often spontaneously sorted the objects into the experimenter's hands, and so the experimenter sat with both hands palm up on the table equidistant from the child. If children threw the objects off the table they were returned to it. Both the experimenter and the parent encouraged the children to handle the objects in general terms, but no specific prompts were given. Objects were presented for 3 min and then removed.

*Language testing.*—Approximately 1 week before they arrived in the laboratory, parents were sent a questionnaire including a copy of a portion of the MacArthur Communicative Development Inventory (MCDI) (Toddler Version). This is a checklist of 615 words commonly found in children's early vocabularies (Bates, Bretherton, & Snyder, 1987; Bretherton, McNew, Snyder, & Bates, 1983). This checklist has been found to be a

reliable indicator of children's vocabularies (Dale, Bates, Reznick, & Morisset, 1989). Parents were sent all the object names on the MCDI list, 364 words in all, and were asked to check off the words their child used spontaneously. Usually mothers filled in the form, though sometimes they enlisted the assistance of fathers, caregivers, and others familiar with the child's language. On the first visit to the laboratory, parents handed in the questionnaire to a trained language interviewer. She ensured that the parents understood the directions and discussed any questions or problems. There were few changes. At the end of the second session parents checked the questionnaire and added any additional names that had emerged in the intervening week.

*Cognitive scoring.*—The cognitive tasks were videotaped and were scored from the tapes by an observer who was blind to the children's language status. The scoring criteria for the object-permanence and means-ends tasks were taken directly from previous research using the Uzgis and Hunt scales. (For more details on administration and scoring, see Gopnik & Meltzoff, 1986b; Uzgis & Hunt, 1975.) As in previous studies, children were counted as having attained the highest level of ability in these areas if they solved the most difficult serial invisible displacement task (Task 14) or if they solved any one of the three most difficult means-ends tasks using insight (Tasks 10–12). In earlier studies, children's abilities in these areas, determined by these same criteria, had been related to other language developments (Gopnik & Meltzoff, 1984, 1986a, 1986b; Tomasello & Farrar, 1984, 1986).

The scorer determined three levels of categorization behavior: single category sorting, exhaustive serial touching, and exhaustive grouping. (These levels roughly correspond to categorization levels 1, 2, and 3 in Gopnik & Meltzoff, 1987a.) Scoring procedures were similar to those used in Gopnik and Meltzoff (1987a), Mandler and Bauer (1988), Ricciuti (1965), Starkey (1981), and Sugarman (1983). However, for purposes of the present study we restricted our analysis to level 3 categorization, exhaustive grouping.<sup>2</sup> Exhaustive grouping was scored if the

<sup>2</sup> Eighteen of the children produced single-category sorting of the basic-level objects, and 21 produced exhaustive serial touching. Twenty-four children produced single-category sorting of identical objects, and 24 produced exhaustive serial touching. There were no significant relations between these behaviors and the number of names. However, assessing the relation between these behaviors and language is rather difficult. In particular, many children produced these behaviors in the course of producing exhaustive groupings. Eliminating these children left

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children systematically placed the objects of different kinds into physically distinct locations. Typically, doing this involved making two separate piles on the table, or placing all the objects of one kind into one of the experimenter's hands and all the objects of another kind into the other. However, children also sometimes placed objects in their mother's hands, and sometimes used a mixture of hands and locations on the table. Children were scored as having achieved the appropriate level if they displayed the behavior on any one of the three sorting tasks.

In most cases of exhaustive grouping, children sorted all eight objects. However, a few children (five in the identical condition and two in the basic-level condition) produced groupings of three objects in one category and four in the other. Some earlier cross-sectional studies (Nelson, 1973b; Ricciuti, 1965; Sugarman, 1983) specified these sortings as a slightly lower level of classification than four and four sortings, but still higher than single-category sorting. Others, particularly both Mandler and Bauer (1988) and Starkey (1981), include such behaviors in their highest category. Thus Mandler and Bauer (1988) described behaviors as "exhaustive" when they included four touches followed by three. Since the current study required a single criterion for "exhaustive grouping," we followed the example of these investigators and credited these children with exhaustive grouping.

*Language scoring.*—The number of names listed in the MCDI checklist was recorded. Possible values ranged from 0 to 364.

*Data reduction.*—Since there was a gap between the two testing sessions, some children scored differently on the object-permanence and means-ends tasks in the two sessions. However, as we might expect with such a small interval, there was not a substantial difference between performance on one task and the other. Sixteen children attained the highest level on means-ends tasks in the "basic-level" session, while 15 attained this level in the "identical" session; similarly, 17 children attained the highest level on object-permanence in the "basic-level" session, while 13 attained this level

in the "identical" session. Moreover, some parents reported a small increase in words in the second testing session. For the purposes of analysis, therefore, the relevant statistical comparisons were calculated within a test session so that even these small developmental changes were controlled for. Object-permanence, means-ends, and language scores in the basic-level session were compared to basic-level categorization scores, while object-permanence, means-ends, and language scores in the identical sessions were compared to the identical-object categorization scores.

*Reliability.*—The cognitive performance of eight randomly selected subjects (25% of the sample) was scored by an additional observer. There was high intercoder agreement on all measures. For the basic-level sessions, there were no disagreements between the two observers: there was agreement on the child's cognitive level (that is, solving or not solving task 14) in eight of the eight cases for object-permanence, agreement on whether or not the child had attained the highest level of means-ends development in eight of the eight cases, and agreement on whether or not the child had achieved exhaustive grouping in eight of the eight cases for categorization. For the identical sessions, there was agreement on the child's cognitive level in eight of the eight cases for object-permanence, agreement in seven of the eight cases for means-ends, and agreement in seven of the eight cases for identical categorization. Overall, observers agreed on 46 out of 48 judgments, or 95%. In all cases the primary coder's scoring was used.

## RESULTS AND DISCUSSION

### *Cognitive Measures*

*Relations to age, order, and gender.*—Children in the study were chosen to be very similar in age, with a mean of about 18 months old, and a range of 2 months. In fact, there were no significant effects of age on any of the cognitive or linguistic measures (object-permanence, means-ends, and categorization performance, and number of names). Children who solved the tasks were no older than those who did not, and there was no significant correlation between age

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too few children to make statistically significant comparisons. Moreover, there may have been ceiling effects involved, particularly for the children in the identical tasks. Thus it would be difficult to draw conclusions about the relations of these abilities to language, one way or another, from the current study.

and number of names. There were also no significant effects of order, that is, whether the basic-level or identical stimuli were presented in the first session, or gender, on any of the dependent variables.

*Relations between categorization, object-permanence, and means-ends abilities.*—The percentage of children passing the identical-object exhaustive grouping task, means-ends task, and object-permanence task was quite similar. Approximately half the children in the group passed each task (53%, 56%, and 50% of children passing for exhaustive grouping, object-permanence, and means-ends, respectively [ $N = 30$ ]). However, as in the Gopnik and Meltzoff (1987a) longitudinal study, there was no evidence of a consistent relation between performance on the sorting task and the other two cognitive measures. Individual children could do very well on one task and poorly on another. The degree of association between each individual child's performance on these tasks can be measured using the phi coefficient, which provides a measure of the extent of association between two sets of attributes when each is measured using a dichotomous ("yes/no") scale (Siegel & Castellan, 1988). (Since maximum possible values for phi may vary depending on the total  $N$  in the table and the marginal totals, we will report both actual values and maximum possible values for each test.) The phi statistic reveals virtually no association between individual children's performance on object-permanence and identical-object exhaustive grouping ( $\phi = .14$ ,  $p > .50$  by Fisher's exact test, maximum  $\phi = .99$ ). Similarly, there was no correlation between means-ends performance and identical-ob-

ject exhaustive grouping ( $\phi = .13$ ,  $p > .50$  by Fisher's exact test, maximum  $\phi = 1.00$ ).

On average, fewer children passed the basic-level task than the object-permanence and means-ends tasks (29% of 31 children passing vs. 42% passing for object-permanence, and 52% passing for means-ends). Again, however, within individual children, there was no correlation between performance of basic-level exhaustive grouping and the object-permanence and means-ends abilities (both  $\phi$ 's  $< .05$ ,  $p$ 's  $> .50$ , maximum  $\phi$ 's = .92, .62, respectively) (see Table 1).

*Relations between identical-object and basic-level categorization.*—In contrast, there was some indication that performance on the basic-level and identical-object exhaustive grouping tasks was correlated for individual children: Children who demonstrated basic-level exhaustive grouping were also likely to demonstrate identical exhaustive grouping ( $\phi = .40$ ,  $p < .05$  by Fisher's exact test, maximum  $\phi = .89$ ). In this study, children consistently performed worse on the basic-level task than on the identical one. Of the 29 children who received both tasks, nine passed the identical task but not the basic-level task, while only one showed the reverse pattern ( $p < .05$  by McNemar's test for the significance of changes) (see Table 1). However, this finding was hard to interpret given the differences in the materials used in the two tasks. It might be either that basic-level arrays are intrinsically more difficult to sort or simply that the materials in the basic-level tasks prompted less sorting. This point is systematically tested in Study 2.

TABLE 1  
STUDY 1: RELATIONS BETWEEN PERFORMANCE ON DIFFERENT COGNITIVE MEASURES

COGNITIVE TASK	IDENTICAL CATEGORIZATION			BASIC-LEVEL CATEGORIZATION		
	No	Yes	Phi	No	Yes	Phi
Object-permanence:						
No .....	5	8		13	5	
Yes .....	9	8	.14	9	4	.03
Means-ends:						
No .....	8	7		11	4	
Yes .....	6	9	.13	11	5	.05
Identical categorization:						
No .....				12	1	
Yes .....				9	7	.40*

\*  $p < .05$ .

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### Language Measures

There was a very wide variation in the number of names recorded by the parents on checklists (range = 5–238, median = 48, mean = 59.5). The children were fairly evenly distributed across the range between five and 120 names, but there were no children in the 120–200-name range, and two children had over 200 names.

### Relations between Cognitive and Linguistic Measures

We investigated the relation between children's cognitive performance and the number of names they used. We assessed the relation between naming and object-permanence, between naming and means-ends performance, and between naming and categorization behavior. One-tailed Mann-Whitney *U* tests were used throughout to test the hypothesis that children who solved the cognitive tasks would produce more names. We also report Glass rank-biserial correlations (indicated by  $r_g$  values), which give some idea of the magnitude of the association.

The analyses yielded no relations between object-permanence and means-ends abilities and the number of names children produced. Children who passed these tasks used no more names than those who did not. No measure approached significance. However, both basic-level and identical-object exhaustive grouping were related to naming. There were 17 children who produced exhaustive grouping in either the basic-level or identical testing session, and these children produced more names than the 12 children who did not produce any exhaustive grouping (for purposes of this analysis we used the maximum number of names reported) (median names of children with ex-

haustive grouping = 55, range = 6–262; median names of children without exhaustive grouping = 26, range = 4–69,  $z = 1.88$ ,  $p < .05$  by Mann-Whitney *U* test,  $r_g = .41$ ). This pattern also held for each individual type of sorting; children who produced exhaustive grouping produced significantly more names than those who did not (for the identical sessions,  $z = -1.76$ ,  $p < .05$ ,  $r_g = .37$ ; for the basic-level sessions,  $z = -1.79$ ,  $p < .05$  by Mann-Whitney *U* tests,  $r_g = .41$ ) (see Table 2).

Five of the six objects used in the basic-level test ("horse," "pencil," "car," "key," and "rock") appeared on the MCDI naming checklist, and so it was possible to examine the relation between children's knowledge of the individual names of the objects and their sorting of those objects. There was no such relation. Individual children who knew the name of a particular category were no more likely to sort objects into that category than those who did not. There was also no relation between the children's use of names during the session and their performance on the cognitive measures. The linguistic developments that were related to cognition appeared to involve the children's general naming ability rather than their ability to use some particular name. This is consistent with earlier findings (Nelson, 1973b; Sugarman, 1983).

### Study 2

In the first study, basic-level categorization appeared to be more difficult than identical-object categorization. This may, however, have been due to the difference in the materials employed in the two tasks. Previous studies have suggested that children are more likely to sort some types

TABLE 2

STUDY 1: MEDIAN NUMBER (and Ranges) OF NAMES PRODUCED BY CHILDREN WHO DID AND DID NOT DISPLAY COGNITIVE ABILITIES

	Object-Permanence	Means-Ends	Exhaustive Grouping
Identical sessions ( $N = 30$ ):			
No .....	49 (8–262)	44 (8–119)	34 (4–82)
Yes .....	47 (4–204)	49 (4–204)	57* (6–262)
Basic-level sessions ( $N = 31$ ):			
No .....	45 (8–230)	43 (4–126)	40 (4–129)
Yes .....	29 (4–220)	55 (6–220)	55* (28–230)

\*  $p < .05$  by Mann-Whitney *U* test.



of materials than others (Ricciuti, 1965; Starkey, 1981), and we have also found in our own pilot studies that some materials prompt relatively little sorting. It was possible that the sorts of stimuli used in the basic-level task, essentially natural objects, prompted less sorting than the simpler and more geometric objects used in the identical task. In Study 2, we controlled for this difference in materials by presenting the children with the same objects in basic-level and identical arrays. This also allowed us another test of the hypothesis that there was a relation between identical categorization and naming, using a new set of materials. Moreover, in the present study, children received both basic-level and identical categorization tasks in the same session.

#### METHOD

##### *Subjects*

Subjects were 32 children from the Berkeley area, 17 boys and 15 girls. The age range was even narrower than in the first study, with ages ranging from 529 days (17.39 months) to 570 days (18.74 months), with a mean of 550.47 days (18.10 months).

##### *Materials*

Materials were the same as those used in the first study for the means-ends tasks. In three of the four basic-level categorization tasks, the materials were the same as those in the Study 1 basic-level tasks; that is, there were arrays of four different horses with four different pencils, four different cars with four different keys, and four different rocks with four different rings. In addition, one extra set of materials was used to make an additional task. This fourth task presented an array of four measuring spoons of different sizes and materials and four plastic bracelets of different sizes, shapes, and colors.

In this study, for the identical tasks the objects in each category were four identical instances of one member of the basic-level group. Thus children were presented with an array of four identical instances of one of the horses in the basic-level array, combined with four identical instances of one of the pencils. Similarly, the other tasks involved arrays of four identical cars and four identical keys, four identical rocks and four identical rings, or four identical measuring spoons and four identical bracelets.

##### *Procedure*

Children were tested in a single session. During the session, children received four categorization tasks, two basic-level and two

identical. Each child received four different sets of materials to avoid any training or boredom effects; that is, a given child did not receive both basic-level and identical arrays of the same objects. However, the different materials were counterbalanced across children. Half the children received the rocks/rings and spoons/bracelets in identical arrays and the horses/pencils and cars/keys in basic-level arrays, and the other half received the rocks/rings and spoons/bracelets in basic-level arrays and the horses/pencils and cars/keys in identical arrays.

The children also received the means-ends tasks in Study 1, interspersed between the categorization tasks. Administering these tasks allowed us to test for effects of general cognitive development (see below) and to prevent boredom. The order of administration of the different tasks within each group (the four categorization tasks and the four means-ends tasks) was randomly determined on each trial. Pilot testing indicated that children had difficulty maintaining attention across four categorization tasks and six other cognitive tasks, and therefore no object-permanence tasks were administered. In other respects the procedure was identical to Study 1.

Language testing and scoring were carried out in the same way as in Study 1.

##### *Reliability*

The records of eight randomly chosen children (25% of the sample) were rescored by a second scorer who was uninformed about the children's language. Interscorer agreement was high on all measures. The second observer assigned the same overall means/ends score in eight of the eight cases, and she assigned the same overall basic-level categorization score in eight of the eight cases. She assigned the same identical categorization score in seven of the eight cases. Overall, out of 24 judgments there were 23 agreements (95%). In all cases the primary scorer's coding was used.

#### RESULTS AND DISCUSSION

There were no significant effects of test materials (that is, which set of objects was identical and which was basic), age, or gender on any of the dependent variables (categorization, means-ends performance, or number of names). By contrast with Study 1, there was also no significant difference between performance on basic-level and identical arrays. Eight of the children sorted the

identical array and seven sorted the basic-level array. The absolute levels of performance (7–8 children passing) were roughly similar to those on the means-ends task—12 children also passed the means-ends task. However, as before there was no evidence of an association between performance on the categorization tasks and the means-ends task ( $\phi = .00$  and  $.10$  for identical and basic-level categorization, respectively,  $p > .50$  by Fisher's exact test in both cases, maximum  $\phi$ 's =  $.89$  and  $.85$ ). Children could do well on each of the categorization tasks and poorly on the means-ends tasks and vice versa. There was, however, evidence for an association between the two types of categorization ( $\phi = .39$ ,  $p < .05$  by Fisher's exact test, maximum  $\phi = .95$ ). Children who did well or badly on the identical-object categorization task also tended to do well or badly on the basic-level task (see Table 3). We calculated an additional measure of categorization by examining whether individual children passed *either* the basic-level or identical categorization tasks. There was also no relation between the ability to exhaustively group either array and means-ends ability ( $\phi = .02$ ,  $p > .50$  by Fisher's exact test, maximum  $\phi = .91$ ).

The range of responses on the MCDI was similar to that in Study 1, though the median was somewhat lower (range = 1–261, median = 29, mean = 51). In this study, as in Study 1, there was a specific relation between naming and exhaustive grouping. The 11 children who produced exhaustive grouping of either identical or basic-level arrays used significantly more names (median = 54, range = 6–261) than the 21 who did not (median = 25, range = 1–181,  $z = 1.97$ ,  $p < .025$  by Mann-Whitney  $U$  test,  $r_g = .43$ ). Again, as in the earlier

study there was also evidence suggesting a relation between naming and each categorization task (identical or basic-level) taken individually. Children who produced identical exhaustive grouping, even with these new materials, continued to use more names than children who did not ( $z = -2.05$ ,  $p < .025$  by Mann-Whitney  $U$  test,  $r_g = .49$ ). There was also weaker evidence suggesting a trend toward a relation between basic-level exhaustive grouping and naming ( $z = -1.35$ ,  $p < .10$  by Mann-Whitney  $U$  test,  $r_g = .34$ ). There was no evidence of any such relation between means-ends performance and naming ( $z = -0.21$ ,  $p = .42$  by Mann-Whitney  $U$  test,  $r_g = .04$ ) (see Table 4).

### General Discussion

The results of these studies show that some 18-month-old infants will spontaneously and exhaustively group objects with basic-level intracategory variation, as well as grouping identical objects. However, there may be considerable independence between both identical-object and basic-level exhaustive grouping and other significant cognitive abilities, in particular, object-permanence and means-ends abilities. These cognitive abilities are not correlated with each other within individual children; they do not emerge en bloc. Individual children may do well on categorization and poorly on these other tasks and vice versa. There is, however, evidence for a relation between identical and basic-level exhaustive grouping. Children who do well on one categorization task are likely to do well on the other. In the first study, it appeared that basic-level exhaustive grouping might be more difficult than identical exhaustive grouping. However, in Study 2, where differences in materials were controlled for, the overall levels

TABLE 3  
STUDY 2: RELATIONS BETWEEN PERFORMANCE ON DIFFERENT COGNITIVE MEASURES

COGNITIVE TASK	IDENTICAL CATEGORIZATION			BASIC-LEVEL CATEGORIZATION		
	No	Yes	Phi	No	Yes	Phi
Means-ends:						
No .....	15	5		15	5	
Yes .....	9	3	.00	10	2	.10
Identical categorization:						
No .....				21	3	
Yes .....				4	4	.39*

\*  $p < .05$ .

TABLE 4

STUDY 2: MEDIAN NUMBER (and Ranges) OF NAMES PRODUCED BY CHILDREN WHO DID AND DID NOT DISPLAY COGNITIVE ABILITIES ( $N = 32$ )

	Means-Ends	Identical Exhaustive Grouping	Basic-Level Exhaustive Grouping
No:			
Median .....	29 (4-261)	25.5 (1-181)	26 (1-261)
Yes:			
Median .....	30 (1-181)	63* (6-261)	54* (17-91)

\*  $p < .10$  by Mann-Whitney  $U$  test.

\*  $p < .05$  by Mann-Whitney  $U$  test.

of exhaustive grouping of the two types of arrays were almost identical. This may suggest that there is a single developmental shift from single-category to exhaustive sorting that affects both identical and basic-level categorization equally.

There does appear to be a relation between nonlinguistic exhaustive grouping behaviors and the development of naming. Children who produce such behaviors, both with identical objects and with objects with basic-level intracategory variation, are likely to have more names than those who do not. In particular, the current studies replicate the earlier Gopnik and Meltzoff (1987a) finding of a relation between identical-object exhaustive grouping and increases in naming. The present studies, however, involved a larger  $N$  and a cross-sectional rather than longitudinal design. The cross-sectional design also rules out practice and training effects that might influence a longitudinal study. This convergence of results from two cross-sectional studies and a fine-grained tri-weekly longitudinal study provides strong evidence that these two achievements are linked. Moreover, the current investigation used a different measure of naming, the MCDI, and, in Study 2, used sorting materials different from those in Gopnik and Meltzoff (1987a). The relation between identical-object sorting and naming thus appears to be a rather robust one. The current studies also tested for and found evidence suggesting a new relation between basic-level categorization and naming. Moreover, there appeared to be a relation between the more general ability to exhaustively group either type of array and naming. We would hypothesize, then, that there is a general shift from single-category to exhaustive grouping, applicable to either basic-level or identical cat-

egories, that is related to the emergence of the naming spurt and the increase in naming that results.

Importantly, this relation does not merely reflect a more general relation between cognitive ability and linguistic ability. If it did, we would expect that other cognitive measures should also be related to naming. In fact, in the current Study 1, both object-permanence and means-ends development were *not* related to naming. In Study 2, where only means-ends tasks were administered, they also were not related to naming. This is in spite of the fact that children's overall level of performance on these tasks, on average, was similar to their overall level of performance on the sorting tasks. Moreover, these same cognitive measures have been shown to be related to other aspects of early semantic development, in particular, the development of relational words (Corrigan, 1978; Gopnik & Meltzoff, 1984, 1986b; Tomasello & Farrar, 1984, 1986).

There is one interesting divergence between Gopnik and Meltzoff (1987a) and the current study, however. Gopnik and Meltzoff (1987a) found a relation between object-permanence and naming, and both Corrigan (1978) and Lifter and Bloom (1989) reported evidence of such a relation. Lifter and Bloom (1989) also report a relation between spontaneous hiding and finding play and the vocabulary spurt. However, no such relation emerged in the current study. Gopnik and Meltzoff (1987a) suggest that both object-permanence abilities and classification abilities may call on the same sorts of object-based knowledge, in contradistinction to the action-based knowledge involved in means-ends abilities. While this is possi-

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ble, there is no evidence supporting this hypothesis in the current studies.

More generally, however, the findings provide some support for "the specificity hypothesis": the idea that there are close relations between early semantic abilities and related early conceptual abilities (Gopnik & Meltzoff, 1986b, 1987a, 1987b). Children in these studies who were reported to use more names were also more likely to exhaustively group objects in nonlinguistic tasks. These children, however, were not more advanced in other areas of cognition. It should be pointed out, however, that in the current study we did not assess nonnominal vocabularies. Thus we do not know whether this relation only involves names or reflects a wider relation between vocabulary size and categorization.

Clearly, the development of naming is not simply a linguistic development. It also has cognitive ramifications. There is some interaction between linguistic and cognitive developments. The directions of these interactions cannot, however, be determined from the current cross-sectional studies. In particular, it is not entirely clear how the cross-sectional measure of total number of names relates to the longitudinal measure of a sudden increase in the number of names. Nor is the developmental sequence of naming and sorting apparent in this type of study. It is possible that the conceptual abilities involved in object sorting provide support for the learning of names. However, it is also possible that learning that all things can be named helps children to discover that all objects can be sorted. Some cross-linguistic evidence supports this idea. Gopnik and Choi (1990) found that Korean children who had less exposure to names developed exhaustive grouping abilities later than their English-speaking counterparts. In fact, both these processes may interact in the course of development. These studies do suggest, however, that advances in naming and advances in categorization are related to one another in intriguing ways.

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