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The Development of Identity as a Privileged Relation in Classification: When Very Similar is Just Not Similar Enough

Paul M. Evans
Princeton University

Linda B. Smith
Indiana University

Young children classify by overall similarity the same stimuli that older children and adults classify by part identity. This developmental trend is typically discussed in terms of a shift from comparing wholes to comparing parts. The present study investigates if the trend reflects more than one developing ability. The results of Experiment 1 showed that, in the absence of a part identity relation, older children classify by wholes, not parts. Experiment 2 demonstrated a developmental trend from classifying by similarity to classifying by identity and showed that absolute identity classifications are made more readily than overall similarity classifications by older but not by younger children. Experiment 3 investigated adults' use of absolute identity and showed that identity classifications reflect a strategically imposed and thus shiftable criterion by which stimuli may be classified. In conclusion, the results of the present study suggest that the developmental trend from overall similarity to part identity classifications involves a shift from comparing *wholes* to comparing *parts*, and also involves a shift from classifying by *similarity* to classifying by *identity*. The revised description of the developmental trend may be related to the trend from conceptual representations based on characteristic features to representations based on defining features.

A well-documented trend in the developmental literature is that there is psychological growth toward increasing differentiation (Gibson, 1969; Kemler, 1982, 1983a; Smith, 1979, 1981; Werner, 1957). One empirical result that provides support for the trend is a shift from classifying by overall similarity to classifying

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Correspondence and requests for reprints should be addressed to Paul M. Evans, Department of Psychology, Green Hall, Princeton University, Princeton, NJ 08544.

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by part identity. In the present study, we ask if this trend reflects more than one developing ability.

The study of children's overall similarity and part identity classifications stems directly from a distinction made in the adult literature between integral and separable stimulus dimensions. Garner (1974, 1978a, 1978b) and others (Handel & Imai, 1972; Lockhead, 1966; Shepard, 1964) have argued that adults perceive some stimuli wholistically, as global, unitary wholes, but perceive other stimuli analytically, in terms of their component dimensions or parts. It has been argued that integral dimensions, such as saturation and brightness, combine to form stimuli that are perceived as unitary wholes. Separable dimensions, such as color and size, combine to form stimuli that are perceived in terms of their component dimensions or parts.

Performance on several tasks distinguishes integral and separable stimulus dimensions, and one such task is a standard classification task (Garner, 1974; Garner & Felfody, 1970). An individual is given a set of stimuli and instructed to "put together the stimuli that go together." Typically, the stimuli are structured in a mannner similar to that illustrated in Figure 1. The figure shows three stimuli represented by their coordinate values in two-dimensional space. The dimensions might be color and size (separable dimensions) or saturation and brightness (integral dimensions). Stimuli B and C are, overall, very similar to each other. Stimuli A and B are overall dissimilar, but they share a value on one of the dimensions. Stimuli A and C are neither similar overall nor do they share a value on any of the dimensions.

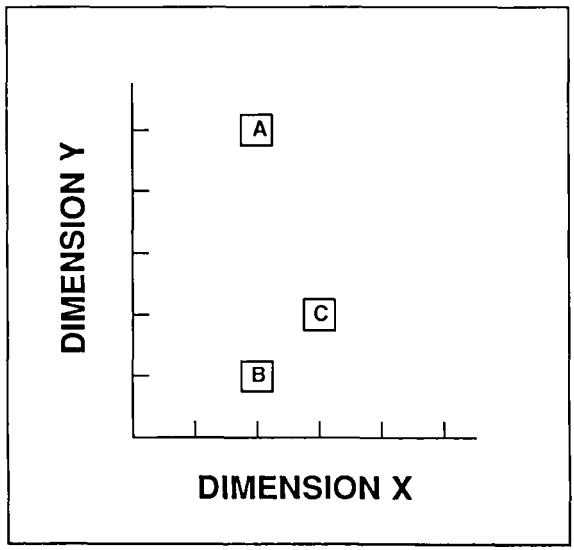

Figure 1. Representation of the two-dimensional set of stimuli used in the standard classification task

When the stimuli vary on integral dimensions, adults produce an overall similarity classification (B and C vs. A). Here, the dimensional structure of sameness and difference on a dimension is ignored and what appears to matter is that the stimuli are similar or different on all the dimensions. In contrast, when the stimuli vary on separable dimensions, adults produce a part identity classification (A and B vs. C). In this latter classification, the adult ignores the overall similarity relations that exist between the stimuli: What appears to matter is only whether the stimuli are the same or different on one of the component dimensions.

Young children under the age of about 6 or 7 classify by overall similarity even when the stimuli being classified vary on separable dimensions (by adult criteria). In general, the dominant relation for the young child is the similarity of stimuli across all varying dimensions and not their identity on just one dimension. In other words, young children produce organized classifications, but their classifications are similar to those produced by adults when presented with stimuli varying on integral (nonanalyzable) dimensions. Older children perform very much like adults; that is, they classify by identity on one dimension those stimuli that vary on separable dimensions (a part identity classification). This developmental trend from classifying by overall similarity to classifying by part identity is a pervasive phenomenon (Kemler, 1982, 1983a, 1983b; Kemler & Smith, 1978, 1979; Smith, 1979, 1981; Smith & Kemler, 1977, 1978; Shepp, 1978).

The developmental trend in classification is usually explained in terms of a progression from comparing and classifying stimuli as unitary wholes to comparing and classifying stimuli on the basis of their parts. One possibility is that young children classify by the wholistic relation of overall similarity because they do not perceive the dimensional structure of stimuli (Smith & Kemler, 1977; Shepp & Swartz, 1976). Alternatively, perhaps young children do perceive the dimensional structure of stimuli but have difficulty in attending selectively to the component dimensions of objects when classifying them (see Pick & Frankel, 1973). However, whether young children do or do not perceive the dimensional structure of stimuli is not critical to the present work (see Smith & Evans, 1987, on this point). In the present article, we do not ask about the mechanisms that underlie the developmental trend from overall similarity to part identity classifications. Rather, we ask whether the current description of the developmental trend as it exists in the literature is correct. The specific issue we address is whether the developmental trend from overall similarity to part identity classifications involves more than just a trend from comparing and classifying stimuli as wholes to comparing and classifying stimuli on the basis of their parts. Our hypothesis is that in addition to a trend from classifying by *wholes* to classifying by *parts*, there is also a trend from classifying by *similarity* to classifying by *identity*.

Our proposed two-factor developmental trend is suggested by a logical exam-

ination of the standard classification task. Given a set of stimuli varying on separable dimensions that are structured as illustrated in Figure 1, the overall similarity classification of the young child and the part identity classification of the older child and adult differ objectively in two ways. The first difference concerns the number of dimensions that contribute to the within-group similarity. In the overall similarity classification, the stimuli are similar as wholes; that is, they are similar on all dimensions. In the part identity classification, the stimuli are similar in part only; that is, they are similar on only one dimension. The second, and we think important, difference concerns the kind of similarity on which the particular classification is based. In the overall similarity classification, the stimuli grouped together are very similar as wholes. In the part identity classification, the stimuli are not just very similar in part, they are identical in part.

To clarify our argument, consider Figure 2. Here, we have illustrated the orthogonal nature of the two factors. First, one can attend to the whole stimulus and classify by similarity, or one can attend selectively to part of the stimulus and classify by similarity. If one attends to the whole stimulus, the resulting classification may legitimately be termed an overall similarity classification (the stimuli grouped together are similar overall). If one attends selectively to part of the stimulus, the resulting classification may be termed a part similarity classifica-

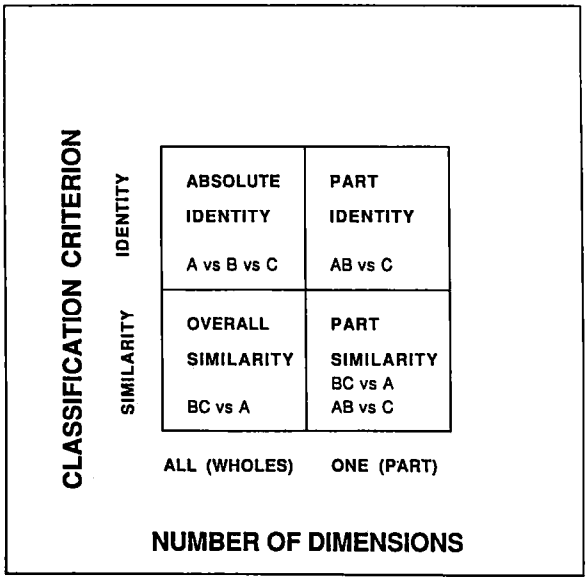

Figure 2. Illustration of two factors that may be involved in the developmental trend from overall similarity to part identity classifications. Stimuli as denoted in Figure 1.

tion (the stimuli grouped together are similar in part). Of course, the best part similarity classification may also be a part identity classification because identity is the highest possible similarity.

EXPERIMENT 1

In Experiment 1, we ask if the developmental trend in classification is primarily a trend from classifying by wholes to classifying by parts. If it is, then it seems reasonable to expect there to be a trend from overall similarity to part similarity classifications. However, if older classifiers, as we suspect, classify by single dimensions in order to classify by identity, then they may not produce part similarity classifications. Rather, when there is no part identity, older classifiers may classify on the basis of overall similarity.

To examine this issue, children and adults classified two sets of stimuli composed of separable dimensions (see Figure 3). Subjects were presented with an exemplar stimulus (E) and three other stimuli. They were instructed to choose one of the three stimuli that was most like the exemplar. In Set 1, there was one overall similarity classification (E and A), and two part identity choices (E with B or E with C). In Set 2, there was one overall similarity choice (E with A), and two possible part similarity choices (E with B′ or E with C′).

When presented with stimuli from Set 1 or from Set 2, young children ought to choose the stimulus that is similar overall to the exemplar. Thus, young children should place together stimuli E and A when presented with Set 1 or Set 2. Older children and adults, on the other hand, ought to choose one of the part

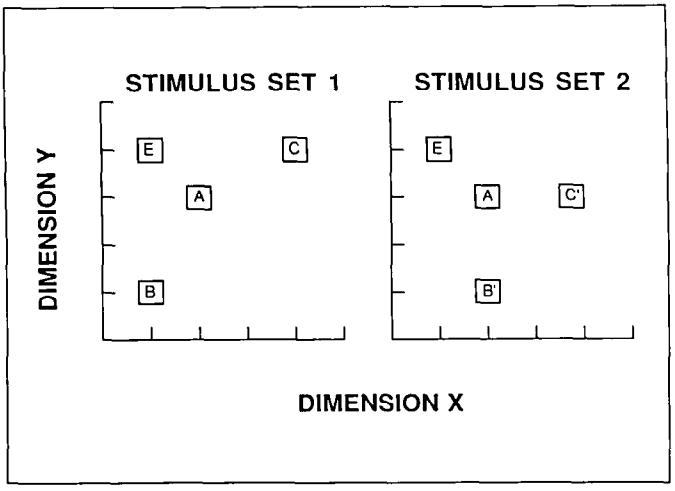

Figure 3. Representations of the two sets of stimuli used in Experiment 1. The two dimensions are size and brightness.

identity choices when presented with stimuli from Set 1. The issue is how the older children and adults will classify the stimuli in Set 2.

If the developmental trend in classification is primarily a trend from classifying by wholes to classifying by parts, then Set 2 offers three good classifications by part: All three choices are equally similar in part to the standard. More precisely, if subjects classify by parts, then we would expect them to produce overall similarity and part similarity classifications with equal frequency. Indeed, Set 2 was constructed to make this specific prediction. To clarify, consider the possibility that the older child and adult attend selectively to dimension X. There are two good classifications by this dimension; stimuli A and B′ are equally similar to the exemplar stimulus (E) on dimension X. Thus, if selective attention to dimension X is perfect, and if the older child and adult are classifying by parts, then both of these stimuli should be chosen with equal frequency.

The prediction of equal part similarity and overall similarity classifications also holds if classifiers attend to one dimension on some trials and attend to the other dimension on other trials. For example, if classifiers attend to dimension X on 70% of the trials, then they should choose stimulus A 35% of the time and stimulus B′ 35% of the time. On the trials when they attend to dimension Y (30%), they should choose stimulus A 15% of the time and stimulus C′ 15% of the time. Thus, the overall similarity classification would be expected 50% of the time (35% + 15%).

We do not expect the 50/50 pattern of classifications (50% overall similarity classifications and 50% part similarity classifications) to hold for anyone. By our view, older children and adults classify by part identity, not by part similarity. In the absence of a part identity relation, older children and adults may, like young children, classify by overall similarity. Without an identity relation, there may be no point in classifying stimuli by parts.

Method

Subjects. The subjects were 12 preschoolers, 12 first graders, and 12 undergraduate college students. Each group contained an equal number of males and females. The mean age of the preschoolers was 4 years, 6 months (r = 4 years, 2 months to 5 years, 2 months). The mean age of the first graders was 6 years, 7 months (r = 6 years, 3 months to 7 years, 2 months).

Stimuli and Design. The stimuli consisted of constant, irregular, quadrilateral forms that varied on two dimensions—size and brightness—dimensions that are clearly separable by adult criteria (Garner, 1974). The forms were mounted on 4″ × 6″ white index cards. There were six values of size (2.71, 4.65, 6.45, 8.26, 16.71, and 25.03 cm^2), and six values of brightness steps from nearly white to black. In Coloraid notation, the six brightness steps were 1, 3, 4, 5, 7, and black. To ensure that all of the smallest dimensional differences were

discriminable, 8 preschoolers participated in an oddity task. In this task, children were presented with sets of three stimuli and asked to point to the stimulus that was "odd" (two stimuli were identical and a third stimulus was different on one of the dimensions). No child had any difficulty in picking the stimulus that differed by the smallest dimensional difference.

There were two kinds of classification sets and each set contained four stimuli: one exemplar and three other stimuli that were to be compared to the exemplar (see Figure 3). In Set 1, one stimulus was overall similar to the exemplar, one stimulus was identical to the exemplar on the size dimension, and one stimulus was identical to the exemplar on the brightness dimension. In Set 2, one stimulus was overall similar to the exemplar, one stimulus was very similar to the exemplar on the size dimension, and one stimulus was very similar to the exemplar on the brightness dimension. There were six unique Sets 1 and six unique Sets 2. Each Set 2 was identical to Set 1 except for the location in multidimensional space of stimuli B and C. Sets 2 were formed by moving stimuli B and C from Set 1 to form stimuli B′ and C′ of Set 2. Because nonsystematic distortions in the psychological closeness of stimuli could lead to an advantage of one classification over another classification, the six unique sets of each type were selected from throughout the multidimensional space to minimize any possible effects of perturbations in the space.

Procedure. On each trial, the exemplar was placed in front of the subjects on a mat. The three remaining cards were then placed on the mat and the subject was asked to choose one of the three cards that was most like the exemplar. Three practice trials were given to ensure that the subject understood the task. On these practice trials, one of the three choice items was absolutely identical to the exemplar, and the other two were very different on both dimensions. The 12 experimental trials were each presented once to the subject in one of two random orders. The adult subjects, in addition to classifying the stimuli, were also asked to rate on a scale from 1 to 5 how confident (or "happy") they were about their choices, with 5 representing the highest level of confidence.

RESULTS AND DISCUSSION

Children's Performance

All children classified the practice sets without error. Table 1 shows the percentages of overall similarity and part identity classifications of Set 1 and the percentages of overall similarity and part similarity classifications of Set 2. An analysis of variance conducted on the percentages of overall similarity classifications produced by the two groups of children showed a significant effect of stimulus set, $F(1,22) = 17.01$, $p < 0.001$, and a significant interaction between stimulus set and age, $F(1,22) = 8.04$, $p < 0.01$. The oldest children produced significantly more overall similarity classifications on Set 2 than on Set 1, Tukey HSD

Table 1. Percentages of Overall Similarity (OS) and Part Identity (PI) Classifications for Set 1, and Percentages of Overall Similarity (OS) and Part Similarity (PS) Classifications for Set 2 for the Two Groups of Children in Experiment 1

	Set 1		Set 2	
	OS	PI	OS	PS
Age 4	66	34	72	27
Age 6	41	59	79	20
Adults	25	75	82	18

= 19%, $p < 0.05$. The youngest children consistently classified by overall similarity. The older children, on the other hand, classified by part identity when this classification was possible and classified by overall similarity when a part identity classification was not possible.

An analysis of variance was also conducted on the percentages of dimensional choices of Sets 1 and 2. In this analysis, the dimension (size or brightness) on which the identity or similarity obtained was also included as a factor. This factor did not interact with any other. Across both age and stimulus sets, classifications by size were more frequent than were classifications by brightness (26% vs. 8%).

The important finding is that, in the absence of a part identity relation, the older children did not classify by part similarity. The strong test of this claim consists of showing that individual patterns of responding to Set 2 do not fit those to be expected if the children were classifying by part similarity. If the children were classifying by parts, then we would expect them to produce the overall similarity and the part similarity classifications equally often. However, an examination of each individual's responses on Set 2 showed that each of the 4-year-old children and 8 of the 12 6-year-old children produced significantly more overall similarity classifications when presented with stimuli from Set 2 than would be expected if they were classifying by parts, $\chi^2 > 4.00$, $p < 0.05$.

Adults' Performance

The adults, just like the older children, produced part identity classifications of Set 1 (75% of the time), and produced overall similarity classifications of Set 2 (82% of the time). Each of the 12 adults' individual response patterns on Set 2 differed reliably from that to be expected if they were classifying by parts, $\chi^2 > 4.00$, $p < 0.05$. In other words, in the absence of an identity relation, adults did not classify by part similarity. Instead, they placed together the stimuli that were similar on both dimensions. Parenthetically, the analysis of adults' confidence ratings showed that they were clearly unhappy with their overall similarity classifications of Set 2. The mean confidence rating that they assigned for their part

identity classifications of Set 1 was 4.19. The mean confidence rating that they assigned to their overall similarity classifications of Set 2 was 3.29. The difference between these two confidence ratings is highly reliable, $t(11) = 7.00$, $p < 0.001$.

EXPERIMENT 2

The results of Experiment 1 support the suggestion that there is more to the developmental trend from overall similarity to part identity classifications than simply a shift from classifying by wholes to classifying by parts. Older children and adults appear to classify by parts only when such a classification is also an identity classification. In the absence of an identity relation, older children and adults do not classify by parts. Instead, they classify by the whole object relation of overall similarity. Thus, identity appears to emerge with development as a special relation, a relation that is particularly valued when classifying objects. Early in development, there may be just one relation—similarity—with objects being more or less similar to each other. Later on in development, similarity becomes differentiated in kinds, and identity emerges as being more than simply very high similarity (Smith, 1987). Experiment 2 was designed to investigate the differentiation of identity from high similarity with development.

In Experiment 2, children classified four different sets of stimuli, and each set contained four stimuli (see Table 2). In two of the sets, Sets 1 and 2, classifications were possible by the relation of overall similarity. In order to be scored as a "correct" classification, the children had to place together pairs of stimuli in Set 1 (a 2 vs. 2 overall similarity classification), and they had to group three stimuli together and separate them from a fourth stimulus in Set 2 (a 3 vs. 1 overall similarity classification). Because young children show a propensity toward pairing objects, and because they have difficulty in constructing 3 versus 1 classifications (Smith, 1983), we expected the children to produce more overall similarity classifications of Set 1 (2 vs. 2) than of Set 2 (3 vs. 1). It should be noted that Set 2 also afforded part identity classifications; that is, some of the overall similar stimuli were also identical in part. Whether or not the presence of these part identities contributes to the children's performance will be empirically

Table 2. Illustrative Coordinate Values of the Four Stimulus Sets Used in Experiment 2

Stimulus Set and Type of Classification Partition	Coordinate Values of Stimuli Varying on Two Dimensions
Set 1 (2 vs. 2 by overall similarity)	(1,1)(2,2) (4,4)(5,5)
Set 2 (3 vs. 1 by overall similarity)	(1,1)(1,2)(2,2) (5,5)
Set 3 (2 vs. 2 by absolute identity)	(1,1)(1,1) (5,5)(5,5)
Set 4 (3 vs. 1 by absolute identity)	(1,1)(1,1)(1,1) (5,5)

determined by assessing the extent to which the children were more likely, when not grouping three overall-similar stimuli together, to group two similar and part identical stimuli together than to group two similar but not part identical stimuli together.

In the two remaining classification sets, Sets 3 and 4, classifications were possible by the relation of absolute identity. In order to be scored as a correct classification, the children had to place together pairs of objects in Set 3 (2 vs. 2 absolute identity classification), and they had to group three objects together and separate them from a fourth object in Set 4 (3 vs. 1 absolute identity classification). Again, because children have little trouble in forming groups by pairs, we expected them to produce more absolute identity classifications of Set 3 (2 vs. 2) than of Set 4 (3 vs. 1). Also, because absolute identity is the highest overall similarity that is possible, we expected more absolute identity classifications of Set 3 than overall similarity classifications of Set 1.

Our major prediction concerns how readily the children classify the stimuli in Set 2 and in Set 4. Recall that for these sets of stimuli, the children have to group either three overall-similar stimuli together and apart from a fourth, dissimilar stimulus (Set 2) or they have to group three identical stimuli together and apart from a fourth, different stimulus (set 4). If the children's classifications are organized solely by the relation of similarity (and identity is simply high similarity), then we expect two main effects and no interaction. The children should produce more 2 versus 2 classifications than 3 versus 1 classifications because they have difficulty in forming groups containing more than two stimuli. Also, because absolute identity is the highest possible overall similarity, the children may produce more absolute identity classifications than overall similarity classifications.

If, on the other hand, the children's classifications are organized by two relations, by similarity and by identity (with identity having a special status), then we would expect the 3 versus 1 absolute identity classifications to be considerably easier than the 3 versus 1 overall similarity classifications. If identity emerges with development as a special and potent relation, then the 3 versus 1 absolute identity classifications should increase with age relative to all other classifications. To put it another way, if identity is more than simply very high similarity, its existence may overcome the difficulty that children have in forming groups containing more than two stimuli.

Because the possibility exists that identity emerges as a special relation relatively early in development (before the child begins to classify on the basis of parts instead of wholes), we selected children for Experiment 2 who were younger than those used in Experiment 1.

Method

Subjects. There were three groups of subjects, each containing 5 males and 5 females. The mean age of Group . was 3 years, 3 months (r = 3 years, 0

months to 3 years, 5 months); the mean age of Group 2 was 4 years, 4 months (r = 4 years, 1 month to 4 years, 7 months); and the mean age of Group 3 was 5 years, 5 months (r = 5 years, 1 month to 5 years, 10 months).

Stimuli and Design. The stimuli consisted of circles, squares, and triangles that varied in color. The forms were mounted on 4″ × 6″ white, index cards. There were four kinds of sets (Sets 1, 2, 3, and 4 as in Table 2), and there were four unique instances for each set. Each instance was structured analogously to the sets illustrated in Table 2. In Sets 1 and 2, overall similarity classifications were possible by grouping the stimuli by pairs (Set 1) or by grouping three stimuli together and apart from a fourth stimulus (Set 2). In Sets 3 and 4, absolute identity classifications were possible by grouping the stimuli by pairs (Set 3) or by grouping three stimuli together and apart from a fourth stimulus (Set 4).

Procedure. On each trial, the child was presented with one of the stimulus sets and instructed, "Put together the objects that go together." The classification task was a completely free one: Children were not constrained as to the number of groups that they could form nor the number of stimuli that they could place in a group.

As in Experiment 1, there were three practice trials requiring the separation of two identical stimuli from a very different third stimulus. There were 12 experimental trials, 4 trials on which the child classified Sets 1 and 3 (2 vs. 2 classifications by overall similarity or by absolute identity) and 8 trials on which the child classified Sets 2 and 4 (3 vs. 1 classifications by overall similarity or by absolute identity). The 12 experimental trials were presented once to each subject in one of three random orders. Before classifying each set, the child was reminded, "Put together the ones that go together." General encouragement was periodically given, but no specific feedback was provided.

RESULTS AND DISCUSSION

All children correctly classified the practice sets. Childrens' responses on the experimental sets were coded as follows: For Sets 1 and 3, in order to be scored as an overall similarity classification (Set 1) or an absolute identity classification (Set 3), the child had to form two groups of two stimuli, and each group had to contain either two similar stimuli (Set 1) or two identical stimuli (Set 3). For Sets 2 and 4, in order to be scored as an overall similarity classification (Set 2) or an absolute identity classification (Set 4), the child had to group three similar stimuli together and apart from a fourth dissimilar stimulus (Set 2) or the child had to group three identical stimuli together and apart from a fourth different stimulus (Set 4).

Table 3 shows the percentages of overall similarity classifications produced by the three groups of children for Sets 1 and 2 and the percentages of absolute

identity classifications produced by the children for Sets 3 and 4. An analysis of variance showed a significant effect of the type of classification (overall similarity vs. absolute identity), $F(1,27) = 16.47$, $p < 0.001$, and a significant effect of classification partition (2 vs. 2, and 3 vs. 1), $F(1,27) = 53.81$, $p < 0.001$. There was also an interaction between age and classification partition, $F(2,27) = 6.27$, $p < 0.01$, and an interaction between type of classification and classification partition, $F(1,27) = 4.26$, $p < 0.05$.

As anticipated, the results showed that all of the children easily classified by overall similarity or by absolute identity when, in order to produce such a classification, they had to form groups by pairs. Grouping more than two stimuli together did cause problems. The children were less likely to produce overall similarity classifications when they had to group three stimuli together (Set 2) than when they had to group by pairs (Set 1), Tukey HSD = 16.14%, $p < 0.05$. This finding replicates that reported by Smith (1983). Moreover, the youngest children, the 3-year-olds, also produced significantly fewer absolute identity classifications when they had to group three stimuli together (Set 4) then when they had to group by pairs (Set 3), Tukey HSD = 15.14, $p < 0.05$. However, there was a large significant increase with age of 3 versus 1 absolute identity classifications (Set 4) over the number of corresponding overall similarity classifications that were made (Set 2), Tukey HSD = 27.30%, $p < 0.05$. By our interpretation, these are the predicted results if absolute identity emerges as a special relation with development. For the youngest children, the relation of absolute identity is not sufficiently strong enough to obviate their tendency to form groups by pairs.

An inspection of the means in Table 3 suggests a small decline in the number of 3 versus 1 overall similarity classifications (Set 2) between the ages of 4 and 5 years. This decrease was due to the oldest children, the 5-year-olds, sometimes classifying by absolute identity. The oldest children classified by absolute identity, placing each stimulus by itself, 37% of the time overall, that is, almost as often as they produced the 3 versus 1 overall similarity classification. The youngest children, on the other hand, rarely placed each stimulus by itself (13% of the time).

Most of the "other" classifications of Set 2 consisted of forming one pair of

Table 3. Percentages of Overall Similarity Classifications (OS) and Absolute Identity Classifications (AI) Produced by the Three Groups of Children in Experiment 2

	Stimulus Set and Classification Partition			
	Set 1 (OS) 2 vs. 2	Set 2 (OS) 3 vs. 1	Set 3 (AI) 2 vs. 2	Set 4 (AI) 3 vs. 1
Age 3	85	33	95	33
Age 4	85	63	95	85
Age 5	90	45	100	93

similar stimuli and leaving the remaining two stimuli by themselves. This partial classification of sets requiring groups of three has also been reported before by Smith (1983). Even though the children in Experiment 2 were at an age where part identity classifications are not typical, perhaps the existence of the part identity relation (some of the overall similar stimuli were also identical in part) influenced their classifications? The evidence, however, suggests that the children simply had difficulty in forming groups containing more than two stimuli. The percentages for the (1,1)(2,2) pair, and the (1,2)(2,2) pair were 35%, 30%, and 35%, respectively. If the part identities had influenced their classifications, we might have expected more than 30% (1,1)(1,2) classifications and more than 35% (1,2)(2,2) classifications. The fact remains, of course, that in total the children produced 65% part identity classifications (30% + 35%). However, this is not too surprising because there were two pairs of stimuli that were similar on one dimension and identical on one dimension and only one pair of stimuli that were similar on both dimensions. Because all three pairwise combinations of the three stimuli were produced with almost equal frequency, it seems that it did not matter to the young children which pair of stimuli were placed together as long as they were similar.

The increase with age in the number of absolute identity classifications of Set 4 provides support for the suggestion that identity becomes a special and valued relation with development. The finding also provides additional evidence for our claim that the developmental trend in classification involves more than simply a shift from comparing wholes to comparing parts. Furthermore, all of the children in the present experiment were at an age where classifying by wholes, not parts, is the rule in the standard classification task. This suggests that identity, as a special relation, may emerge with development before the child attends to the parts of stimuli.

EXPERIMENT 3

The results of Experiment 1 showed that older children and adults do not simply place together stimuli that are merely similar in part. What appears to be important for the older child and adult is that the stimuli placed together are identical in part. The results of Experiment 2 showed that in a task that did not require selective attention to parts, young children, who would typically not produce part identity classifications, show an appreciation of the relation of absolute identity. In Experiment 3, we ask if adults, in addition to valuing part identity, also value the relation of absolute identity. We also ask if, for adults, the valuing of identity is context dependent and reflects a shiftable criterion by which stimuli may be classified.

To illustrate the logic behind Experiment 3, consider the following thought experiment: An adult is given three stimuli to classify. Two of the stimuli are overall similar to each other (a red square and a red–orange square), and these

two stimuli are overall different from a third stimulus (a blue square). We would expect the adult to place together the red square and the red–orange square. Another adult is given the same three stimuli together with an additional red square identical to the first red square. How will this adult classify the stimuli? Will they, for example, place together the three stimuli that are overall similar to each other (the two red squares and the red–orange square)? Alternatively, perhaps they will now place together only the two identical red squares. If the latter result obtains, it would suggest that when identities are present, overall similarity becomes an insufficient basis for classifying stimuli. Such a result would also suggest that the treatment of identity as special is context dependent. In the absence of an identity relation, the adult places together the stimuli that are similar overall; in the presence of an identity relation, those very same stimuli are now grouped apart.

Method

Subjects. The subjects were undergraduate students who received course credit for participating in the experiment. Of the three groups of subjects, each contained 4 men and 4 women.

Stimuli and Design. The stimuli consisted of circles, squares, and triangles that varied in color and size. The forms were mounted on 4″ × 6″ white, index cards. There were three kinds of sets. Set 1 contained five stimuli. Sets 2 and 3 each contained seven stimuli. For each set, there were nine unique instances. Figure 4 illustrates the construction of each stimulus set.

There were five stimuli in Set 1 (Figure 4). Stimuli A and B were very similar to each other (i.e., a red square and a red–orange square), as were stimuli Q and R (i.e., a blue square and a blue/green square). Stimulus I was overall dissimilar

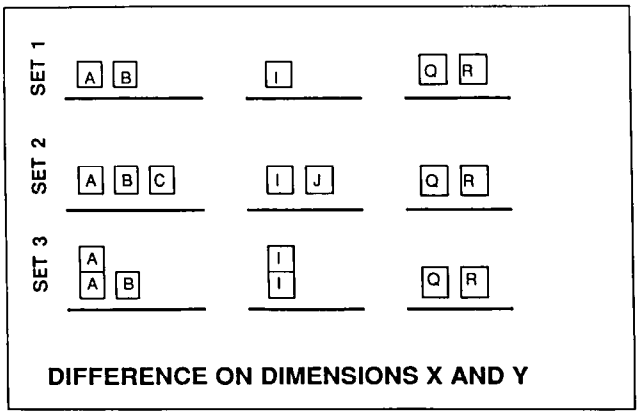

Figure 4. Representations of the three sets of stimuli used in Experiment 3

from the other four stimuli in Set I (i.e., a black square). Overall similarity classifications of Set I were possible by grouping together stimuli A and B and by grouping together stimuli Q and R.

Sets 2 and 3 each contained seven stimuli. Overall similarity classifications of Set 2 were possible by grouping together stimuli A, B, and C, by grouping together stimuli I and J, and by grouping together stimuli Q and R. Overall similarity and absolute identity classifications of Set 3 were possible. Subjects could classify solely by absolute identity by grouping together the two identical A stimuli and by grouping together the two identical I stimuli. Alternatively, subjects could classify by overall similarity and by absolute identity. For example, they could place the two identical A stimuli with stimulus B (an overall similarity classification), group stimuli Q and R together (an overall similarity classification), and group the two identical I stimuli together (an absolute identity classification).

Procedure. The three groups of subjects were assigned one of the three stimulus sets to classify. All subjects were instructed, "Put together the ones that go together." There were nine experimental trials and each subject received each trial once in one of two random orders. In addition, at the end of the main experiment, the subjects who received Set 2 were asked to classify Set 3, and the subjects who received Set 3 were asked to classify Set 2.

RESULTS AND DISCUSSION

We scored each classification as either an overall similarity classification, an absolute identity classification, a similarity plus identity classification, or an "other" classification. Table 4 lists each classification of each kind for Sets 1, 2, and 3. Table 5 shows the results.

Consider first the subjects who classified Set 1. The results showed that subjects produced a preponderance of overall similarity classifications. As is apparent in Table 5, no other classification occurred with any marked frequency.

Consider now the results from the subjects who classified Set 2. Here, the subjects were given the five stimuli from Set 1 together with two additional stimuli that were similar (but not identical) to two of the stimuli in front of them. The results showed that these subjects performed like those who classified Set 1, that is, they produced a preponderance of overall similarity classifications, and it is clear from Table 5 that no other classification was produced with any marked frequency.

The types of classifications produced by the subjects who classified Set 3 were qualitatively different from those produced by the subjects who classified Set 1 and from those produced by the subjects who classified Set 2. In this set, there were pairs of stimuli that were similar overall and pairs of stimuli that were absolutely identical. However, as is evident from Table 5, subjects principally classified by absolute identity.

Table 4. Instances of Each Type of Classification Scored for Sets 1, 2, and 3 in Experiment 3. "Other" Classifications Consist of All Classifications Not Listed. Stimuli Are Denoted as in Figure 4.

	Type of Classification Partition		
	Overall Similarity	Absolute Identity	Similarity plus Identity[a]
Set 1	(AB) I (QR)	A B I Q R	(AB) I Q R or A B I (QR)
Set 2	(ABC) (IJ) (QR)	A B C I J Q R	(ABC) I J Q R or (AB) C (IJ) Q R or A B C I J (QR)
Set 3	(AAB) (II) (QR)	(AA) B (II) Q R	(AA) B (II) (QR) or (AAB) I Q R

Note: grouped stimuli are in parentheses.

[a]Denotes at least one overall similarity group formed and at least one identity group formed.

The pattern of results thus far indicates that adults prefer absolute identity classifications to overall similarity classifications (Set 3), but that this preference requires the presence of an identity relation: In the absence of an identity relation, the subjects had no difficulty in grouping the stimuli on the basis of overall similarity. However, the results from the postexperiment shift also suggests strategic control over the use of identity as a criterion for forming groups. As is apparent in Table 5, the subjects who originally classified Set 2 by overall similarity continued to classify by overall similarity when given Set 3. In contrast, the subjects who originally classified Set 3 by absolute identity continued to classify by absolute identity (placing each stimulus by itself) when given Set 2. Apparently, at the outset of the task, adults select a criterion for classifications based on the kinds of relations available to them. However, the criterion that is

Table 5. Percentages of Overall Similarity (S), Identity (I), Overall Similarity and Identity (S + I), and Other (O) Classifications of Sets 1, 2, and 3 in Experiment 3

	Main Experiment				Postexperiment Shift			
	S	I	S + I	O	S	I	S + I	O
Set 1	61	8	6	25	—	—	—	—
Set 2	66	4	14	16	46	18	22	14
Set 3	11	66	13	10	29	49	15	7

chosen is not solely determined by the stimuli themselves. Once selected, adults can maintain identity or overall similarity as the criterion for classification across a range of stimulus sets.

GENERAL DISCUSSION

The results of the present study support three conclusions. First, the developmental trend in classification reflects more than simply a shift from classifying by wholes to classifying by parts. In addition to a shift from wholes to parts, there is a shift from classifying by similarity to classifying by identity. The results of Experiment 1 show that older children and adults classify by parts only when such a classification is also an identity classification. In the absence of an identity relation, older children and adults classify by wholes on the basis of overall similarity. Second, the results of Experiment 2 suggest that identity emerges as a special relation, one that is particularly valued in classification tasks, before the child classifies on the basis of parts. Recall that, in Experiment 2, the children were at an age where part identity classifications are not typical, and that they did not show a proclivity when placing two stimuli together to pair on the basis of part identity. Thus, it would seem that the young child classifies by overall similarity not because of a lack of an appreciation of identity relations but because of a failure to compare objects by parts. Third, adults, in addition to valuing part identity, also value the relation of absolute identity. The use of identity as a criterion for classifying objects appears to be strategic and to reflect a shiftable criterion by which stimuli may be classified. The results of Experiment 3 show that, in the absence of an absolute identity relation, adults place together objects that are similar overall. In the presence of an absolute identity relation, in contrast, overall similarity is an insufficient basis for forming a group. Moreover, once set, adults maintain their similarity or identity criterion across various sets.

The finding that there are two components to the developmental trend in classification may necessitate a change in explanations of the trend. Specifically, the differentiation of identity from similarity may be a prerequisite to the shift from comparing objects by wholes to comparing objects by parts. The comparison process may shift with development from wholes to parts because the older child is looking for part identities. The valuing of identity in classification tasks, the strategic seeking of identity, may motivate selective attention to, or the accessing of, constituent dimensions or parts of objects and thus foster the emergence in development of the comparison of objects in terms of their component dimensions. By our view, it is precisely because older children and adults seek identities in classification tasks that they bother to selectively attend. Absolute identity is not a common relation between objects; part identities provide a basis for identity classifications even when the objects being classified are discriminably different from each other.

We envisage a two-step process in the shift from classifying by overall similarity to classifying by dimensional identities. We suggest that absolute identity first emerges as a special relation distinct from overall similarity. Once identity is the valued relation for classification, the child begins to look for part identities and, as a consequence, begins to attend selectively to single dimensions in classification tasks. Just how much and what kind of lag exists between valuing identity and selectively attending to single dimensions is an empirical question worthy of future investigation. It may be that very young children are able to attend selectively in classification tasks, but that it takes some time after identity emerges as a distinct relation for it to be a sufficient motivator that the child successfully classifies by part identities. Alternatively, it may be that classification by part identities is principally limited by the perceptual separability of the dimensions for the children. Answers to these questions await further research.

Why is there a developmental shift from similarity to identity classifications? Such a shift may make cognitive sense. Identity (both absolute and part) is an equivalence relation, reflexive, transitive, and symmetric, and supports powerful inferences. Similarity possesses none of these properties and hence affords considerably less conceptual power (see Smith, 1979; Smith, 1987 on this point).

The finding of a shift from similarity to identity in perceptual classification fits well with the proposal made by several investigators of a shift from representing concepts (such as island) in terms of their characteristic features to representation based on defining features (Carey, 1978; Keil & Batterman, 1984; Landau, 1982; Werner, 1957). It seems that, for the young child, no one feature of a stimulus is crucial for determining instances of a concept. For the older child, in contrast, concepts are often structured by criterial or defining features.

The trend in perceptual classification, from similarity to identity, might be related to the trend from characteristic to defining features. Keil and Batterman (1984) considered if the shift from wholes to parts might be related to the shift in conceptual representation and rejected such a relationship. They based their argument on the fact that the shift in conceptual development reflects the amount of knowledge that an individual has about a particular concept and not development, per se. Although the shift from characteristic to defining features may well depend on knowledge, there may also be developmental contraints. Specifically, the appreciation of identity as a relation distinct from similarity may be a necessary precursor to the organization of concepts as equivalence classes defined by necessary and sufficient features. We concur with Keil and Batterman (1984) that a shift from wholes to parts may play little role in the shift from characteristic to defining features. However, the differentiation with development of similarity into kinds of similarity, the emergence of identity as a privileged relation in classification, may be more intimately related to the possibility of shifts in conceptual representation given sufficient knowledge.

REFERENCES

Carey, S. (1978). The child as a word learner. In M. Halle, J. Bresnan, & G. Miller (Eds.), *Linguistic theory and psychological reality*. Cambridge, MA: MIT Press.

Garner, W. R. (1974). *The processing of information and structure*. Potomac, MD: Hillsdale, NJ: Erlbaum.

Garner, W. R. (1978a). Aspects of a stimulus: Features, dimensions, and configurations. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and categorization*. Hillsdale, NJ: Erlbaum.

Garner, W. R. (1978b). Selective attention to attributes and to stimuli. *Journal of Experimental Psychology: General, 3*, 287–308.

Garner, W. R., & Felfody, G. L. (1970). Integrality of stimulus dimensions in various types of information processing. *Cognitive Psychology, 1*, 225–241.

Gibson, E. J. (1969). *Principles of perceptual learning and development*. New York: Appleton-Century-Crofts.

Handel, S., & Imai, S. (1972). The free classification of analyzable and unanalyzable stimuli. *Perception & Psychophysics, 12*, 108–116.

Keil, F. C., & Batterman, N. (1984). A characteristic-to-defining shift in the development of word meaning. *Journal of Verbal Learning and Verbal Behavior, 23*, 221–236.

Kemler, D. G. (1982). Classification in young and retarded children: The primacy of overall similarity relations. *Child Development, 53*, 768–799.

Kemler, D. G. (1983a). Holistic and analytic modes in perceptual development. In T. J. Tighe & B. E. Shepp (Eds.), *Perception, cognition, and development: Interactional analyses*. Hillsdale, NJ: Erlbaum.

Kemler, D. G. (1983b). Exploring and reexploring issues of integrality, perceptual sensitivity, and dimensional salience. *Journal of Experimental Child Psychology, 36*, 365–379.

Kemler, D. G., & Smith, L. B. (1978). Is there a developmental trend from integrality to separability in perception? *Journal of Experimental Child Psychology, 26*, 498–507.

Kemler, D. G., & Smith, L. B. (1979). Accessing similarity and dimensional relations: The effects of integrality and separability on the discovery of complex concepts. *Journal of Experimental Psychology: General, 108*, 133–150.

Landau, B. (1982). Will the real grandmother please stand up? *Journal of Psycholinguistic Research, 11*, (2).

Lockhead, G. R. (1966). Effects of dimensional redundancy on visual discrimination. *Journal of Experimental Psychology, 72*, 95–104.

Pick, A. D., & Frankel, G. W. (1973). A study of strategies of visual attention in children. *Developmental Psychology, 9*, 348–358.

Shepard, R. N. (1964). Attention and the metric structure of the stimulus space. *Journal of Mathematical Psychology, 1*, 54–87.

Shepp, B. E. (1978). From perceived structure to dimensional space: A new hypothesis about perceptual development. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and Categorization*. Hillsdale, NJ: Erlbaum.

Shepp, B. E., & Swartz, K. B. (1976). Selective attention and the processing of integral and nonintegral dimensions: A developmental study. *Journal of Child Psychology, 22*, 73–85.

Smith, L. B. (1979). Perceptual development and category generalization. *Child Development, 50*. 705–715.

Smith, L. B. (1981). The importance of overall similarity of objects for adults' and children's classifications. *Journal of Experimental Psychology: Human Perception and Performance, 1*, 811–824.

Smith, L. B. (1983). Development of classification: The use of similarity and dimensional relations. *Journal of Experimental Child Psychology, 36*, 150–178.

Smith, L. B. (1987). From global similarity to kinds of similarity: The constraints of dimensions in development. In S. Vosniadou & A. Ortony (Eds.), *Similarity and analogy*. Cambridge, England: Cambridge University Press.

Smith, L. B., & Evans, P. M. (1987). A model of perceptual classification in children and adults. In B. E. Shepp & S. Ballesteros (Eds.), *Perception of objects: Process and structure*. Hillsdale, NJ: Erlbaum.

Smith, L. B., & Kemler, D. G. (1977). Developmental trends in free classification: Evidence for a new conceptualization of perceptual development. *Journal of Experimental Child Psychology, 24*, 279–298.

Smith, L. B., & Kemler, D. G. (1978). Levels of experienced dimensionality in children and adults. *Cognitive Psychology, 10*, 502–532.

Werner, H. (1957). The conception of development from a comparative and organismic point of view. In D. Harris (Ed.), *The concept of development*. Minneapolis: University of Minnesota Press.