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ABSTRACT

Discussed are results of studies of the cognitive development of 2- and 3-year-old children which suggest that the mind makes gains in the ability to think as gains in language development are made. "Thinking" in this context refers to the judgments children made as they selected objects and maneuvered them into one arrangement or another. A study of forty 1- to 3-year-old children's spontaneous manipulations of a series of object sets (divisible into two classes of four objects each) indicated two major shifts in the children's conceptual structuring. The first shift in structuring, which was found to occur during the second year, involved the construction of explicit similarity or equivalence relations between discrete objects. Beginning at 12 months, children selecting same-class objects tended to manipulate one type of object throughout a task. Between 12 and 24 months children produced two-class groupings only by arranging one class at a time. The second shift in structuring, which occurred in the third year, involved a change in the procedure children used to construct two-class groupings. Half the 30- and 36-month-old children shifted between classes as they grouped items. It is concluded that age difference in manipulative procedure suggests a difference in conceptual strategy. Implications of the findings for Piagetian theory are discussed. (RH)

CHILDREN'S EARLY THOUGHT:

DEVELOPMENTS IN CLASSIFICATION DURING LANGUAGE ACQUISITION

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Headnote: Analyses of children's object grouping strategies suggest a major shift in cognitive organization during the period of rapid language growth. The capacity for human reason, which the cognitive shift seems to represent, may emerge with the capacity for language proper.

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My concern in this paper is with the development of intellectual capacity outside language during the period in which children learn to talk. At present we know little about what the mind of the 2- to 3-year-old can do other than learn language. But, the fact that that mind learns language, and in the way that it does, suggests that it may be expanding in other ways as well. In particular, the fact that children between 2 and 3 years of age develop a grammar tells us that as early as the third year children not only represent their experience--in this case, by symbolizing it in words--but that they reflect on and regulate the way in which they do so. They structure the way they structure things. The study I will describe was an attempt to observe this process at work on input other than speech sounds and to observe its consequences on behavior other than language production.

One might object that this project ignores the integrity and uniqueness of different intellectual functions (domains of knowledge, etc.). After all, language is language, and not just any cognitive system. But whatever our theories of the development of specific systems may eventually look like, they must conform to the general principles of any evolving cognitive system, and they must take into account the type of organism with which they are dealing--a 2-year-old and not a 10-year-old, or even a 4-year-old. It is in the language acquisition period that we have had the least idea of what those general principles might be.

The results I will discuss suggest that the mind <u>is</u> making gains between 2 and 3 besides language development. Like the fact that children develop a grammar during this period, these gains suggest an important dimension of intellectual development that traditional cognitive-developmental accounts have overlooked.

The Object of Study

The object of inquiry was children's thinking. The context was children's classification of simple sets of objects, that is, the organization of objects according to their similarities and differences. "Thinking" in this context refers to the judgments children make as they select objects and maneuver them into one arrangement or another. Even a very simple array, one that contains only a few objects from a small number of highly discriminable classes, leaves open both the kind of internal organization a child can impose on the objects and the way in which any particular organization is realized in behavior.

The results I will present draw from a study (Sugarman, 1983) in which 40 1- to 3-year-old children were presented with a series of object sets divisible into two classes of four objects each: for example, four blocks and four plates. Objects within a class were identical. I will be discussing mainly trends in children's spontaneous manipulation of these sets, but will allude to certain elicitation probes, which I will describe along the way.

Several investigators have shown that when children as young as 1 or 1½ are presented with sets of this sort, they spontaneously select objects by class. For instance, when given a mixed group of dolls and cubes and the instruction to "Fix them all up" (Ricciuti, 1965), a 1½-year-old might touch a doll, then another doll, then another, and so on, passing over the intervening cubes. This early systematic responding provides a baseline of cognitively structured behavior against which age-related change may be measured.

This issue is, however, what to measure. Most studies in the area have identified units of class-consistent organization, as an endpoint of investigation. These units include, for example, spatial groupings of objects by class (a stack of blocks, a row of plates), or the sequential handling of

several objects from the same class (manipulating, in turn, four discrete blocks and then, in turn, four discrete plates). As I will show later, these forms cannot specify by themselves the series of judgments that led to their production. The reason is that the same outcome could result from any one of several different series of judgments. Supplementary data are needed to permit more precise inferences about what the children are thinking. These data can be derived from the children's own behavior, specifically, from additional features of the activity stream in which class-consistent organization is embedded.

The results indicate that there are two major shifts in children's conceptual structuring of simple sets of objects during the second and third years of life. The first shift, which occurs during the second year, seems consistent with existing accounts of early representational intelligence. The second shift, which occurs in the third year, has no clear counterpart in accounts of cognitive development during this age period, particularly and most interestingly in Piaget's theory. This is the change that shares properties with the construction of a grammar.

In the remaining time, I will present, in turn, results that are illustrative of each of the two developmental shifts. I will discuss their relation to Piaget's account of early thought and to trends in language development.

The Second Year: From Object-by-Object Responses to Object-Object Relations

The oritical development during the second year is the construction of explicit similarity or equivalence relations between discrete objects. The data I will use to document this shift are children's sequential manipulations, rather than their spatial arrangements (Sugarman, 1981). I am using these data because at least until 2 years of age, children are more

likely to demonstrate class-consistency in the order in which they contact objects than in the order in which they place them.

Beginning at 12 months, children successively contacted same-class objects more than chance would predict, in at least some tasks. The frequency of this behavior did not vary significantly with age between 1 and 3 years. But, other aspects of the behavior did. Initially, the selection of same-class objects coincided with a tendency to manipulate one type of thing throughout a task. The 12-month-olds, for instance, selected same-class objects in sequence above chance only if they were selecting objects from one class on at leat 75% of their moves: for example, selecting plates three-quarters of the time when both blocks and plates were available. This single-class bias declined significantly with age, as the children came to select objects by similarity while handling items from the two classes with incresasingly equal frequency: for instance, selecting blocks half the time and plates the other half (but rotating between these groups--dolls, rings, dolls, rings, etc.).

The association of the youngest subjects' similarity selection with selection of only one class suggets that these children were selecting objects on the basis of perceptual salience, as opposed to conceptual comparison. There is further support for this interpretation in that the 12- and 18-month-olds always selected the same class in tasks in which they favored one class over the other, for example, always choosing plates, and not blocks. Even where the older children favored one class, different children the same age favored different classes--one child might select blocks most of the time, and one, plates.

The developmental trend toward class-consistent selection of two classes suggests that the older children chose objects on the basis of a strategy in

which discrete objects are conceptually compared. Rather than picking up an object because it "stood out," they picked it up because it looked like something else. There is additional evidence of an increasing focus on similarity as such in the children's increasing tendency during the second year to collect several objects of a kind in one place and to verbally refer to simiilarity: "This is like this" (see Sugarman, 1982).

The interpretation is consistent with accounts of early representational intelligence. By most accounts, representational thought involves mentally connecting two states of affairs at the same time (Fischer, 1980; McCall, Eichorn & Hogarty, 1977; Piaget, 1963). This is what is entailed in the formation of a symbolic relation between word and object, for example. Likewise, in conceiving that some x_1 is like some x_2, a child has judged that two entities exist that share something in common. That the objects being related are visible (as opposed to imagined) does not obviate the need for representational thought. It is the nature of the relation that requires representational thought, not something about the entities being related.

Note that this account does not contradict the finding of concept discrimination in infants. From early in the first year infants habituate to series of similar stimuli successively presented to them and recover attention when presented with discrepant stimuli (Bornstein, 1981). This finding shows that infants respond the same way to discrete events over time. But it does not address whether the infants themselves conceive that several discrete events that are the same have passed. They may simply recognize something familiar each time without awareness that 'another x' has gone by. The trend I have just described in children's object selections shows stronger evidence of such awareness. It is of interest in this regard that reliable sequential selection of similar objects is difficult to elicit in infants below 1 year

(Langer, 1980).

The Third Year: From Successive to Coordinated Object-Object Relations

Once children can be said to be conceptually comparing the elements in an array, the question arises of how much structure they impose and how this structuring subsequently develops. An analysis of children's procedures for spatially grouping objects into classes permits the necessary inferences (see Sugarman, 1982). All subjects in the study spatially grouped same-class objects, and did so with roughly the same frequency. Two features of their groupings changed. At 12 and 18 months groupings consisted primarily of single classes: for exaple, a collection of some or all of the plates, with the remaining objects scattered. From 24 to 36 months, at least half of the children's groupings contained two classes, and virtually all children at these ages could group exhaustively. The second change occurred in the procedure children were using to construct two-class groupings. With one exception, all children between 12 and 24 months produced two-class groupings only by arranging one class at a time: for example, stacking the blocks and then aligning the plates (all subjects at each age produced at least one such grouping). Half the 30- and 36-month-olds produced the same product another way: they shifted between classes as they grouped them, for example, putting two blocks to one side, three plates to the other side, putting two blocks with the first two blocks, adding the fourth plate to the plate group.

Two probes designed to elicit the latter shifting-class procedure replicated this sequence. In one probe, the experimenter set out an object from each class and handed the remaining six objects to the child in a mixed-class order. Most children who grouped in mixed order under these circumstances had grouped in mixed order spontaneously. A number of younger children tried to group the classes one at a time, despite the mixed

presentation order. For instance, they accepted only one class from the experimenter and batted objects from the second class out of the way as they were presented. In a second probe, the experimenter presented a partially grouped array with one object from each class misplaced with three correctly grouped objects from the other class. The 2½- and 3-year-olds immediately lifted and reversed the two misplaced objects. Younger children who corrected the array did so by arranging all the objects one class at a time.

The difference in manipulative procedure in these observations suggests a difference in conceptual strategy. In order to group one class at a time, children need to keep only one type of thing in mind: they locate one thing, look for something else like it, look for something like that, and so on. They must also be able to discard objects that do not belong to the class being formed, and such rejection did occur. But they need not immediately reclassify those items with some other group. Children grouping two classes in tandem, however, take an object and decide with which of two groups that object belongs. An object judged not to belong in one group is considered as a possible member of another group; it is not simply rejected. Both procedures, then, involve a conceptual comparison of individual objects on the basis of their similarities and differences: is x like a or not? The shifting-class method, though, implies a coordination of these comparisons: what is not like a is (or may be) like b. Alternatively put, with this method the child not only 'keeps two things in mind and conceptually relates them,' as with the earlier shift, but can conceive of alternative bases for that relationship.

At the risk of reifying, it would seem that what we are dealing with here is the beginning of reasoning. Children are beginning to coordinate their judgments insofar as one judgment is contingent on the next, rather than on

some external perception or internal state. What we do not have evidence of in these observations is coordination by necessary subordination, or a closed system of relations--as would be involved in a transitive inference, for example. Suppose a child knows that an object, a, is like another object, b and that b is like a third object, c. Suppose the child also knows that a and b are related in the same way as b and c, for instance, by sharing the color red. The child need not recognize the consequence that a is like c (I am disregarding the case in which the child determines the similarity of a and c by direct comparison). But the child could still do something more than sequentially compare a with b, and b with c. He or she could compare these comparisons, if only to say that there are two sets of things that are related in the same kind of way (or in a different way, as the case may be). Indeed, as early as 2½, children made verbal comments along these lines. One child, for example, remarked, "Two colors. I join the same color," as she grouped two yellow and two green blocks (Sugarman, 1982).

This step, involving a comparison of comparisons (without necessary subordination), seems absent from Piaget's account of development in this period. Piaget maintained that children's classification remains limited throughout the preschool period to "successive two-term comparisons" (Inhelder & Piaget, 1964). Hence the occasional appearance of alignments with fluctuating criteria, for example (see Sugarman, 1982, for a further discussion of findings of this sort). Piaget maintained this view despite his own observation in the third year of what he termed analogical reasoning (Piaget, 1962):

In a frequently cited example, Piaget's daughter is told she cannot have some oranges because they are still green (and therefore not ripe; if they were ripe, they would be yellow). Later on, while drinking camomile tea,

which is yellow, Jacqueline asserts, "Camomile isn't green. It's yellow already. . .Give me some oranges!" (Obs. 111, p. 231). Jacqueline observes that the color of food is related to its edibility. She encounters one instance in which she is allowed to eat something that is the "right" color and then infers that another item that she had previously been denied because of its color must also have "ripened" (turned yellow).

Piaget was quick to pick up the flaws in such arguments: the child "egocentrically assimilates" the oranges to the tea, as if by "magical participation" of one in the other. He likened such reasoning to the behavior of the 5-month-old infant who strikes a rattle against his crib, delights in the noise, and then when given a cushion, strikes that as well.

But the fact remains that Jacquline had to coordinate several judgments to draw the analogy between the oranges and the tea in the first place. However self-serving, flawed, and magical her reasoning may have been, she was acknowledging different dimensions of variation along which things are ordered (color and edibility) and was looking to coordinate them. What was missing, as in the "Two colors. I join the same color" example, was the organization of these dimensions into some kind of system. But it is not that there was no coordination whatsoever.

Piaget's treatment of this example does, however, give us some insight into why the 'comparison of comparisons' has escaped notice. Piaget's analysis picks up instead the continuity between early representational thought and sensorimotor intelligence, thus showing that representational thought does not emerge de novo in the child. Parallel arguments have been made about language. Language also does not create ideas anew, but reflects previously existing sensorimotor concepts (e.g., Brown, 1973).

While valid in their own right, these arguments leave much of their

target phenomena unexplained (as Brown's account implies). In the case of language, the sensorimotor-origins account cannot explain the development of grammar. Grammar involves not just a reflection, but a reorganization of concepts. Childrn begin language acquisition with very simple linguistic forms that map directly onto some meaning. But they then progressively codify the linguistic system itself, by analyzing words, phrases, and whole sentences into units and discover the rules for combining those units (Bowerman, 1981; Karmiloff-Smith, 1979; Maratosos & Chalkley, 1980; Newport, 1981; Slobin, 1981).

In the case of reasoning, Piaget's claim that early thought involves a reflection of sensorimotor tendencies leaves much of his own example--and the present data--unexplained. This may explain what is reflected, but not how it is reflected. As with language, children move quickly beyond the ability to conceptually relate things (or words and things, in the case of language) to an organization of these relations at a higher level. This is a development of some consequence, since it makes possible the creation of a linguistic system and the ability to reason, in however primitive a form.

Summary

In summary, in arbitrary classification tasks, as in the development of language, children between 1 and 3 years of age appear to conceptually structure the same input to different degrees. In classifying objects children move quickly beyond the ability simply to conceptually relate one thing to another particular thing, to an ability to reflect on and interrelate these relations. This increment can be seen as the beginning of reasoning. Yet, it has been largely overlooked by majcr theories of cognitive development. On the other hand, it makes sense that the dawn of reasoning should coincide with the dawn of language proper. Neither ability is

reducible to the other, but each one represents a significant advance toward human rationality.

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