DOCUMENT RESUME

ED 134 040 FL 008 368

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TITLE The Syntax of Conservation.
PUB DATE 5 Nov 76
NOTE 11p.; Paper presented at the Southeastern Conference on Linguistics (Atlanta, Georgia, November, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Child Language; *Cognitive Development; Cognitive Processes; *Conservation (Concept); Function Words; Language Development; Logical Thinking; Nominals; *Problem Solving; Sentence Structure; *Syntax; Thought Processes; Verbs

ABSTRACT

This paper outlines the syntactic structures which represent a stage in the cognitive development of children, and focusses on an aspect of cognitive development known as conservation. The cognitive components of conservation are presented as the primordial base for the set of syntactic structures which map or mirror them. Piaget proposed four periods or levels of cognitive development; during the third period, that of concrete operations, a child learns to use logical processes to solve concrete problems. Some of these problems have to do with conservation. The ability to conserve requires that the child realize that the amount or quantity of substance or matter stays the same even though its shape or position is changed. These problems include the conservation of number, mass, and volume. The ability to conserve presupposes a mastery of subsets of cognitive structures such as reversibility and seriation. Each of these cognitive structures is represented by some primary syntactic form. Conservation in its cognitive and linguistic sense is the effective interaction of these composite structures. (Author/CLK)

The Syntax of Conservation

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This paper outlines the syntactic structures which represent a stage in the cognitive development of children. The outline focuses on that aspect of cognitive development known as conservation. The cognitive components of conservation are presented as the basis for the set of syntactic structures which map or mirror them in communication.

Piaget has provided a widely known and accepted theory of cognitive development. In general he proposes four periods or levels of cognitive development: The first is sensori-motor from 0-2 years; the second is preoperations from 2-7 years; the third is concrete operations from 7-11 years; the fourth is formal operations from 11-15 years. During the period of concrete operations, a child learns to use logical processes to solve concrete problems. Some of the primary problems a child learns to solve during this period have to do with conservation. The ability to conserve requires that the child realize that the amount or quantity of substance or matter stays the same even though its shape or position is changed. These problems include the conservation of number, mass, length, area and volume. Examples of tests (Fogelman 1970) which determine a child's knowledge of conservations are as follows:

I. Conservation of liquid

Tests whether a child understands that variations in the shape of the container of liquid do not effect the quantity of that liquid.

Test A. Materials: Two identical jars of water at equal levels. A tall thin glass and a wider shorter glass.

Procedure: Examiner says, "I am going to pour my jar of water into this glass. Now do we have the same, or have you got more, or less than me? Why: Water then returned to

jar. "Now I'll pour mine into this (the other glass). Have we got the same, or have you got more, or less than me? Why?

Test B. Materials: Two identical narrow glasses and one short wide glass.

Procedure: The two narrow glasses filled to top with water so child agrees that same amount is in both. The water is then poured from one glass into the short wide glass. The examiner asks, "Now is there the same amount to drink in this glass as there is in this glass?"

II. Conservation of solids

Tests whether a child understands that the volume of an object remains the same even though the shape has been changed greatly.

Test A. Material: Clay

Procedure: Make two balls of equal sixe, then roll one into a long sausage form. Examiner asks, "Is there still as much clay in the sausage as there is in the ball?"

Test B. Material: Two balls of clay identical in size.

Procedure: Change one ball into a sausage, ring, cross, and or other shapes. At each change the examiner asks, "Do you think there is more clay in this or in the ball, or are they both the same?"

III. Conservation of number

Tests whether a child understands that the number of two groups of objects remains the same even though the configuration of the two groups has been changed.

Test A. Material: Two rows of seven poker chips, one row red, the other blue.

Procedure: The red row is extended in both directions to length about double that of the blue row. The examiner asks,

"Who has more chips you or I? The red chips now may be piled or reordered in a variety of forms. The same question is asked at each transformation.

Test B. Materials: A box containing 20 beads and a bigger empty box.

Procedure: The beads are poured from the smaller into the larger box. The examiner asks, "Have I got more beads now, or the same number, or less beads?

The ability to conserve presupposes a mastery of subsets of cognitive structures. Each of these cognitive structures is represented by some primary syntactic form. Conservation in its cognitive and its linguistic sense is the effective interaction of these structures. The first of these substructures is "reversibility" (of course developmentally all previous structures are a necessary basis for the next but the most immediate structures are being considered here.) Reversibility is the ability to mentally reverse a perceptual physical change. The child learns to recognize that if the shape of a substance is transformed it may undergo a perceptual alteration, but that this perceptual change does not indicate a change in the characteristic in question. Without reversible thought a child can be shown two rows of coins with equal numbers and laid out in equal lengths. The child will agree that each row has the same number of coins. One row is then lengthened. The child will no longer agree that there are the same number of coins in each row. The child is unable to mentally reverse the lengthening transformation. His thinking is dominated by the single perceptual change.

When reversible thought is acquired the child's awareness of covarying relationships or dimensions has been developing. A child learns to perceive that when the clay ball get long it gets thin too. Adverbial clause forms introduced by when, while, or "as" seem to most simply reflect the notion of covarying dimensions. Initially this relationship may be thought of as coincidental but it is the readiness basis for the mental reversal of the

transformation. The syntactic frames which represents reversibility are best represented by the conditional clause form "if ____ then", and the coordinating conjunction "____, but ____." If a substance is altered then some characteristics change, but all characteristics (the conservable ones) do not change. A child learns that "If I pour water from the tall thin glass into the short wide glass, then the shape changes but the volume does not change." The conditional clause form concedes the transformation of one aspect of the liquid. The coordinating conjunction but indicates the preservation of the conservable characteristic which is undergoing the transformation, in this case volume.

The second substructure is "seriation". This is the mental ability to order elements according to increasing or decreasing size, weight, or volume. The fundamental syntactic forms involved in the representation of seriation are the comparative constructions. When a child has mastered some comparative forms he or she may begin to use the awareness of covarying dimensions in making simultaneous comparisons. The comparatives involved in seriation include the comparison of count and mass nouns as well as the comparison of adjectives which indicate various dimensions. The comparisons are based on a level of equality or inequality or difference. The as...as frame is commonly used when the conceptual base is a level of equality. The frames er...than, more...than, and less...than are used when the conceptual base has to do with a level of inequality or difference. The comparison of adjectives is represented as follows:

as...as

1. The boy is as tall as the girl.
2. The red box is as big as the blue box.

er...than

1. The boy is taller than the girl.
2. The red box is bigger than the blue box.

The comparison of mass nouns proceeds as follows:

as (much)...as

1. Joe has as much clay as Fred.
2. The cup holds as much water as the glass.

more...than

1. Joe has more clay than Fred has.
2. The cup holds more water than the glass.

Count nouns are compared as follows:

as (many)...as

1. Joe has as many marbles as Fred.
2. The bus has as many wheels as the truck.

more...than

1. Joe has more marbles than Fred.
2. The bus has more wheels than the truck.

When comparisons are made in the direction of the smaller quantity or number, the frames less...than and fewer...than are used. Count nouns are usually compared with the fewer...than frame and mass nouns with less...than.

less...than, fewer...than

1. The cup holds less water than the glass.
2. Joe has fewer marbles than Fred.

When some comparisons are made on the basis of equality of quantities or number the frame the same...as may be used.

the same...as

1. Joe has the same number of marbles as Fred.
2. The cup holds the same amount of water as the glass.

In these structures, determiner sturctures (pre-articles or partitives) such as amount of, quantity of, or number of are used in the frame depending on whether count or mass nouns are compared.

If some dimension is the basis for comparison, then frames will contain

the words height, length or size. When weight is compared the word weight is used:

dimensions

1. Joe is the same height as Fred.
2. The stick is the same length as the snake.
3. Joe is the same weight as Fred.

The frame different...than (from) shares some of the same characteristics as the above structures. Consider:

different...than (from)

1. The cup holds a different amount of water than the glass.
2. Joe wears a different size than Fred.

One comparative form functions in the determiner as a prearticle or partitive:

pre-articles

1. The taller of the two trees is a maple.
2. The red one is the larger of the two blocks.

Superlative constructions appear to have close conceptual relationship. Implicit in superlative is multiple comparison with the selection of one from a set of three or more. The superlative appears to be a prearticle or partitive as well.

superlatives

1. He bought the largest of the balloons.
2. He climbed the tallest tree.

Some complex seriation tasks require comparisons to be made deductively when all of the objects for comparison are not available for simultaneous comparison and ordering. If a child is shown two sticks of slightly different lengths (X and Y) the visual comparison will indicate that X is shorther than Y. Next if the child is shown stick Y together with stick Z (X is hidden) the comparison will indicate that Z is longer than Y. Then the child is asked

to compare mentally Z with X, (which is still hidden). The syntactic frame involved in this deduction is the combination of the conditional clause with the three comparatives.

Complex seriation

1. If X is shorter than Y and Z in longer than Y, then X is shorter than Z.

   [or]

2. If Y is longer than X and Y is shorter than Z, the Z is longer than X.

The direction the comparisons take is arbitrary but the same conclusion may be reached.

In the conservation tasks the child must hold constant the conservable component of a substance while it undergoes some visible change. This requires a comparison over time or to some equivalent standard. The manipulation may require a conceptual reversal, in order that this comparison be made. Hence the examiners questions which determine if the child has followed these lines of reasoning. Notice that the questions necessarily contain the syntactic forms, especially the comparative forms, which represent the logical processes.

Question forms used in assessing conservation

1. If I pour the water from the bottle into the dish would there be more water in the dish then in the bottle, or less, or the same? Why?
2. I'm going to pour mine into the glass. Now have we both got the same, or have you got more, or less than me? Why?
3. Is there still as much clay in the sausage as there is in the ball?
4. If I change my chips this way, who has more chips, you or I?

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and rates of accomplishment also correspond to order and rates for language acquisition.

Further on in this discussion (P. 41) Chomsky suggests, "It is a coherent and perhaps correct proposal that the language faculty constructs a grammar only in conjunction with other faculties of mind. If so, the language faculty itself provides only an abstract framework, an idealization that does not suffice to determine a grammar."

This seems consistent with the view of Piaget (1970) and Sinclair (1969) when they state that language is not the source of logic but is on the contrary structured by logic.

The various reported test situations vary considerably, but I feel that these structures abstract the essence of the cognitive and linguistic processes involved. Often, it seems to me, the discourse and interrogation could be greatly simplified over what is reportedly used and the concept assessed with possibly greater accuracy. Generally, the quoted language is overly complex thereby imposing performance loads beyond that required of the indicated task.

Cognitive development especially during the operational period seem to me to offer a suggested route for the study language acquisition. The emergence of cognitive structure seems to suggest a concommitant syntactic structure to permit its communication. As the cognitive structure emerges so then do the syntactic ones. The emergence of the cognitive structure does not guarantee the emergence of a mapping syntactic structure as is evidenced in the language deficiency of congenitally deaf children who do master the cognitive structures (Furth, 1966). But it is a necessary base for the emergence of them as is evidenced in the language of retarded children who are deficient in the comparable cognitive structure (Hargis, 1975). Chomsky (1975) seems to agree with this approach when he states (p. 35) "Alongside of the language faculty and interacting with it in the most intimate way is the faculty of mind that constructs what we might call "common sense understanding," a system of beliefs, expectations, and knowledge concerning the nature and behavior of objects, their place in a system of "natural kinds," the organization of these categories, and the properties that determine the categorization of objects and the analysis of events." His reverence to common sense understanding seems to me to be very much related to the cognitive theories of Piaget. These early levels of cognitive development appear to be common to all members of the species, they are acquired in an ordered sequence, even if subject to varied time schedules, and their order of acquisition