The Utility of "Simplification" as a Developmental Research Strategy

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SURBER, COLLEEN F. *The Utility of "Simplification" as a Developmental Research Strategy.* CHILD DEVELOPMENT, 1979, **50**, 571–574. Piagetian tasks require a complex of different cognitive processes. The "simplification strategy" of research attempts to hold constant over age some of the task requirements, allowing systematic examination of developmental differences in performance on other aspects of the task. It is argued that this research method is useful for understanding the basic cognitive processes that are necessary for mature performance in conservation, transitivity, moral judgment, causal inference, and other Piagetian tasks. The simplification strategy has the potential to provide a more detailed description of development and allows empirical examination of the patterns and structure of development.

American researchers have expended a great deal of energy and resources examining children's performance in a variety of experimental tasks similar to those used by Piaget. Researchers have searched diligently for the earliest age at which evidence of understanding of a particular Piagetian concept can be found (e.g., Gelman 1972; Mehler & Bever 1967), or taught (see Kuhn [1974] for a review and evaluation of the conservation-training literature). Attempts to simplify the traditional Piagetian tasks in examining the performance of children have been criticized recently by Larsen (1977). This paper argues that Larsen has overlooked an important purpose of such experiments, and that "simplification" is an important strategy for examining developmental processes that should not be dismissed. The major purpose of simplification research is (or should be) to disentangle the multitude of variables that influence performance on Piagetian tasks. Regardless of whether a researcher's a priori belief is that development occurs through qualitative versus quantitative steps, simplification research can yield information about the variables that are related to development.

Most would agree that performance on perspective-taking, transitivity, conservation, causal inference, and other Piagetian tasks is, as acknowledged by Larsen, multiply determined. Performance in such tasks depends on several variables. As an example, consider Inhelder and Piaget's (1958) task of the flexibility of rods. In this task, rods are clamped to a piece of wood such that they are suspended parallel to the surface of a basin of water. Weights can be placed on the end of each rod, and the child's task is to explain what causes the rod to bend far enough to touch the water. The variables in the task are the material of the rod (brass vs. steel), the cross-sectional area of the rod, the shape of the cross section (round vs. square), the length of the rod, and the amount of weight placed on the end of the rod.

It is apparent that the flexibility task makes many demands on the child. First, the child must be able to conceptualize the variables (length, etc.) and discriminate among the levels of the variables. For example, if one either does not have the concept of length or cannot discriminate the difference in length between two rods, one cannot consider the length of the rod as a possible explanation. Second, as Inhelder and Piaget performed the experiment, the *child* determines what observations of the possible causes and effect to make by freely manipulating the experimental materials. This introduces a variable—specifically, the available information about the covariation of the effect (bending far enough to touch the water) with the possible causes will vary from child to child. Third, the accuracy of encoding and memory for the information made available by the manipulations may vary. Perhaps younger children either encode information inaccurately or fail to remember it.

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Fourth, the interpretation of the information as it relates to the viability of possible explanations may vary from child to child.

It is clear from Inhelder and Piaget's observations that developmental differences in performance in the flexibility task (and other causal inference tasks) exist, just as it is clear that there are developmental differences in other traditional Piagetian tasks, such as conservation. To what variables should these developmental differences be attributed? Should the differences be attributed to lack of the "combinatorial operational scheme," as suggested by Inhelder and Piaget for the flexibility task, or similarly, a failure of the child to really "understand conservation" in conservation tasks, as suggested by Larsen? For the example discussed above, it seems that what Piaget terms the "combinatorial operational scheme" is a combination of many cognitive skills—ability to discriminate the variables, ability to manipulate the materials to produce a set of observations adequate for solution, ability to accurately encode and remember the information produced by the manipulations, ability to accurately interpret the information as it relates to a set of causal hypotheses under consideration, and finally to combine or coordinate these skills.

Empirical examination of developmental change in the above cognitive skills does not assume that the child's "combinatorial operational scheme" is developmentally static (Larsen 1977). Instead, such an analysis assumes that the development of the combinatorial operational scheme can be more accurately described by breaking it down into components. Such a description can best be accomplished by research that systematically manipulates the variables one suspects to be important. One way of systematically manipulating variables is exemplified in research characterized by Larsen as "simplification." When an experimental task is simplified, the investigator is attempting to hold certain variables constant to examine the influence of other variables.

The utility of the simplification strategy can be illustrated by consideration of the concept-attainment, rule-learning, and hypothesis-testing literature as it relates to the question of developmental change in the processes of causal inference. Although this tradition of research did not grow out of Piagetian ideas on causal inference, it provides an example of an attempt to assess the cognitive capacities of young children by using simple experimental tasks. Research has shown that by directing a child's attention to particular dimensions of a task, that performance (as measured by trials to a criterion or number of errors) usually improves (Eimas 1970; Gholson & McConville 1974; Johnson, Warner, & Lee 1970). The strategies that children use to select information have been studied with the "twenty questions game" as well as with concept-attainment and rule-learning tasks (Phillips & Levine 1975). More recently, researchers have begun to directly examine children's interpretations of observations in terms of causation (Shultz & Mendelson 1975; Siegler 1975). All of the above studies could be criticized as attempts at simplification since they examine only a limited aspect of the whole process of causal inference. For example, how does memory for the stimuli influence performance, or how does the observation that one event temporally precedes another influence the child's impression of a causal relationship? These questions bring us closer to an understanding of the process of causal inference and developmental change in it.

A better example of research in which the simplification strategy has been successful in determining the locus of developmental change is the work of Siegler (1976) on understanding of the balance scale and the proportionality concept (Siegler & Vago 1978). Siegler's research on the proportionality concept also shows that understanding all the components of a cognitive skill is not necessarily sufficient for successful performance. Combining the components has been shown to be an important aspect of these cognitive developments that does not always occur spontaneously once the components have been learned. Further research on the processes of combining component cognitive skills (Siegler terms this process "invention") will undoubtedly lead to a better understanding of cognitive development.

Performance in a conservation task can also be analyzed as a combination of several cognitive skills. It appears that understanding conservation of liquids requires that the child (*a*) discriminate the differences in width and height of the two containers, (*b*) integrate height and width information into an impression of volume for each container, (*c*) compare the impressions of volume of the two containers, (*d*) recall the physical transformation that led to the current perceptual array (pouring liquid from one container into another) and use this knowledge to modify the comparative judgment of the volumes of the containers, and (*e*) express a judgment and explain it to the experimenter. Such a conceptual analysis of conservation does not necessitate the assumption that understanding of conservation is developmentally constant. The analysis has the potential to describe the development of conservation in richer detail, as Larsen admits, and this description can be accomplished through research systematically manipulating the variables in question. Experiments attempting to use nonverbal means of assessing conservation, for example, represent attempts to hold constant the ability to verbally express and explain one's judgments (Miller 1976), and recent research by Anderson and Cuneo (Note 1) suggests that there may be developmental differences in the way height and width are integrated into an impression of volume. Such research brings us closer to an understanding of what it means to "understand conservation" and does not assume that "understanding of conservation" is developmentally static.

Larsen argues at length that "interfering factors" such as attention to the important dimensions of the stimuli, lack of confidence in one's judgment, and deficiencies in verbal comprehension are inadequate as scientific explanations of children's performance in conservation tasks. The crux of his argument seems to be that a better explanation is that poor performance on a conservation task is due to an incomplete understanding of conservation. The basis of his assertion that one explanation is better than the other is unclear, although he seems to imply that the Genevan explanation is less tautological. Most would agree with his arguments that the direction of the causal relation is unknown (e.g., both verbal deficiency and poor conservation performance could be caused by lack of understanding of conservation, or verbal deficiency could cause poor performance which is then interpreted as a lack of understanding of conservation). However, it can be argued that "understanding conservation" is not an explanation, but merely a label for a phenomenon that itself requires explanation. To paraphrase Larsen (1977, p. 1162), we want to know not just whether a child "has" a concept, but how he has it.

An analysis of Piagetian concepts as combinations of cognitive skills instead of simplistically as wholistic units frees the researcher to pursue an empirical examination of the qualitative and quantitative patterns and structure of behavior and their development, instead of assuming a certain structure (that proposed by Piaget) from the outset. The question of how various behaviors are interrelated should be an empirical one, rather than a topic for armchair arguments. How are conservation judgments related to conservation explanations? How is memory for a moral dilemma related to either moral judgments or explanations of moral judgments? These and many other questions would not be approached by a researcher with Larsen's view of Piagetian concepts as "central variables."

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