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ABSTRACT

This study investigates the effects of a training procedure on children's conservation. Volume conservation was induced in twenty-one 8-year-old non-conserving children by a procedure that combined two sources of conflict. First, the competing schemes used in making decisions on volumes were aroused; second, the non-conserver was made aware of a conserving peer's judgments at strategic points in the training. The training effects were specific to the conservation of quantity, weight, substance and interior volume. These concepts depend on the assimilatory schemes brought into conflict by the training program. The findings suggest that training based on conflict arousal between schemas, and made more salient by peer interaction is an effective stimulant to development. (Author/MP)

Cognitive Conflict, Peers, and Volume Conservation

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Statement of Research Problem

The notion of equilibration has been the basis of two distinct types of conservation training programs during the past two decades. The first seeks to induce conflict in the assimilatory schemes of a child by presenting a series of transformations of materials each of which calls for a different and competing scheme (Smedslund, 1961; Inhelder, Sinclair and Bovet, 1974). The second seeks to induce conflict by pairing children who are at different developmental levels. The confrontation of opposing viewpoints is thought to induce conflict in the less integrated schemes of the non-conserver and thereby lead to more coordination (Murray, 1972; Botvin and Murray, 1975; Doise, Mugry, and Perret-Clermont, 1976).

The induction of cognitive conflict is the goal of both these approaches, but the conditions under which conflict is effectively induced have not been clarified. In order to guarantee conflict the researcher needs to ensure that the content of the training procedure is based on competing schemes likely to be used by non-conservers. Furthermore the salience of the inconsistencies in the non-conservers responses needs to be heightened so that there is motivation to reconsider the adequacy of his/her responses. If both these conditions are satisfied the training procedure should be very effective in inducing conservation.

This investigation was undertaken to devise and test such a training procedure in the area of volume conservation. The notion of volume conservation was chosen as particularly suitable in a training study because its

antecedents are well known and it is possible to explore the extent of training effects across progressively more advanced notions of volume: interior volume, interior volume requiring metrical calculation, occupied volume, and displacement volume (Piaget, Inhelder and Szeminska, 1960).

Moreover the schemes used by children in attaining volume conservation have been clarified in part. Non-conservers interpret a change in shape of an object as a change in volume. This response involves use of the deformation scheme. Deformation may be achieved either by adding or subtracting bits or by changing the shape by displacing bits. The deformation scheme, therefore, is only a partly adequate assimilatory structure because a change of shape may or may not mean a change of volume. Another scheme that is necessary in the development of volume conservation is atomism (Piaget, 1970, p. 706). This scheme enables the child to consider objects as composed of a certain number of parts. This conceptualization enables the child to decide that volume is changed only when parts are added or subtracted. It is apparent, therefore, that the atomism scheme is in potential conflict with the deformation scheme when displacements occur simultaneously with addition and subtraction.

The integration of the deformation and atomism schemes should enable the child to conserve interior volume as well as the related concepts of weight quantity and substance. The concepts of "interior-volume-requiring-metrical-calculation," occupied volume and displacement volume, however, depend on the elaboration of logical multiplication scheme and the increasing use of metrical measurements (Piaget, Inhelder and Szeminska, 1960, p. 379). These concepts should not be influenced by the integration of the atomism and deformation schemes.

The research was designed, therefore, to test the effectiveness of conflict arousal between the deformation scheme and the atomism scheme, with and without the co-occurrence of a conserving peer's judgments of the situation. It was hypothesised that the motivation to reconsider one's inconsistent response would be heightened by the presence of a peer's judgments that conflicted with the non-conservers judgment.

Subjects and Procedures

Twenty-one non-conservers were chosen on the basis of pretest scores on tests of continuous and discontinuous quantity, substance, weight interior volume, occupied volume and displacement volume. There were 11 boys and 10 girls, all white, of average age 8 years 10 months. They were from a predominantly lower-middle class suburban area. The subjects were randomly assigned to three conditions within sex: a peer conflict condition (4 M, 3 F); a non-peer conflict condition (3 M, 4 F); and control (4 M, 3 F).

The training program for peer conflict and the non-peer conflict procedure followed this pattern:

Step (i). Two equal "houses" were constructed from 3/4" cubes.

Step (ii). One or both houses were transformed without addition/subtraction.

Step (iii). The child was asked to judge the relative amount of room in the two houses. Cubes were subsequently subtracted from, or added to, one house until the houses were judged equal again. If the child responded they were the same after the initial transformation, blocks were added or subtracted as dictated by the program.

Step (iv). The houses were returned to the original base outlines.

Step (v). The cubes added or subtracted were now either taken away or put back in order to achieve the equality of the houses again. A total of twelve such transformations occurred in the training program involving blocks that began as 2x3x2; 2x4x2; 2x4x1; 3x5x2; 2x2x4; 4x2x2; 2x2x3; 2x2x2; 4x1x2; 3x2x2; 3x3x1; 2x3x1. In the peer conflict condition the conserving child was asked to judge the relative amount of room after the non-conserving child, at steps (ii), (iii), and (iv). The conserving child was chosen on the basis of pretest scores. Posttesting occurred no sooner than 7 and no later than 10 days after the training was completed.

There were two dependent measures: one score included tests of discontinuous and continuous quantity, substance, weight, and interior volume. These concepts are elaborated during the concrete operational period. The second score included items on interior volume requiring metrical calculation, occupied volume, and displacement volume. These concepts are elaborated typically during the formal operational period.

Results

The results of the experiment are presented in Table 1. One way analysis of variance on the scores for the concrete-operational items indicated that there was a significant effect ($F=4.24$; $df=2, 18$; $p<.05$). Subsequent comparison of the means using Newman-Keuls procedure indicated that the peer conflict condition was significantly different from the non-peer conflict condition (required difference = 3.27; observed difference = 3.86) and control condition (required difference = 3.99; observed difference = 4.00) which did not differ from each other. The one way analysis of variance for the formal operational items was not significant ($F=0.158$; $df=2, 18$; N.S.).

Implications

The peer conflict procedure appears to be a very effective means of inducing conservation of volume at the concrete-operational level. This procedure creates conflict in two ways. First by simultaneously, or almost so, eliciting schemes that are likely to be used by a non-conserver, and second by confronting the non-conserver with a conflicting judgment from a conserving peer during training. It seems that insufficient conflict is aroused when the peer judgment component is not included since the non-peer conflict condition did not differ from the control group. Simultaneous elicitation of competing schemes may not be motivating enough in itself to induce restructuring and integration of schemes. This study therefore supports the view that exposure to a peer's conserving judgment is a particularly salient means of inducing integration and coordination of competing schemes.

The training effects were specific to the concrete-operational items which indicates that the child was not simply applying a general rule such as "it's the same when nothing is added or subtracted." Such a rule would have lead to four correct responses on the formal-operational items. This finding shows that the training produced a developmental increment in the child's emerging notion of volume that closely follows the developmental course hypothesized by Piaget. This illustrates the advantage of conducting training studies on concepts such as volume where a clear developmental progression has been articulated. Furthermore the specificity of the training effect supports the view that the training procedure produced a restructuring of schemes that develop during the concrete operational period.

Table 1. Mean conservation scores and standard deviations for the three experimental groups on the two posttest measures.

	Peer Conflict Condition		Non-Peer Conflict Condition		Control	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Concrete-Operational Concepts (9 items)	7.57	.73	3.71	3.15	3.57	3.38
Formal-Operational Concepts (7 items)	2.43	1.76	2.00	2.07	1.86	1.64

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