Title: The place of conservation training in early cognitive development
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The Place of Conservation Training in Early Cognitive Development

During the early 1960s, a highly investigated topic in cognitive development research had been the study of conservation acquisition in young children. A huge effort was made on the part of developmental psychologists to determine how and to what extent the development of the young child's thinking and reasoning ability might be stimulated and accelerated. Conservation mastery is central in the research and theory of Jean Piaget. Its presence according to him is an important sign that the child has now acquired a new ability to perform mental operations and he has in possession an essential condition for the development of rational thinking and has moved from the stage of pre-operational to operational thinking. This acquisition of conservation implies that a modification has taken place in the child's intellectual structure.

Piaget believes that specific training or teaching plays a very small and non-significant role in the concept of conservation. His theory is that within the cognitive function, two very different aspects should be distinguished — the figurative and the operative. The figurative aspect deals with static configurations and in physical reality, there are states and transformations which lead from one state to another. Examples of figurative aspects in cognitive functioning are perception, imitation and mental imagery. Operative aspects, on the other hand, include operations and actions which also lead from one state to another. In cognitive development, the figurative aspects are subordinate to the operative aspects. Any given state is the result of some transformation and it is also the departing point for another. The pre-operational child does not understand transformation and therefore emphasizes the static quality of the states. In a conservation experiment, he simply compares the initial state and the final state and has no concern regarding its transformation. Concerning conservation training, Piaget believes that "in exercising perception and memory..., you will reinforce the figurative aspects without touching the operative aspects. Consequently I'm not sure that this will accelerate the development of cognitive structure" (Ripple and Rockcastle, 1964, p. 20).

Numerous studies have been conducted which supported or negated this theoretical Piagetian position. Many of these have used a variety of training techniques as well as diverse populations. Some have been successful in inducing conservation (Brainerd, 1974; Bucher, 1973; Gelman, 1969; Smith, 1968; Kingsley and Hall, 1967), but on the other hand, a number of experimental studies has also been ineffective (Mermelstein and Myer, 1969; Mermelstein, Carr, Mills and Schwartz, 1967).

According to Murray (1978), since 1961, 140 research studies were published on training young children between 4 and 7 years old to conserve. The greater bulk of conservation training research was done between 1970 and 1975. Initially this effort was motivated by a variety of forces, some of which were rather praiseworthy, for example, investigating conservation training as a mechanism to solve the problem of cultural deprivation in early life. There was also the general concern that our young children were not learning fast enough and that providing the child with a structured learning experience may prove to be a very effective way to develop mastery of conceptual material. However, the major influence came from the growing involvement of cognitive, developmental and educational psychologists in the area of conceptual development. Experimental studies were conducted to question how a child progresses through the stages of concept formation as described by Piaget. Experimental inducements of conservation were made to demonstrate that conservation could be trained despite what Piaget believed in. As mentioned earlier, some of the earlier experiments were ineffective although it is currently believed that conservation can be taught.

Strauss (1972) made a review of several conservation training experiments and investigated three classes of conservation studies. These were disequilibrium, mental operations and regression.

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Each technique was discussed in detail and comparisons were made between the Genevan and Harvard approaches, e.g. Smedslund's (1963) use of cognitive disequilibrium as a training technique exemplified the Piagetian stand whereas Frank (1966), a Brunerian, employed a screening technique as a training condition. Strauss's review is very selective and biased towards the Piagetian stand. According to Brainerd (1973), he had left out many other training experiments which do not support a developmental hypothesis.

From the review, it seems that a clearcut, sharp definition of what constitutes conservation is highly lacking in several conservation training studies. Each experimenter establishes his own criteria which are not considered in depth. Most of the minimal behavioural evidence like pointing or responding univocally appears very simple as in the operant training study made by Bucher and Schneider (1973). Some studies are stricter in their criteria which involve judgment and explanation as in the procedures used by Smith (1968) and Gelman (1969).

A very different technique of conservation training has been adopted by Bruner (1964). His criteria are based on the linguistic aspect of a situation as he believes that language development is an important cognitive tool. It appears that improvement in language at any given age should aid conservation and this is probably the best way to improve language skills. Bruner suggests that activation of language habits will improve the child's performance and this can be done by practising saying the description of something before him that he must deal with or saying it in its absence. Such an approach will help decrease irrelevant perceptual cues. The effects of saying before seeing are demonstrated in experiments reported by Frank and Nair (Bruner, 1964). The Brunerian training approach assumes that conservation is a function of the language activated. This is in contrast with Piaget who believes that mental structure precedes language development. Without the concept, the language facility cannot be appropriately directed.

Strauss emphasises that the more powerful criterion is that established by Piaget. Here a child is assumed as having reached conservation if he makes a correct judgment of equivalence and logically justifies that judgment. He is able to resist countersuggestion and to transfer conservation to other related tasks. Not all conservation training experiments have adopted this strict list of criteria. The choice of a clear criterion is very important in conservation training research for it apparently will exert a very influential effect on the findings. A study of conservation training techniques used by investigators like Beilin, Sigel and Hooper, Smedslund, Bruner and Brainerd show that they all use different criteria. It is conceivable therefore that the success in their training programme may be related not to the Piagetian concept of conservation but to some other concepts depending on the criteria used.

Training for conservation in general therefore appears equivocal in its success depending on the different criteria and methodology adopted by each experimenter. According to Piaget, in order for conservation training to be effective, two other criteria have to be met. These are generalizability and durability. Therefore a concept which has been trained not only had to be transferred to other situations but it should not be extinguished over time. Most training studies posttested their subjects from as short as three days to five months. The generalizability and durability criteria are in some of these studies not satisfied.

The selected training technique depends to a large extent on whatever theoretical assumptions the experimenter has on the nature of learning. This further points out the difficulty of comparing these conservation training experiments. Historically, two opposing interpretations of cognitive development may be traced to the diverging positions between the empirical and the rational views (empiricism and rationalism). The former stresses experience and the latter the internal structure of the mind which exists independent of any experience. Today there are more interpretations of cognitive development based on other theoretical standpoints, e.g. nativistic, maturational, learning or developmental. There are of course many intermediate positions and conservation training researchers have each adopted their own rationale and methodologies based on their stance, e.g. between the learning theorists and the developmentalists one could identify the following:

<table>
<thead>
<tr>
<th>Theoretical Position</th>
<th>Conservation Training Technique</th>
<th>Representative Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Theorist</td>
<td>Language Activation</td>
<td>Bruner</td>
</tr>
<tr>
<td></td>
<td>Multiple Classification</td>
<td>Sigel</td>
</tr>
<tr>
<td></td>
<td>Social Interaction</td>
<td>Beilin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Murray</td>
</tr>
<tr>
<td>Developmentalist</td>
<td>Adaptation</td>
<td>Piaget</td>
</tr>
<tr>
<td></td>
<td>Cognitive Conflict</td>
<td>Smedslund</td>
</tr>
<tr>
<td></td>
<td>Verbal Feedback</td>
<td>Brainerd</td>
</tr>
</tbody>
</table>

Some of the above conservation training experiments are very complex and yet exploratory. They serve to raise a number of questions regarding conservation induction rather than answering its
presence. The need for a set of assessment criteria for conservation still remains and no one significant training strategy, from whichever theoretical inspiration it may have come from, has shown itself to be better than the others.

Research has yielded contradictory data concerning the effectiveness of conservation training strategy because it is impossible to equate methodologies based on differing criteria. Some possible levels of criteria for conservation are indicated below:

<table>
<thead>
<tr>
<th>Criteria for Conservation</th>
<th>Related Training Techniques</th>
<th>Basic Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explanation</td>
<td>Social Interaction</td>
<td>Stress on</td>
</tr>
<tr>
<td>Judgment</td>
<td>Role Playing</td>
<td>Disequilibrium</td>
</tr>
<tr>
<td>Equivalence</td>
<td>Language</td>
<td>Cognitive Conflict</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Perceptual Flexibility</td>
<td>Feedback</td>
</tr>
<tr>
<td>Identity</td>
<td>Verbal Rule</td>
<td>Stress on</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Cue Reduction</td>
<td>Mental Operation</td>
</tr>
</tbody>
</table>

The adequacy of any training technique is therefore influenced by the choice of criteria. It is noted that experiments training immediate and simple response learning will not be likely to lead to any profound cognitive thinking, whereas experiments stressing more than one stimulus may induce conservation at a higher level. Some variations to the above sample techniques may have to be made in order to make them suitable for different "trainability" levels in children. Studies are encouraged which involve multiple conservation training experimentations and these can be varied systematically so as to provide insight into their effects.

A review of conservation training literature permits one to formulate certain tentative generalizations. There is no doubt that there is tremendous potential for educational application; for instance, some of the training procedures can be applied to school situations. However these methods of training for conservation may have differential impact on different children depending upon the extent to which training is aimed at any specific area of deficit in the child. The trainability of any child is also dependent on his or her pre-training stage.

A vast majority of conservation training studies have been highly concerned with the effectiveness of the training method itself and not with the important variables that influence susceptibility to training. Whether it is possible or not to induce conservation depends on the subject's already "available schemata" (Piaget). According to Smedslund (1961), "if he has a structure which already approaches the given notion, the possibility of the desired reorganization is high, whereas if he is still far from the notion the chances are small that he will change sufficiently during a limited series of experimental sessions" (p. 19). With young children it is hard to believe that identical stimuli are obtained by asking everyone the same question. Even in the nonconserving stage the child is attempting to analyze and to dissociate variables. They are reorganizing relations which they cannot yet grasp in full. Before training it is important to draw up a strict definition of the differing possible levels of nonconservation.

In 1969, Mermelstein and Meyer conducted four types of conservation training techniques on differing populations drawn from three places. A total of 416 subjects from 3-6 years were involved and number conservation was taught using cognitive conflict, verbal rule instruction, language activation and multiple classification techniques. The results indicated that these different training procedures were not only ineffective but also failed with the different groups of children (regardless of their backgrounds). Brainerd (1972) questioned if experimentally induced conservation is a function of chronological age, developmental stage or both. 88 nonconserving kindergarten children were trained on number conservation and analysis revealed that the developmental stage was the only reliable predictor of posttest performance. His findings indicated that the benefit derived from training experiments by a nonconserving child depended on his pre-training stage. This reflects the significance of establishing the learning levels of nonconservation before experimentation begins. Because of this importance it is urged that more experiments be designed to test the influence of this variable.
References


