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RELATIONAL TERMS TRAINING AND CONSERVATION

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Thirty-four kindergarten children ranging in age from 56 to 76 months, were administered a relational terms test and a conservation test. The children were divided into an experimental group and a control group. The experimental group received relational terms training. Posttest results indicated a significant effect of training on both relational terms comprehension and conservation. Negative findings of earlier research may be due to methodological shortcomings. Theoretical implications of language training research are shortly discussed.

Griffiths et al. (1967) point out that correct use of the relational terms "more", "same" and "less" is a prerequisite for conservation, because conservation tests commonly ask for verbal reactions, involving these terms. On the other hand, Sinclair-de Zwart (1967) holds that the correct use of relational terms follows the acquisition of conservation.

The same controversy is reflected in relational terms training research. Hamel et al. (1972) found that their relational terms training did promote conservation reactions. In a recent study of Holland and Palermo (1975) however, it could not be demonstrated that training of the "less"-"more" distinction does improve conservation performance.

The purpose of this study is to investigate whether a relational terms training promotes conservation reactions, avoiding some weaknesses noted in earlier studies. In the study of Hamel et al. (1972) the correct use of relational terms was trained on pictorial representations of the conservation pre- and posttest-tasks, possibly resulting in a contamination of relational terms training and conservation response training. In our training procedure no conservation test tasks were used. To reduce the influence of practice effects, pre- and posttraining measures were not obtained on the same tests, as by Sinclair-de Zwart (1967) and Hamel et al. (1972), but on parallel tests. Finally, we used a more heterogeneous set of materials for training relational terms than Holland and Palermo's which possibly was too specific to permit generalisation to their conservation posttest. – The main hypotheses of this study are :

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1. The relational terms training increases the correct use of these terms;
2. the relational terms training promotes conservation reactions.

In connection with the Bruner-Piaget discussion (cf. Hamel 1974) concerning the role of the identity-concept in conservation acquisition, we tested the following three hypotheses:

3. Non-conservers give more perceptual than identity reasons for their conservation judgments;
4. partial conservers give more identity than perceptual reasons;
5. partial conservers give mainly perceptual reasons for incorrect conservation judgments and identity reasons for correct conservation judgments.

Earlier studies about preschool children's difficulties with the correct use of relational terms (Griffiths et al. 1967, Hamel 1974) led to the next hypotheses:

6. The use of relational terms is more difficult with continuous than with discontinuous materials;
7. the use of "same" is more difficult than the use of "more" or "less".

For testing the hypotheses the .01 level of significance was adopted.

METHOD

Subjects: Seven male and 27 female kindergarten children ranging in age from 56 to 76 months, with a mean age of 67 months, served as subjects. The children predominantly came from lower middle class homes.

Relational terms pretest: Half of the items of the relational terms test were presented in pictorial form, the other half in the form of real objects. Both halves consisted of eight items of discontinuous quantity and eight items of continuous quantity. The discontinuous items consisted of two or more groups of discrete objects (e.g. apples, flowers). The experimenter asked to point out the group of objects in which there were more than in the other groups, or in which there were less, or to point out two groups that had the same number of objects. The continuous items consisted of two or more objects (e.g. beakers, buckets), containing varying quantities of water, sand etc. The children were asked to point out the object which contained more than the other objects, or which contained less, or to point out two objects which contained the same amount of water, sand etc. All questions were formulated with concrete reference to the materials used. E.g. "can you show me in which of these groups there are more apples"?; "can you show me which of these glasses have the same amount of water?"

Conservation pretest: As a conservation pretest the Concept Assessment Kit-Conservation (form A) was used (Goldschmid and Bentler

1968). This test contains items for conservation of two-dimensional space, number, substance, continuous and discontinuous quantity and weight. The experimenter begins with two identical objects (e.g. balls of clay). Than one of the objects is transformed, e.g. one of the clayballs is rolled into a sausage. A child's conservation judgment is scored as correct if, after the transformation of one of the objects by the experimenter, it says that the objects are the same (in amount, number or weight). Its response to the question "Why?" is scored as correct only if its judgment was scored as correct and if the reason it gives falls in one of the following three categories:

1. Identity: "You did not add or substract anything"; "It is the same number".
2. Compensation: "This glass is taller, but it is also thinner"; "The sausage is longer, but thinner".
3. Reversibility: "If we put this back into the glass, it would be the same"; "If we made this back into a ball, it would be the same".

Matching: Following the pretests the children were divided into two groups, matching for conservation and relational terms pretest scores, sex and age. This resulted in an experimental and a control group with mean ages 67.2 and 66.8 months, conservation pretest scores 2.41 and 2.35 and relational terms pretest scores 21.23 and 21.17 respectively. As a check on the effectiveness of the matching procedure differences in pretest scores between the two groups were tested (Mann Whitney U). The results (conservation pretest: $z = 0.13$, relational terms pretest: $z = 0.19$) were satisfactory.

Training: The day after the pretest the children in the experimental group were trained on the sixteen real object items of the relational terms pretest. Training started with giving feedback of right or wrong. If a child failed to give the correct answer, the next step consisted of simplifying the item (i.e. changing the spatial arrangement or reducing the number of elements), or reformulating the question (e.g. "which of these would you like to have most?").

When the child succeeded in solving the simplified version, the experimenter worked back to the original item. Almost all children could answer the items correctly then. Those who still failed received no additional training. Following the training the children in the experimental group were tested on the pictorial items of the relational terms pretest. The control group received no training.

Posttests: Two days after the training of the experimental group, all children were tested on a parallel form of the relational terms test and on form B of the Concept Assessment Kit-Conservation, a parallel form of the conservation pretest.

Relational terms pretest : No significant differences were found between continuous and discontinuous items ($t = 1.95$, $df = 33$, n.s.), nor between pictorial and real objects items ($t = 1.87$, $df = 33$, n.s.). Items involving "same" were significantly more difficult than items involving "more" ($t = 7.26$, $df = 33$, $p < .001$), and items involving "less" ($t = 5.69$, $df = 33$, $p < .001$), which is in agreement with hypothesis seven. Items concerning "more" did not differ significantly from items involving "less" ($t = 1.60$, $df = 33$, n.s.).

Conservation pretest : Children who gave correct judgments and correct reasons on all six items are considered conservers. Children who gave incorrect judgments on all six items are considered non-conservers. Children not in one of these categories are considered partial con-

	identity	compensation	reversibility	perceptual	rest	number of reasons
NC	4 (3%)	—	—	106 (80%)	22 (17%)	132
PC	31 (43%)	3 (4%)	—	21 (29%)	17 (24%)	72

TAB. 1. NUMBER OF REASONS GIVEN BY NON-CONSERVERS (NC) AND PARTIAL CONSERVERS (PC) IN SUPPORT OF THEIR CONSERVATION JUDGMENTS ON THE PRETEST

servers. Applying these criteria, both the experimental group and the control group consisted of eleven non-conservers and six partial conservers. The kinds of reasons given by non-conservers and partial conservers are presented in Tables 1 and 2. Non-conservers mainly gave perceptual reasons (e.g. "There is more water because this glass is thinner"), whereas partial conservers gave more identity than perceptual reasons ($\chi^2 = 56$, $df = 1$, $p < .001$); these results confirm

	identity	compensation	reversibility	perceptual	rest	number of reasons
NCR	1 (4%)	1 (4%)	—	17 (74%)	4 (18%)	23
CR	30 (61%)	2 (4%)	—	4 (8%)	13 (27%)	49

TAB. 2. NUMBER OF REASONS GIVEN BY PARTIAL CONSERVERS IN SUPPORT OF THEIR NON-CONSERVATION RESPONSES (NCR) AND CONSERVATION RESPONSES (CR) ON THE PRETEST

hypotheses three and four. As shown in Table 2, partial conservers gave primarily perceptual reasons in support of their non-conservation responses and identity reasons in support of their conservation responses ($\chi^2 = 33$, $df = 1$, $p < .001$); this confirms hypothesis five.

Relational terms posttest : As shown in Table 3, for the control group, scores on the relational terms pre- and posttests did not differ significantly ($z = 0.79$, n.s., Wilcoxon's sign rank test). For the experimental group, scores on the posttest were significantly higher than on the pretest ($z = 3.43$, $p < .001$); this confirms hypothesis one. Results

	C	E
pretest	21.17	21.23
posttest	21.95	26.35

TAB. 3. MEAN SCORES FOR THE EXPERIMENTAL GROUP (E) AND THE CONTROL GROUP (C) ON THE RELATIONAL TERMS PRE- AND POSTTEST

of further analysis, presented in Table 4, indicate that progress was most marked on the real object items ($z = 3.51$, $p < .001$), the kind of item used in the training. On the pictorial items pre- and posttest scores did not differ significantly ($z = 1.41$, n.s.). However, scores on the pictorial items of the pretest administered immediately after

	real objects	pictures
pretest	10.06	11.18
posttest	14.18	12.18

TAB. 4. MEAN SCORES FOR THE EXPERIMENTAL GROUP ON REAL OBJECT ITEMS AND PICTORAL ITEMS OF THE RELATIONAL TERMS PRE- AND POSTTEST

training, were significantly higher (M = 13.82) than scores on both pretest ($z = 3.51$, $p < .001$) and posttest ($z = 2.66$, $p < .01$). These last results indicate that transfer of the training to pictorial material is relatively short-lived.

Conservation posttest: As shown in Table 5, for the control group, scores on the conservation pre- and posttests did not differ significantly ($z = 0.10$, n.s.). For the experimental group, scores on the posttest were significantly higher than on the pretest ($z = 2.52$,

	C	E
pretest	2.35	2.41
posttest	2.23	4.59

TAB. 5. MEAN SCORES FOR THE EXPERIMENTAL GROUP (E) AND THE CONTROL GROUP (C) ON THE CONSERVATION PRE- AND POSTTEST

$p < .01$); this confirms hypothesis two. Both pretest partial conservers and non-conservers gave more correct judgments and more correct reasons.

DISCUSSION

Our main hypotheses (hypotheses one and two) about the positive effects of the training were confirmed. Different from Hamel et al.

(1972) the progress in conservation cannot be attributed to direct response training.

The confirmation of hypotheses three, four and five on the reasons given for conservation judgments, sustains the findings of Hamel et al. We agree with their conclusion that these results support Bruner's view that recognition of identy plays an important role in conservation acquisition. We could not confirm the finding of Hamel et al. that the use of relational terms is more difficult with continuous than with discontinuous material (hypothesis six). In our opinion Hamel's results are due to the differences in item format between continuous and discontinuous items. For his discontinuous items there are two, for his continuous items there are three answer alternatives to choose from. Further more, assuming that on each of Hamel's three questions ("where are more", "where are less", "where are the same") a correct answer is possible, it follows that on the discontinuous items for one of these questions both alternatives will be correct. From the above it is evident that for Hamel's discontinuous items the chance probability to give a correct answer is appreciably higher than for his continuous items. Our finding that "same" is more difficult than "less" or "more" is consistent with the results of Griffiths et al. (1967). Items involving "more" did not differ significantly from items involving "less". This is consonant with the finding of Donaldson and Balfour (1968), Palermo (1973) and Holland and Palermo (1975), that three to five year olds treat "less" as a synonym of "more".

Increase in the correct use of relational terms and promotion of conservation reactions following our training parallel the findings of Hamel et al. In our opinion Holland and Palermo's negative finding can be considered a consequence of their rather uniform training material and a resulting lack of transfer to the conservation tasks.

Recently an information processing alternative (Bryant, 1974, Bower, 1974) for the Piagetian approach to cognitive development is getting more and more attention. We tend to agree with Harris (1977) that the conflict between the two approaches may force us to conceive of mental operations as functioning on two levels: "a set of developmentally stable operations for classifying, transforming and comparing data, and an increasingly coherent and stable set of principles for justifying the conclusions which are reached by means of these relatively invariant mental operations". In our opinion the effects of language training – for instance relational terms training – on conservation can be interpreted as a training in justification. The empirical evidence of language training research can elucidate which part of Piagetian structural theory can be replaced by a set of rules describing how children learn to justify the conclusions they reach by their mental operations.

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