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THE EFFECT OF STIMULUS FAMILIARITY ON THE CONSERVATION PERFORMANCE OF RURAL GUATEMALAN CHILDREN* [1]

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SUMMARY

Twenty boys and 20 girls at five and seven years of age in rural Guatemala were tested and then retested after a one-month interval on four conservation tasks. The conservation tasks were the following: conservation of continuous quantity, conservation of matter, and two tests of conservation of area—one with familiar and the other with unfamiliar stimulus materials.

Performance on the conservation of area task with familiar stimulus materials was found to be superior to the area task with unfamiliar materials, as well as to the other conservation tasks. Conservation performance also improved from first to second testing. The results suggested that both the age at which conservation develops and the sequence of development of different conservation abilities may be affected by the use of familiar stimulus materials. Also, the importance of retesting, particularly in cross-cultural research, was discussed.

A. INTRODUCTION

The study of the attainment of conservation, marking the transition from a preoperational phase of thinking to concrete operational thought, has been a popular target for cross-cultural research. In general. most investigations have replicated the age specific cognitive stages identified by Piaget, suggesting that the attainment of concrete operations may be universal (3, 4, 6). Indeed,

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both Greenfield (7) and most recently Lloyd (8) have pointed out that most cross-cultural conservation research reflects a timetable approach, simply comparing performance of Western and non-Western children on standard conservation tasks.

One issue of both theoretical and methodological importance that has been addressed by cross-cultural investigators of conservation is the effect of stimulus familiarity on conservation performance. Price-Williams (12) employed stimulus materials familiar to the indigenous Nigerian culture and found conservation of quantity to be evident at the same age reported for Western societies. However, as Lloyd (8) pointed out, he did not use standard Western materials as controls. Lloyd (8), also working in Nigeria, examined conservation of number and continuous quantity, using both familiar and alien materials and found no differences in performance as a function of type of material.

In a subsequent study, Price-Williams (13) reported that children from pottery-making families in Mexico conserved at earlier ages on a conservation of matter task using clay than did children from similar but nonpottery making families. It is not clear, however, whether these differences in performance were due to differential familiarity with the stimulus materials or to basic differences in cognitive capacity stemming from the greater experience of the children from the pottery-making families in the manipulation of clay.

The role of stimulus materials in relation to conservation performance has also been investigated in several studies in the United States. Uzgiris (15) reported that performance varied with changes in stimulus materials for several conservation tasks (substance, weight, and volume) and suggested that past experiences may account for such situational specific responses. In addition, Calhoun (1) and Lovell, Healey, and Rowland (9) have employed the concept of stimulus familiarity to account for discrepancies in the sequence of development of conservation as postulated by Piaget. In sum, studies have been reported, both in the United States and in other parts of the world, in which conservation performance was found to interact with the stimulus materials used. Furthermore, several authors have invoked the notion of stimulus familiarity to explain this interaction.

The present study was an attempt to test the effect of stimulus familiarity on a conservation of area task in rural Guatemala. In addition, performance on the conservation of area task is compared with performance on other types of conservation for the same children. Finally, changes in performance over a one-month interval are reported for all conservation tasks.

B. Method

1. *Subjects*

The subjects comprised almost the entire population of five- and seven-year-old children of a semirural village in Guatemala, Central America. The pueblo of Canalitos is a Spanish-speaking, predominantly agricultural community of about 2000 people located 15 kilometers from Guatemala City, capital of Guatemala.

Subjects were tested during a one-month period and then retested during the following month in the same order and on the same tests. Thus, each child was tested two times on each test, and the testing sessions were one month apart. The design provided for 80 children balanced for age (five and seven years) and sex within age. All subjects were not available for the retesting because of the lack of cooperation of some families. Thus, the four groups at second testing were five-year-old boys ($N = 18$), five-year-old girls ($N = 17$), seven-year-old boys ($N = 17$), and seven-year-old girls ($N = 19$).

The children typically did not attend school until seven or eight years of age. None of the five-year-olds and only 12 of the seven-year-olds were attending school (six boys and six girls).

2. *Experimenters*

The conservation tasks were administered and scored by an experienced female Guatemalan psychometrist. The psychometrist was trained and standardized on the conservation tasks in a day-care center in Guatemala City and achieved 100% interscorer reliability with a second Guatemalan psychometrist.

3. *Procedure*

a. General. The conservation data reported here were part of a larger cross-sectional study which included 11 psychological tests. The tests in the battery were presented in a standard order during two sessions on the same day beginning with the conservation tasks reported here.

b. Conservation tasks. Four conservation tasks adapted from standard experiments modeled after Piaget and others (3) were employed. These were conservation of continuous quantity, conservation of matter, and two conservation of area tasks—one with familiar stimulus materials, area (farm); and the other with unfamiliar stimulus materials, area (cubes). The tasks were presented in the order just described, on a table between the subject and the experimenter.

As a metric for the determination of stimulus familiarity has not been reported in previous conservation research, the present study included a sample of adults who were asked to judge the familiarity of the two conservation of area tasks. Twenty mothers of the subjects were shown the two sets of stimulus materials after the children were tested. None of the mothers witnessed the testing procedure. The materials were described to the mother as two different toys, and the mother was asked to judge which of the toys was more familiar to her child. Ninety-five percent of the mothers reported that the area (farm) materials were more familiar to their children than the area (cubes) materials.

The internal structure of each of the tasks involved the initial presentation of two stimuli judged as equal by the child, followed by a series of transformations which changed the perceptual quality of one of the two stimuli. Following each transformation, the child was asked to judge the equality of the two stimuli. The equality of the stimuli was re-established before each transformation for three of the conservation tasks: conservation of continuous quantity, conservation of matter, and conservation of area (cubes). This procedure was not used in the conservation of area (farm) task, since the transformations in this task involved the addition of new stimuli. Finally, 44 of the 71 children (62%) tested during the retesting session, one month later, were asked to supply reasons or justifications for their responses.

c. Continuous quantity. Two 185 ml glasses (A and B) were each half filled with water. With glass B in view of the child, three transformations followed in which the water from glass A was successively poured into the following containers: A 100 ml graduated cylinder, a flat saucer type bowl, and six other identical glasses. In the last transformation, the water in glass B was also equally divided into three identical glasses. After each transformation, the subject was asked if the amount of water in the new container(s) had more, the same, or less water than glass B.

d. Substance. Two balls, A and B (15 cm circumference) of yellow plasticine were shown to the subject. With ball B in view of the child, ball A was successively transformed into the following shapes: A pancake, a sausage, and a sausage divided into four smaller sausages and placed in a linear fashion on the table. In the last transformation, ball *B* was also transformed into one long sausage. The subject was asked, after each transformation, if the amount of clay in the transformation of ball A (for example, the pancake) was more, the same, or less than the amount of clay in ball B.

e. Area. Two conservation of area tasks were used to assess the effect of familiar and unfamiliar materials on conservation. In the area (farm) experiment (familiar materials), two identical green boards, A and B (35 cm × 35 cm), were presented to the subject as pastures of grass. A toy cow was placed in the center of each green board pasture, A and pasture B, and the subject was asked whether or not the two cows had the same amount of grass to eat. The subject was then told that a farmer wanted to build a house on each pasture; the examiner then placed a model house in a corner of each field. Three more houses were then added to each field. In pasture B the houses were adjacent to each other in a corner, whereas in pasture A the houses were scattered over the pasture. After the addition of each house, the subject was asked if the cow in pasture B had more, the same, or less grass to eat then the cow in pasture A.

In the area (cubes) task (unfamiliar materials) two squares, A and B, each composed of six 21 cm^3 red cubes were shown to the subject. Six transformations followed in which square A was rearranged so as to form various flat geometric shapes. During these transformations, both the transformed square and the original square remained in front of the subject. After each transformation, the subject was asked if the cubes in square B occupied more, the same, or less than the cubes in square A.

f. Scoring. Proportion of correct responses was calculated by comparing each subject's total number of correct responses with the total number of possible responses for each conservation task. Proportions rather than means were used, since the four conservation tasks differed with respect to the number of possible responses. For both conservation of continuous quantity and conservation of matter, there were three transformations, so that a subject's score ranged from zero to three. Conservation of area (farm) and area (cubes) consisted of four and six transformations, respectively, and a subject's score, therefore, ranged from zero to four and zero to six.

The reasons or justifications given by the subjects for their responses were not subjected to statistical analysis because most were completely uninformative. When asked to explain why two stimuli were the same or different, a common response was "*porque si*" ("because they are").

C. Results

Analyses of variance were performed first, to determine the effects of age, sex, and repeated testing on conservation performance and, second, to compare performance across the four tasks.

All analyses were based on the proportion of correct conservation responses for each of the four tasks. The mean proportion of correct conservation responses by age, sex, and testing are presented in Table 1.

TABLE 1
MEAN PROPORTION OF CORRECT RESPONSES FOR FOUR CONSERVATION TASKS BY AGE, SEX, AND TESTING

		5 Years				7 Years			
		Boys		Girls		Boys		Girls	
Task	Range	Testing 1 ($N = 20$)	Testing 2 ($N = 18$)	Testing 1 ($N = 20$)	Testing 2 ($N = 17$)	Testing 1 ($N = 20$)	Testing 2 ($N = 17$)	Testing 1 ($N = 20$)	Testing 2 ($N = 19$)
Continuous quantity	0-3	.02	.17	.10	.12	.23	.33	.18	.19
Matter	0-3	.07	.09	.10	.10	.12	.28	.15	.12
Area (farm)	0-4	.11	.38	.28	.29	.43	.66	.44	.51
Area (cubes)	0-6	.18	.13	.16	.12	.23	.22	.20	.22

To assess the relation between performance and the factors of age, sex, and repeated testing, a 2 (sex) × 2 (age) × 2 (testing) analysis of variance with repeated measures over the last factor was performed for each conservation task. Performance on conservation of continuous quantity and conservation of area (farm) improved with age irrespective of sex or repeated testing ($F = 5.34$, $df = 1/66$, $p < .05$, and $F = 8.08$, $df = 1/67$, $p < .01$, respectively). However, for both conservation of matter and conservation of area (cubes), performance did not improve across the five to seven age range.

Repeated testing was associated with significant improvement in performance across the one-month period for both conservation of continuous quantity and conservation of area (farm), $F = 4.04$, $df = 1/66$, $p < .05$, and $F = 3.34$, $df = 1/67$, $p < .07$, respectively. This was also the case for conservation of matter, though only for boys, as indicated by a significant sex × testing interaction ($F = 4.46$, $df = 1/66$, $p < .05$). Apart from this sex × testing interaction, there were no performance differences associated with the sex of the child. For the conservation or area (cubes) task, there were no significant main effects or interactions.

To compare performance across the four tasks, a 2 (sex) × 2 (testing) × 4 (task) analysis of variance was performed with repeated measures over the last two factors. Significant main effects were found for age ($F = 7.16$, $df = 1/65$, $p < .01$) and task ($F = 24.60$, $df = 1/195$, $p < .001$). As discussed above, the age effect was due to the improvement in performance between ages five and seven for conservation of area (farm) and continuous quantity. The main effect for task was associated with superior performance on the area (farm) task as compared to performance on the other three conservation tasks.

However, those main effects must be interpreted in the light of two interaction terms: age × task ($F = 3.45$, $df = 3/195$, $p < .05$) and testing × task ($F = 3.33$, $df = 1/195$, $p < .05$). The age × task interaction was due to superior performance at both five and seven years of age for the area (farm) task. Performance on the other three tasks did not differ from each other at either age.

The significant testing × task interaction reflected a similar pattern. For both first and second testing, performance on conservation of area (farm) was superior to performance on each of the other conservation tasks, while performance levels did not differ among the other three tasks.

D. Discussion

The finding that performance on conservation of area (farm) was superior not only to conservation of continuous quantity and conservation of matter, but also to the other conservation of area (cubes) task, is consistent with other investigations in which conservation performance was found to vary positively with stimulus familiarity (1, 9, 13, 15). This group of studies underscores the importance of interpreting the results of conservation studies with an eye to the appropriateness of the task and the familiarity of the test stimuli.

The results of the present study are also germane to the issue of the age at which conservation develops. Several investigators have reported approximately 75% conservation behavior between seven and nine years of age on tasks similar to those used here (3, 7, 8, 11, 12). Similarly, Goodnow (6) studying three groups of 11-year-old boys on the same conservation of area (farm) task reported here, found 80% conservation performance among "unschooled" Chinese compared to "average" and "dull" North American boys who showed 60% and 40% conservation performance, respectively. In comparison, the findings from the present study suggest that conservation can be demonstrated at earlier ages if familiar stimulus materials are employed. Thus, for the conservation of area (farm) task, the performance of the seven-year-old Guatemalan children compared favorably with the 11-year-old sample reported by Goodnow (6).

The issue of the sequence of development of the various types of conservation is also addressed by these data. Piaget (11) and others (3, 5) reported that conservation of continuous quantity and conservation of matter develop earlier than conservation of area, weight, and volume. This sequence was not observed in the present study. Rather, performance for the conservation of area (farm) task was clearly superior to the other conservation tasks, at both five and seven years of age and for both testing sessions. Thus, it may be argued that the sequence of development of conservation is both a function of the stimulus materials used and the general familiarity of the problem. In an agriculturally based community, such as Canalitos, conservation of area may be demonstrated earlier than conservation of continuous quantity or conservation of matter when familiar stimuli are used in the context of a "real" problem.

Finally, powerful testing effects appeared for two of the conservation tasks. Improvement in conservation performance has been found in conservation training studies in both training and control groups (10, 14) in Western cultures. While these studies have attributed improvement in performance to the "natural" growth of conservation, it is likely that the improvement in the present research is related to the fact that the children in this study had not previously participated in a formal testing session. Since the conservation tests were part of a larger battery, the subjects received considerable practice in test taking between the test and retest sessions. Investigators in other villages in Guatemala have also revealed dramatic improvement in performance across similar test-retest intervals for many different types of cognitive tasks (2).

Inasmuch as previous conservation studies have only examined changes in conservation performance across relatively short intervals in Western societies, these findings should furnish a sober warning to cross-cultural investigators who rely on a single testing of children in societies in which the skills necessary for optimal performance on psychological tests are not normal products of the socialization process.

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