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Correlation of Perceptual and Cognitive Measures in Older Institutionalized Men

Carol Ann Horvat Kominski
College of William & Mary - Arts & Sciences

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CORRELATION OF PERCEPTUAL AND COGNITIVE MEASURES
IN OLDER INSTITUTIONALIZED MEN

A Thesis
Presented to
The Faculty of the Department of Psychology

In Partial Fulfillment
Of the Requirements for the Degree of
Master of Arts

By
Carol A. Kominski
1968
This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Arts

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Approved, May 1968

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Robert T. Brown, Ph.D.
ACKNOWLEDGEMENTS

The author wishes to express her appreciation to Professor Peter L. Derks, under whose guidance this investigation was conducted, for his patient guidance and criticism throughout the investigation. The author is also indebted to Professor Robert T. Brown for his careful reading and criticism of the manuscript.

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Scaled Diagram of Muller-Lyer Illusion Apparatus
ABSTRACT

102 institutionalized veterans from 50 to 81 years of age were given Piaget's test to measure the concept of conservation of surfaces. Realistic instructions, as in the original Piaget test, and abstract instructions were compared. In addition, the Muller-Lyer illusion was administered. A small amount of regression to a more primitive cognitive level of functioning occurred under both instruction conditions with advancing age. Methods of instruction produced no differences between groups. Also no significant differences between age groups on the Muller-Lyer illusion were found. However, stage of cognitive development and accuracy of Muller-Lyer illusion score were positively correlated. Common deterioration in perception of part-whole relations was postulated to account for the relationship.
CORRELATION OF PERCEPTUAL AND COGNITIVE MEASURES
IN OLDER INSTITUTIONALIZED MEN
INTRODUCTION

Conservation of surfaces implies that objects of identical size take up the same amount of space regardless of how they are arranged. Piaget (1960), in illustrating his developmental theory, found three stages in the development of conservation of surfaces in children from five and one half to nine or ten years. At a primitive or Stage 1 level, the child perceives objects to be taking up unequal amounts of space whenever their arrangements differ. At intermediate levels or Stage 2 thinking, the situation is ambiguous to the child and he is likely to vacillate in his responses. At the advanced, mature level of Stage 3, conservation of surfaces is fully recognized. Borrowing techniques used by Piaget to test cognitive development in the young child, Sanders, Laurendeau, and Bergeron (1966) examined a cross-section of primarily non-institutionalized adults divided into three age groups, one 20-39 years old, another 40-59 years, and a third 60 years and over. Sanders et al. found a marked deterioration in the concept of conservation of surfaces with age since 75% of the S's in the oldest group performed at the initial, most primitive stage.

Many studies have reported intellectual deterioration with age in a number of other areas (Birren, 1964; Birren, Butler, Greenhouse, Sokoloff, and Yarrow, 1963; Jones, 1959) but as
Sanders et al. pointed out, "rarely does one find studies pertaining to the use and/or deterioration of concepts in the aged (p. 281)."

Evidently the conservation of surfaces test was more sensitive than other tests such as the Wechsler-Bellevue which shows less deterioration in aged S's. According to Reed and Reitan (1963), deterioration is much greater on tests requiring active problem-solving behavior than with tests of reinstatement or recall of stored information. Nevertheless, although there is a significant deterioration in performance with some active problem-solving tests, it does not appear to be as marked as that demonstrated by Sanders et al. On the Piaget task used in the study by Sanders et al., 75% of the older S's apparently performed at the level of a child younger than six. In other tests such as the block design of the Wechsler-Bellevue (Reed and Reitan, 1963), the median or modal mental age scores, when interpolated, are probably nearer 11 or 12 years at the lower limit.

One purpose of the present study was to replicate the findings of Sanders et al. By examining a somewhat larger group of late middle-aged as well as older S's, it might be possible to delineate the developmental curve more precisely around the age at which the proportion of S's functioning at a primitive level increases most markedly.

Sanders et al. used a problem in which the instructions emphasized a realistic situation where a farmer builds houses
and barns on fields where cows graze. As Sanders, Laurendeau, and Bergeron put it, "one might suspect that aged adults have not lost the concept of the conservation of surfaces but rather that they find it difficult to abstract this aspect of the problem from their experience (p. 284)." Sanders et al. add, however, that "confirmation of our findings in the other two Piaget tasks used, and in which the same practical difficulties did not exist, support our interpretation of these findings (p. 284)." But the titles of the other two tests, "The Model Village or the Task of Situating a Little Man in a Model Layout" and "The Three Mountains or the Coordination of Perspectives" suggest that they also may be contaminated with experiential factors to some extent. Thus, in the present study, instructions were varied in the same task, i.e., instructions stressing spatial and geometric relationships rather than "as if" real life situations were presented to another group of S's in order to control more directly for these factors.

Sanders et al. suggested that it would be interesting to correlate the concept of space in the aged with various perceptual measures. Piaget and Albertini (1950) studied the Muller-Lyer illusion and found a decrease in the illusion with advancing age up to early adulthood. Continuing the study of development in this illusion, Wapner, Werner, and Comalli (1960) and Comalli (1965) found a gradual increase in the extent of the illusion with advancing age up to 90 years. From the early
twenties to the late thirties, the illusion remained relatively stable but after age 40 there was a highly significant increase. However, in the above studies, the difference between the age groups 65-80 years and 80-90 years was not significant although in the expected direction. Moreover, no individuals in the age group 50-65 years were studied. The present study examines the illusion in S's of this age and also uses a larger sample size than did Comalli and his associates.

The performance of the aged on the Muller-Lyer illusion and the Piaget conservation of surfaces test represents an increase in global perception and a decrease in the articulation of parts. According to Wapner et. al. (1960), "the Muller-Lyer illusion is based on a relationship of assimilation to parts: that is, there is assimilation of the horizontal lines to the total configuration. The decrease in susceptibility to the Muller-Lyer illusion from early to middle age is conceived to be a manifestation of decrease in global perception. This increases again at older ages (p. 415)." In short, the Muller-Lyer illusion shows increasing differentiation of percepts from childhood to adulthood and decreasing differentiation of percepts from adulthood to old age.

As in the Piaget test, other studies not dealing specifically with the perception of part-whole relations show a regression to an earlier stage of development with advancing age. One notable study is that of Comalli, Wapner, and Werner (1959) where
the effect of body tilt on perception was shown to be similar in old age to that which occurs in the young child. Just as the effect of body tilt on perception of verticality in old age was interpreted as greater determination of the object world with the self as referent or, in other words, decreased differentiation of self and world, so, too, performance on the Piaget test in old age can be interpreted as decreased differentiation between the perceptual, more immediate field and the conceptual, more external and objective one, between the perceptual effect of differences in configurations and the conceptual operations of addition and subtraction.

The Muller-Lyer illusion, the perception of the vertical, and the conservation of surfaces tests all demonstrate the more general developmental law of increasing differentiation from childhood to adulthood and the reverse with development from adulthood to old age.

Flavell (1963), in his discussion of Piaget's developmental system, emphasizes the essential unity of progression in the development of all structures, both perceptual and cognitive. Both the Muller-Lyer illusion, a perceptual test, and the conservation of surfaces, a cognitive test, measure increases and decreases in differentiation. Therefore, a correlation between the two would be expected.

Four main hypotheses were tested in the present study.
The number of men functioning at Stage 1 will increase with age from 50-81 years.

A greater number of S's will function at Stage 1 with the realistic instructions than with the abstract instructions.

The Muller-Lyer illusion will increase with advancing age from 50-81 years.

There will be a positive correlation between Piaget stage and accuracy of Muller-Lyer illusion score, i.e., the higher the stage, the less the illusion.
METHOD

Subjects.

Subjects, ranging in age from 50 to 81 years, were 102 male residents of the domiciliary at the Veterans Administration in Hampton, Virginia. All residents who volunteered when asked by their respective section leaders to participate in a research study on aging were tested. In order to test the hypothesis that the number of men functioning at Stage 1 will increase with age, S's were divided into three age groups, one composed of S's from 50-59 years (n= 20), another of S's from 60-69 years (n= 35), and a third composed of all S's 70 years and over (n= 47).

Apparatus.

Conservation of surfaces test. For the realistic instructions group, two 9" x 12" pieces of green cardboard were used to represent the green fields where cows graze and buildings are erected. In the abstract instructions group, the same two pieces of cardboard stand for the two areas upon which cubes are placed. Twenty-four one-inch square blocks were used to represent the buildings and cubes respectively.

Muller-Lyer illusion. The segment of the Muller-Lyer illusion to be matched was nine inches in length. The illusion-creating angles were 90° (45° above and 45° below the line) at the ends of the fixed line segment and 270° (135° above and 135° below
the line) at the ends of the adjustable line segment. Lines subtending the angle were one inch in length. (See Figure 1 for a complete diagram of the illusion with the relevant dimensions scaled down proportionately.)
FIGURE 1

SCALED DIAGRAM OF MULLER-LYER ILLUSION APPARATUS

fixed (9 in.) adjustable
Procedure.

The S's were divided randomly into two instructions groups matched for age. Each S was first presented with the conservation of surfaces test and then with the Muller-Lyer illusion.

R- instructions. In the realistic instructions, E placed two green pieces of cardboard in front of S. The S was then told to imagine them as two green fields full of grass. He was then told that Molly, an imaginary cow, could graze on the field on the right, and Peggy, another imaginary cow, could graze on the field on the left. After this, S was shown some one-inch cubes and told to imagine them as buildings. E emphasized that both fields and all houses were the same size. Houses were either added or taken from one field to the other or moved from one place to another. When in each case the arrangement was changed, S was asked: "Does one cow have more grass to eat than the other or do they both have the same amount?" (See Appendix A for verbatim instructions.)

A- instructions. These instructions stressed abstract spatial and geometric relationships and avoided reference to real-life situations. The S was shown the same materials as in R-instructions but the two green cardboards were referred to merely as areas and the cubes referred to merely as cubes. Each time the arrangement was changed, S was asked: "Does one area have more space than the other or do they both have the same
amount of space?" (See Appendix A for verbatim instructions.)

There were twelve different problems or configurations of cubes on the two green pieces of cardboard and the same configurations were presented under both forms of instructions.

As in the Sanders, Laurendeau, and Bergeron (1966) study, responses were classified into three groups corresponding to Piaget's three stages in the development of the concept of the conservation of space.

Stage 1. Conservation is denied whenever placement of the blocks on the two areas is different. When the blocks are in identical patterns, S says the surfaces are equal. The different configurations are enough to give S the impression of inequality.

Stage 2. Intermediate reactions occur at this stage. The S begins by replying as in Stage 1. Whenever the blocks are not in identical positions, he denies that the remaining surfaces are equal in area. But, as one continues testing, S becomes indecisive and wonders whether different placements do indeed change the extent of the remaining empty areas. From then on, either the replies are given hesitantly or they are given systematically correctly. On the other hand, S may begin by replying correctly (as in Stage 3), but after a moment of indecision returns to a type of functioning which denies the conservation (as in Stage 1).

Stage 3. The S replies correctly and without hesitation to all the problems. In other words, his responses show that he is aware that no matter how different the arrangements of the houses
or blocks on the two fields may be, the amount of space remaining is the same if both fields or areas have the same number of houses or blocks.

For the Muller-Lyer illusion, S was required to adjust one moveable segment of the illusion to apparent equality with the other fixed segment by manual sliding. Three ascending and three descending series were given to each S. An average of the values in millimeters was used as a measure of the extent of illusion he perceived.
RESULTS

A chi-square test of the hypothesis that a greater number of S's will function at Stage 1 with realistic instructions than with abstract instructions revealed no significant effect of instructions ($\chi^2 = 2.89, p > .20$). Table 1 gives the number of men functioning at each stage of the Piaget test in abstract and realistic instructions groups respectively.
TABLE 1

NUMBER OF MEN AT EACH STAGE OF THE PIAGET TASK IN REALISTIC AND ABSTRACT INSTRUCTIONS GROUPS

<table>
<thead>
<tr>
<th>Stages</th>
<th>Abstract</th>
<th>Realistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>28</td>
</tr>
</tbody>
</table>
Since there was no difference between instructions, abstract and realistic instructions groups were combined to test the hypothesis that the proportion of men functioning at Stage 1 will increase with age. No significant differences between age groups were found ($\chi^2(4) = 5.00$, $p > .20$). The number of men and the percentage of each age group at each stage of the Piaget test are given in Table 2.
TABLE 2

NUMBER OF MEN AND PERCENTAGE OF TOTAL AT EACH STAGE OF THE PIAGET TEST FOR THREE DIFFERENT AGE LEVELS

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>7 - 35%</td>
<td>5 - 25%</td>
<td>8 - 40%</td>
</tr>
<tr>
<td>60-69</td>
<td>14 - 40%</td>
<td>3 - 9%</td>
<td>18 - 51%</td>
</tr>
<tr>
<td>70-81</td>
<td>16 - 34%</td>
<td>5 - 11%</td>
<td>26 - 55%</td>
</tr>
</tbody>
</table>
The hypothesis that there would be an increase in Muller-Lyer illusion score with advancing age was also not confirmed ($F(2) < 1, p > .05$). Table 3 gives the mean Muller-Lyer illusion scores for the three age levels.
TABLE 3

MEAN MULLER-LYER ILLUSION SCORES FOR THREE AGE LEVELS
OF INSTITUTIONALIZED MEN

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Mean (mm.) (Standard minus Variable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>32.7</td>
</tr>
<tr>
<td>60-69</td>
<td>28.4</td>
</tr>
<tr>
<td>70-81</td>
<td>33.3</td>
</tr>
</tbody>
</table>
However, a single-factor analysis of variance revealed that there was a significant difference in Muller-Lyer illusion scores obtained by S's functioning at the three stages of the Piaget task ($F(2)= 9.90, p < .001, r_m > .4$). Table 4 gives the mean Muller-Lyer illusion scores of S's divided by stages on the Piaget test as well as the results of the analysis of variance.
Table 4

DIFFERENCES ON THE MULLER-LYER ILLUSION WITH PIAGET TEST SCORE AND SUMMARY TABLE FOR ANALYSIS OF VARIANCE

<table>
<thead>
<tr>
<th>Stages</th>
<th>N</th>
<th>Median Age</th>
<th>Means (mm.) (Standard minus Variable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>68</td>
<td>38.5</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>63</td>
<td>30.7</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>69</td>
<td>27.3</td>
</tr>
</tbody>
</table>

Analysis of Variance

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>r_m</th>
</tr>
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<td>Columns</td>
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<td>56.81</td>
<td>28.40</td>
<td>9.90</td>
<td>&lt;.001</td>
<td>&gt;.4</td>
</tr>
<tr>
<td>Within</td>
<td>99</td>
<td>284.11</td>
<td>2.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>340.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
A t Test yielded a significant difference between the Stage 1 group and the Stage 3 group in Muller-Lyer illusion scores ($t(87)= 3.11, p < .01$).

Since, as Muller-Lyer illusion score increased, accuracy decreased, an accuracy score was formed by subtracting each Muller-Lyer illusion score (Standard minus Variable) from 100. An eta correlation between the accuracy of Muller-Lyer illusion score, thus coded, and stage of cognitive development on the Piaget test was .403 ($p < .001$). Thus those men with whom the illusion was least effective were more likely to be at Stage 3 than those with whom the illusion was more effective; those men with whom the illusion was most effective were more likely to be at Stage 1 than those with whom the illusion was found to be less effective.

Thus no significant age differences were demonstrated on either the Piaget test or the Muller-Lyer illusion. Whether instructions were realistic or abstract made no difference. However, Muller-Lyer illusion scores and Piaget stages were positively correlated.
DISCUSSION

In order to understand better the meaning of age changes on the Piaget task as revealed in the present study, Sanders, Laurendeau, and Bergeron's results are represented in Table 6. In the same table, the results of the present study are appended for purposes of comparison. A fourth grouping for the S's in the present study, all S's 60 years and over, has been added so that Sanders and his colleagues' oldest age group and this added grouping are directly comparable in terms of age range sampled. Sanders et al.'s 40-60 year age group and the 50 and over age group of the present investigation obviously are not directly comparable in this way, however.
TABLE 5

THE CONSERVATION OF SURFACES TEST --- PERCENTAGES OF EACH GROUP AT EACH ACHIEVEMENT LEVEL

Sanders, Laurendeau, and Bergeron

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Stages</th>
<th>20-39</th>
<th>40-59</th>
<th>60 &amp; over</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>12.0</td>
<td>25.6</td>
<td>75.8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4.0</td>
<td>2.3</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>84.0</td>
<td>72.1</td>
<td>22.6</td>
</tr>
</tbody>
</table>

Kominski

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Stages</th>
<th>50-59</th>
<th>60-69</th>
<th>70-81</th>
<th>60-81</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>35</td>
<td>40</td>
<td>34</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>25</td>
<td>9</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>40</td>
<td>51</td>
<td>55</td>
<td>53</td>
</tr>
</tbody>
</table>
Nevertheless, if one compares the results of the Sanders et al. study for their two younger age groups with those of the present study's older age group, a clear developmental trend for a more primitive level of functioning with advancing age can be seen. Yet the difference between the 40-60 year age group and the 60 years and over age group is not nearly as marked in the present study as it is in the Sanders et al. study. The lower percentage of the aged functioning at Stage 1 in the present study is difficult to explain since the present sample was institutionalized and the sample in the Sanders et al. study was not (with the exception of 11 S's who had been newly admitted to a home for the aged). The reverse result could be expected according to the findings in several studies (e.g., Comalli, Krus, and Wapner, 1965). The new findings can be explained, however, by pointing out that they are more in keeping with studies of decline in intelligence utilizing more typical intelligence tests (e.g., Reed and Reitan, 1963).

The mean Muller-Lyer illusion score in this study of older men was considerably higher than that which Comalli found for his sample of individuals under 40 years of age (the standard minus variable in comalli's study was 16.2 vs. 21.5 in this study). But nothing more definite can be said at present because details of the Muller-Lyer illusion apparatus differed somewhat from those of the illusion used in the present study. Notwith-
standing, the present results failed to show any significant changes within relatively small, that is, ten year age segments. Therefore, any phenomenon of change that may exist appears to be gradual. Significant differences probably appear statistically only when relatively large or relatively distant age segments are compared once the 40 year mark is passed.

The positive correlation between Muller-Lyer illusion scores and Piaget stage supports Piaget's thesis of the essential unity of progression in both perceptual and cognitive structures. An analysis of the two situations reveals a common deterioration in part-whole relationships. In the Piaget task, it is the inability to include an operational addition or subtraction in the analysis of the spatial situation and a reliance on perception only that leads to a "primitive" response. In the Muller-Lyer illusion, it is, according to Wapner, Werner, and Comalli (1960), an increase in global perception, a failure to assimilate the horizontal lines to the total configuration, that leads to an increase in the illusion with advancing age.

The correlation that exists between such widely divergent tasks as the Muller-Lyer illusion and the Piaget Conservation of Surfaces test tends to support an interpretation of aging emphasizing the deterioration of a wide range of abilities that may be accounted for by a deterioration in a more general factor such as Spearman's "G" or Reed and Reitan's (1963) "immediate
adaptive intelligence." Yet the Muller-Lyer illusion and the Piaget task are even more divergent than most of the tasks usually subsumed under either of these two concepts. Perhaps some even more general physiological factor is responsible for the common deterioration present in the perception of part-whole relations in both the perceptual and cognitive spheres.

On the other hand, perhaps deterioration in visual perceptual abilities is a causal factor for decline in cognitive abilities of the kind necessary for mature performance on the Piaget task. Perhaps it could be shown that on other tests of cognitive abilities, especially those which do not contain an obvious visual perception element, the correlation between Muller-Lyer illusion and the Piaget task is lower or non-existent even though both tasks may involve part-whole relations.

Evidently, considerable work of a correlational nature needs to be done and more careful analysis of the elements going into the Piaget task and the Muller-Lyer illusion would probably illuminate the relationship existing in the present study.
APPENDIX A

INSTRUCTIONS

R- Instructions.

See these two green pieces of cardboard. They are exactly identical in size. I want you to imagine them as two green fields full of grass. Molly, one cow, can graze on the field on the left. Peggy, another cow, can feed on the field on the right. Now tell me which cow has which field so I'll be sure you have them straight.

Here are some cubes colored red, green, yellow, blue, or white. They are all the same size. I want you to imagine them as buildings that a farmer, named Joe, will place on these two fields. He will put up buildings and take them down and each time he does this I will ask you which cow, Molly or Peggy, has more grass on which to feed or do they both have the same amount of grass. OK? Please repeat in your own words what I have just told you.

**Problem 1.** Farmer Joe has just bought these two fields and wants to build a house for himself and his wife to live in. (E then places one block on the field on the left.)

**Problem 2.** Now Farmer Joe wants to add a house right next to his own where his hired hand can live. (E then places an
additional block beside the original block representing the house that Farmer Joe built for himself and his wife.) After working the farm for a year, he decides that the work is too much for him. So he decides to rent out land in the other field to two men who will live in these two houses. (E then places one block in both the upper left and lower right corners of the field on the right.)

Problem 3. Now Farmer Joe has decided to build a tool shed for his things and he places it over here. (A third block is then adjoined to the Farmer's and hired hand's living quarters. Thus far there are three blocks arranged in a straight line in the left hand field.) He also decides to add two wings to the house because he now needs more room for his four children. (Two more blocks are then added to the structure on the left field.) Meanwhile, Farmer Joe hires three more men to help him take care of the farm and he now builds three more houses to take care of these men. (E adds three more blocks to the field on the right: one in the upper right corner, another in the lower left corner, and a third in the center of the field.)

Problem 4. Farmer Joe now takes all the buildings from both fields down. He has decided to do a complete renovation of both fields because he now wants to build a large farmhouse for his family and a similar one for his men. The new farmhouse has ten wings, or sections, to it, two for himself and his wife,
one for each of his four children, two for his aging mother and father who are now living with him, one for his hired hand, and one for his tools. On the other field, he builds a large farmhouse for his five men. Three of the men get two wings each, one who is a bachelor gets only one wing, and the fifth who has five children needs and gets three wings. (Ten blocks are arranged in identical positions on both fields.)

Problem 5. All Farmer Joe's children have now grown up, his mother and father in the meantime have passed away, and his youngest child is the only member of the family who still remains living with him. Joe decides that the large farmhouse is much too big for himself and his wife alone so he takes it down. He then builds a small cottage for himself and his wife in this corner (upper right), another one for his youngest child here (lower right), a tool shed here (lower left), and a small cottage here for his hired hand (upper left). (Four blocks, one in each corner, are then placed on the left hand field.) Meanwhile the bachelor who worked the other field no longer works for Farmer Joe and the other men's children have all grown up and left the farm. Therefore, the men who work the other field do not need a large farmhouse either. In order to spread the men equally over the field, Joe builds four houses for them, like so. (Four blocks are then arranged with corners touching, as diagrammed.)
Problem 6. In the meantime, Farmer Joe's youngest child has moved away and one of the hired men has also left. Consequently, Farmer Joe decides to tear his youngest child's house down and not replace it with anything. On the other field, he takes down the house of the man who left and moves the houses to these three corners of the field (upper left and right hand corners, lower left corner.)

Problem 7. Farmer Joe sells the fields to Farmer Bill because farming has become too much of a strain on his failing health. But Bill's ideas are somewhat different. His wife has run a small dressmaking shop for a number of years. She has had three or four women working for her up to this time but now she sees the opportunity to open a bigger business and wants to hire more. To satisfy her, Bill puts up a large building with twelve compartments, four of which are the front offices where his wife does business and eight of which are for each of the eight women who work in the dressmaking shop. (E then arranges twelve blocks in connected rows of four blocks each in the upper left hand corner of the field on the left.) On the other field, Farmer Bill builds eight individual houses for the eight women who work in the dressmaking shop, two for his farm workers, and two for his family. (E then arranges twelve disconnected blocks in the field on the right in rows of four.)
Problem 8. Farmer Bill decides to cut down on size. Three of the women have been released from his wife's dressmaking shop so he does away with three of the wings and rearranges five others. (E then arranges the nine blocks representing the dressmaking shop in a solid row along the top of the left field. On the other field, he takes down three of the houses where these women lived. (E removes three of the structures from this field in a random fashion.)

Problem 9. Farmer Bill decides to move into the city. Farmer Frank purchases the field from him. A considerable number of people have just been hired at the new industrial plant which was opened out in the country recently and Frank thinks he can make a little bit of money by building homes to rent out to these people who have no permanent residences for the time being. Therefore he builds eight houses on this field (the left). He then builds a house with two wings for his family (two blocks in upper right corner), a building with two wings for two heavy pieces of farm equipment (two blocks in lower left corner), and four more houses (two houses represented by adjoining blocks in both upper left and lower right corners) for the four men who work the field for him.

Problem 10. Frank tears down all the houses and equipment sheds (on the right field) because he decides that the farm could be run more efficiently if the two men who now work for him (he's
gotten rid of two) live with his own family and eat in the same kitchen (his wife is an expert cook). In this way, his machinery can also be kept under close watch. One rented house on the other field is also destroyed since at most times Frank does not get more than six families to rent his houses anyway and as it is, one of the seven houses will probably still be vacant most of the time.

Problem 11. Now it is not nearly as easy to rent Farmer Frank's cottages as it was formerly since most of the employees from the industrial plant have managed to build homes of their own and the plant is not expanding at a fast enough rate to make for many new employees. Therefore, maintenance of the seven cottages is more costly than the amount of revenue coming in from rental payments would justify. Frank tears down the cottages and decides to build a movie theatre on the field since most of the people in the area lack opportunities for entertainment. He also decides to build a modern style farmhouse spread out Texas style for his family and the two men who work for him. He has gotten rid of his heavy equipment and now has a two car garage. (For the movie theatre, E arranges eleven blocks in the upper left corner of the left field in two connected rows of six and five blocks each. For the ranch style farm house, E arranges a row of nine blocks at the bottom of the right field in a solid row with a second row of two blocks on the far right.)
Problem 12. Frank doesn't like the spread out farmhouse and builds a house centered around a courtyard. (E arranges four blocks enclosing an empty space on four sides on the right field.) The moviehouse is not too profitable, either. He tears that building down. But renting can again prove profitable because a new industrial plant has just opened its doors and a flood of new employees will be seeking temporary residences. Frank builds four houses to rent on the left hand field.

After each one of these problems was presented to S, the same question was asked: "Does one cow have more grass to eat than the other or do they both have the same amount?"

These instructions were not administered verbatim to every S but were adhered to as closely as was practicable when one of the major aims of the presentation was to keep the dialogue as spontaneous as possible.

A- Instructions.

I want you to look at these two green pieces of cardboard. I will speak of them as areas. They are exactly identical in size.

Here are some cubes colored red, green, yellow, blue, or white. They are all exactly the same size also.

I am going to place these cubes on these areas in various arrangements and each time I change the arrangement, I am going to ask you to tell me if one area has more space left then the
other or if they both have the same amount of space remaining.

OK? Please repeat in your own words what I have just told you.

For the abstract instructions group, little verbal inter-
change was necessary beyond this point. The arrangement for
each problem was identical to the arrangement under the
realistic instructions, but the only verbal instructions the
S's were given were simply to answer the question: "Does one
area have more space than the other or do they both have the
same amount of space?"
APPENDIX B

THE PERFORMANCE OF TEN YOUNG SUBJECTS ON THE PIAGET
CONSERVATION OF SURFACES TEST --- R INSTRUCTIONS

The S's used in this survey were employees of the Veterans Administration in Kecoughtan, Virginia. All volunteered to participate in a research study on aging.

<table>
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<tr>
<th>Age of S</th>
<th>Stage on Piaget Task</th>
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<tbody>
<tr>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
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<td>3</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
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</tbody>
</table>

Although the above sample was very small, the results are quite similar to those found by Sanders, Laurendeau, and Bergeron (1966) in their sample of S's from age 20 to 39 years.
Ten per cent of the present sample were at stage one whereas Sanders et al. found 12% in this age range to be at stage one.
APPENDIX C

THE PEABODY PICTURE VOCABULARY TEST PERFORMANCE OF 28 SUBJECTS
AND ITS RELATIONSHIP TO PERFORMANCE ON THE PIAGET
CONSERVATION OF SURFACES TEST

The mean raw score on the Peabody Picture Vocabulary Test
(Dunn, 1959) for S's at Stage 3 was higher than that for S's at
Stage 1 but this difference was not significant. The small
sample size may have contributed to the lack of significance,
however. Correlation between I.Q. score and stage on the
Conservation of Surfaces test was very low at .02.

<table>
<thead>
<tr>
<th>Stage on Conservation of Surfaces Test</th>
<th>1 (N=7)</th>
<th>2 (N=3)</th>
<th>3 (N=18)</th>
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<tr>
<td>Raw Score</td>
<td>109</td>
<td>96</td>
<td>123</td>
</tr>
</tbody>
</table>

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REFERENCES


Friedman, H. L. A table for the rapid approximation of $r_m$. College of William and Mary, Williamsburg, Va.


VITA

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