MOTIVATION, FIELD-DEPENDENCE, AND LEVEL OF COGNITIVE PERFORMANCE: AN EXPLORATORY STUDY WITH CHINESE CHILDREN

by

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B.A., University of British Columbia, 1964

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in the Department of

Psychology

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA
April, 1967
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Date 26 May 1967
ABSTRACT

The major purpose of this study was to relate the performance of Chinese Ss in Hong Kong on Piagetian tasks to two factors: first to a cognitive style variable, and secondly, to achievement motivation. It was hoped that the results from this study would provide some new interpretation to Goodnow's (1962) findings in Hong Kong. This study also provided an opportunity to determine if Piaget's results concerning the order of acquisition of tasks as well as levels of difficulty within tasks can be replicated with Ss from another culture. Finally, the performance of a comparable group of white Canadian children was compared to the Chinese Ss both in terms of achievement on the tasks and relationship between the tasks.

It was hypothesized that performance on Piagetian tasks would correlate with scores on the CEFT and with scores on n Achievement. Furthermore, it was believed that the predictions made by Piaget regarding the order of achievement on the Conservation tasks as well as the levels of difficulty within the Water Level Test will be replicated with Ss from Hong Kong. Finally, it was expected that there would be no significant difference in performance between white and Chinese Ss.

Thirty-nine Ss from Hong Kong were individually tested on the following tests: Conservation of Substance, Conservation of Weight, the Water Level Test and the CEFT. Group testing was employed for administering the TAT. Scores
from a group of previously tested white Ss on Conservation of Substance, Conservation of Weight, the Water Level test and the CEFT were used for comparison with the Chinese Ss.

Results for both white and Chinese Ss showed that there was no significant relationship between performance on the Conservation tasks and the CEFT. A significant but low relationship was obtained between performance on the Water Level test and the CEFT for both Chinese and white Ss. Thus, in terms of relationship between Piagetian tasks and the CEFT, the findings were similar for white and Chinese Ss.

There was no significant difference in performance between Chinese and white Ss on Conservation of Weight, the Water Level Test, and the CEFT. However, the white Ss performed significantly better than the Chinese Ss on Conservation of Substance. The order of achievement on the Conservation tasks predicted by Piaget was replicated with the white Ss, but the order was not clear for the Chinese sample. Developmental levels of difficulty within the Water Level Test predicted by Piaget and Inhelder was supported by the findings for both white and Chinese Ss.

No significant relationship was found for the Chinese Ss between performance on any of the Piagetian tasks and n Achievement. There was some indication of a low negative relationship between Conservation of Weight and n Achievement, but this failed to reach significance at the .05 level.
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I wish to express my deep appreciation to Dr. T. Storm and Dr. Juan Pascual-Leone for their help and guidance through all the stages of this study. My sincere thanks to Margaret Obana and Pat Waldron for their expert typing and secretarial work.
CHAPTER I
INTRODUCTION

The major purpose of this study is to relate the performance of Chinese Ss in Hong Kong on Piagetian tasks to two factors: first, to a cognitive style variable, and second to achievement motivation. It is hoped that the findings from this study will help towards clarifying unexpected relationships found between different types of Piagetian tasks, and in particular, to offer new interpretations to the results obtained by Jacqueline Goodnow in Hong Kong (1962). This study also provides an opportunity to determine if Piaget's results concerning the order of acquisition of tasks, as well as stages of responding within tasks can be replicated with Ss from another culture. Finally, in order to find out if the performance of Chinese Ss differs from whites and if so, in what ways, a comparable group of white Canadian children will be compared on the same tasks. Their performance will be compared to the Chinese Ss both in terms of achievement on the tasks, and relationship between the tasks.

In order to provide some background information to the study, several areas of related research will be reviewed. Jacqueline Goodnow's (1962) study in Hong Kong will be examined, followed by a review of the work of Witkin and his associates on cognitive style -- in particular, on field-dependency and field-independency. Following this, the work
of Pascual-Leone, who relates field-dependency to performance of Piagetian tasks will be discussed. Finally, research on the area of achievement motivation as it relates to field-dependency will be reviewed.

Review of Literature

Researchers interested in the work of Piaget have been primarily concerned with the following areas: replication studies to substantiate Piaget's notions of the stages of development and the order of acquisition of the various tasks (Kofsky, 1966; Lovell and Ogilvie, 1961; Elkind, 1961) studies to relate performance on Piagetian tasks and other measures of I.Q. (Feigenbaum, 1963; Elkind, 1961; Deutsche, 1957) and finally, attempts to relate performance on Piaget tasks to milieu differences.

In 1962, Jacqueline Goodnow conducted a study in Hong Kong. Four samples of boys, ranging from 10-13 years of age, were compared. The first group included 148 Europeans. The second group included 151 Chinese from Anglo-Chinese schools, (i.e., schools for Chinese primarily, where the language of instruction is English). The third sample was made up of Chinese boys from low socio-economic areas who were receiving full schooling. The fourth sample included 80 Chinese boys who were also from low socio-economic areas but who were receiving semi-schooling only. A supplementary group of boys from schools with no science course was also included. Five tests were administered to each subject individually: Raven's Progressive Matrices and four Piagetian tasks including judgment of weight and volume,
judgment of space, and a combinatorial problem. Goodnow found that the conservation tasks, both conservation of volume and space, turned out to be more difficult than expected. Furthermore, she found an unexpected relationship among the tasks. She found that performance on the Progressive Matrices was closely related to performance on the combinatorial task, and that the performance of subjects from groups 2 and 3 was closest to that of the European Ss on these tasks. However, performance on the conservation tasks appeared to be unaffected by wide differences in Matrices scores. She found that on the conservation tasks, the children from group 4 and the supplementary Ss were very close to the European children in performance, but children from groups 2 and 3 performed consistently more poorly — those from group 3 being the lowest in performance. In general, the Europeans showed the highest level of performance across all tasks. (The group differences represented trends only, and were not statistically significant).

Goodnow, on the basis of available evidence, suggested that performance on the conservation tasks was sensitive to a combination of age and some sort of personal maturity (Goodnow, 1962, p. 8). She further added that the conservation tasks seemed to give results like those of perceptual constancy tasks, with a tie to chronological and not mental age. She raised the question of what the difference between the conservation and combinatorial tasks implies concerning the interrelationship among tasks, for these represent two
main threads in Piaget's work, the former being the core of 'concrete operations', and the latter being an important part of the development of 'formal operations'. Since Goodnow did not directly test whether it was in fact a combination of age and some sort of personal maturity that contributed to the conservation tasks being insensitive to wide differences in intelligence as measured by the Matrice score, the question is as yet unresolved. It is the purpose of this paper to attempt to investigate this matter further, basing the investigation on the rationale and the available evidence from other workers in this general area.

Witkin et al. (1954), wrote that early in their work, they considered the possibility that individual difference in the area of perception which they have identified, might have their counterpart in intellectual functioning. They state:

Intellectual problems that call for a high degree of creative activity but do not involve perception directly, often also require that 'part be separated from the context in which they are embedded and brought into new relationships. (Wertheimer, 1954). It is likely, and this is of course subject to experimental test -- that if a person has this basic ability to break up a configuration it will be manifested not only in straightforward perceptual situations, but in problem-solving situations as well. (Witkins et al. 1954, p. 477).

The authors quote the findings of Woerner and Levine (1950) who administered tests to a group of 12 year olds, and found a significant relationship between scores on a battery of perceptual tests and scores on the Wechsler
Intelligence Scale for Children, particularly high correlations being found between the perceptual tests and scores on the performance subtests. This raised the possibility that aspects of intellectual functioning which involve an 'analytical ability', such as that required for good performance on the performance test of the WISC, may be contributing significantly to the overall relationship found between intelligence and perception. Analytical functioning was defined as:

the ability to separate an item from the field or context of which it is a part and which therefore exerts a strong influence upon it; to 'break up' a field or configuration. The person with a more field-independent way of perceiving tends to experience his surroundings analytically with objects experienced as discrete from their backgrounds. The person with a more field-dependent way of perceiving tends to experience his surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field or context. (Witkin et al., 1962, p. 35).

Witkin hypothesized that the ability to separate an item from its context is expressed in an individual's intellectual activities as well as in his perception. To test this, he conducted an experiment with a group of 10 year old children. Witkin found that a significant relationship existed between I.Q. scores as measured by the WISC, and the perceptual index, the latter being based on a battery of perceptual tests of field-dependency, including the Children's Embedded Figure Test (CEFT). The results were significant for both boys, ($\gamma = .55, p < .01$), and girls,
(r = .76, p < .01). Factor analytical studies reveal high loadings of Block Design, Picture Completion, and Object Assembly, (sub-tests on the WISC) on the same factor, namely, analytical field approach. This added further support to the notion that there is a general cognitive style that runs through perceptual and intellectual functioning. This cognitive style also appears to underlie the observed relation between the field-dependency index and performance on standard tests of intelligence. One can deduce from this that performance on other tests of intelligence, which, due to the nature of their construction, reflect, and are dependent on an analytical mode of functioning for good performance will also show a correlation with the field dependency index. There is reason to believe that certain Piagetian tasks of cognitive ability fall into tests of this category. The work of Pascual-Leone (1966) supports this contention.

Pascual-Leone (1966) believes that a distinction between developmental level and performance level should be maintained, and that when analyzing performance on certain Piagetian tasks, one should take into account the fact that, regardless of the developmental level attained, there are some 'cognitive style' variables within the subjects changing their level of performance in tune with the kind of experimental situations (Pascual-Leone, 1966, p. 2).

He asserts that performance on certain Piagetian tasks is dependent, in fact, on two related but not identical factors, -- both the intellectual capacity and the cognitive...
style of the individual. He goes on to suggest that the cognitive style in question is the dimension of field-dependency and field independency.

Pascual-Leone believes that because of the particular nature of their construction, many Piagetian tasks present a situation to the individual where,

The inferential or logical behavior of older children must assert itself, in a great many of Piagetian situations, against the misleading appearance of the immediately given field. (Pascual-Leone, 1966, p. 1).

Thus, 'intellectually normal' field-dependent subjects, when confronted with a Piagetian situation which requires an analytical field approach for good performance, but which other wise

they should intellectually handle, will have a tendency to fail induced by the field dependent structure. (Pascual-Leone, 1966, p. 4).

Similarly, to get a good score on a test of field-dependency, an individual must be

able to inhibit the misleading reaction (schemata) elicited by the misleading cues...and extract the relevant information. (Pascual-Leone, 1966, p. 3).

To test this hypothesis, he conducted a study with two groups of subjects: Group 1 consisted of 39 male undergraduates from Brooklyn College and Group 2 consisted of 41 boys with mean age of 10 coming from a lower middle class public school in New York. Each subject was given a battery of twenty tests. These included, among others, two Piagetian tasks -- the Water Level Test and the Conservation
of Continuous Quantity Test. Four tests of field-dependency, including Karp and Konsdadt's (1963) Children's Embedded Figure Test were also administered. With the adult group, he found that 11 Ss who were below the median on the Rod and Frame Test, and thus classified as field-dependent, failed the Water Level Test, while no adults who were classified as field-independent failed the test. The results of the children showed high positive correlations between the Piagetian tasks and the CEFT. These correlations were all significant and in the expected direction. (p<.005) (one tail test). These results offer support to the hypothesis that

Some Piagetian situations are structurally similar to field dependence situations and consequently the subject's performance on these Field Dependence Piagetian tasks correlate highly with Witkin's Field Dependent situations. (Pascual-Leone, 1966, p. 11).

In view of the results obtained by Pascual-Leone supporting his hypothesis that a 'cognitive style' variable such as field-dependency is in fact related to performance on certain Piagetian situations, one could tentatively suggest that the unexpected findings on the conservation tasks in Goodnow's study may have been due also to this same factor. Thus, subjects that were 'intellectually normal' as measured by the Matrices score but who performed poorly on the conservation tasks were perhaps also those who fell into the field-dependent end of the field dependent-independent continuum.
In order to provide some evidence for this hypothesis, this study reports the results of testing Ss in Hong Kong on a number of Piagetian tasks which require the Ss to overcome perceptual cues. The Ss were also given the CEFT from which an index of field-dependency can be obtained. It is hypothesized that a positive relation will exist between scores on the CEFT and scores on the Piagetian tasks: Ss who obtain high scores on the CEFT will also obtain high scores on the Piagetian tasks.

A second variable that may be related to performance on Piagetian tasks and which could have contributed towards Goodnow's findings is that of achievement motivation. The work of Crandall and Sinkeldam (1964) on children's achievement behavior in social situations and their perceptual field-dependence showed that children who were achievement-oriented in social situations displayed more perceptual field-independence than those children who exhibited less preoccupation with achievement. The measures employed for perceptual dependency were the 10 least difficult items of the Witkin Embedded Figure Test. Achievement was assessed by tests dealing with mastery of fine motor skill, task persistence, time alone on tasks, and independent achievement efforts. The authors explained their findings on the suggestion that the Embedded Figure Test situation contained many achievement related cues and was likely to elicit differing achievement motivation in the subjects. Moreover it provided a testing situation in which a "standard of excellence is applied to the competence of an individual's
performance," this being a defining characteristic of achievement situations" (Crandall and Sinkeldam, 1964). To the extent that fantasy measures of achievement motivation and actual measurements of achievement-oriented behavior are positively related, one could infer that there should also exist a positive relationship between fantasy measurements of achievement motivation, such as the TAT, and perceptual field-dependency. Furthermore, scores on these two variables will probably also be related to scores on other tests in which both achievement motivation and field dependency play a role.

The work of Pascual-Leone (1966) has shown that performance on certain Piagetian tasks is positively correlated with performance on tests of field dependency. However, there is also reason to suggest that these Piagetian tasks, just as the Embedded Figure situation, present a situation to the individual which may elicit different motivational responses from different Ss. For instance, tests of conservation are essentially tests in which the individual is required to reason out the fact of invariance of mass, weight, volume and space in the fact of conflicting perceptual data in which one salient perceptual feature changes: for example, the plasticine is changed from a ball into a sausage. Thus, in order to overcome the immediate perceptual information, the individual has to make the effort to think out for himself that changes in one dimension are compensated for and cancelled out by changes in another dimension. Therefore the more motivated individual, who is more willing to stop
and take the trouble to reason things out, instead of passively responding to the immediately given perceptual field, will be more likely to perform well on tests such as these. The same argument can be applied to tests such as the Water Level Test in which the individual also has to overcome misleading perceptual cues, i.e., the walls of the bottle, before he can arrive at the correct response. Furthermore, Piaget has said in his work that achievement on conservation and other conceptual tasks is contingent upon the active interaction between the individual and the environment, where an active searching out of the environment facilitates the attainment of these concepts. It follows therefore, that an individual who is highly motivated to find out about the world around him will have more opportunities to come into contact and to manipulate objects around him and will therefore also have more opportunities to learn of conservation than one who is not so motivated. The findings of Pascual-Leone (1966) has found that field-independent Ss perform better than field dependent Ss on Piagetian tasks, and Crandall and Sinkeldam (1964) have found that children showing high achievement-oriented behavior are more field independent. On the basis of these two findings, one can tentatively predict that high achievers will therefore probably perform better on Piagetian tasks than those who show low achievement motivation.

The question arises as to how valid it is to apply the TAT to a culture that is vastly different from one for which it was originally devised. However, an examination of Chinese culture shows that it is a culture that places a
very strong emphasis on achievement, particularly academic achievement, for this has always been a traditional route of social mobility. Chinese history and folk-lore are full of stories of families making sacrifices just so that their sons could get a better education, of fame and fortune being heaped upon those who succeed academically. Thus, in its emphasis on achievement and postponement of immediate gratification for long range goals, its values are in fact very similar to those found in North American culture. A second question could arise as to whether the situations presented in the TAT pictures are meaningful to Chinese school children. One could point out that being a British Crown Colony, and an important free port, Hong Kong is extremely cosmopolitan, and Western influence is pervasive. There is therefore little reason to suggest that the scenes depicted in the TAT pictures will be unfamiliar to the Ss. However, there is always the possibility that the test may not be valid. One way of finding out is to determine if any meaningful relationships exist between achievement scores on the TAT and other tests for the Chinese sample. A failure to find such relationships, however, may mean either that there are no relationships between achievement-motivation and the tests involved or that the achievement scores are not valid measures of achievement motivation in Chinese children.

A study such as this also provides an opportunity to see if results obtained by Piaget regarding the hierarchy of difficulty between tasks (1962) as well as the stages of
difficulty within each task (1956) can be replicated with Ss from another culture. To determine this, the performance of Ss from Hong Kong on the Piagetian tasks was analyzed both in terms of the hierarchy of difficulty between each task as well as the stages of difficulty within each task. This will allow us to explain tentatively whether differences in culture will have any effects on either performance on the different Piagetian task or on the order and sequence of development. Finally, in order to determine if the performance of Chinese Ss differs from whites, a group of Canadian white children was compared on equivalent tasks. The results from the two groups were compared both in terms of achievement within tasks, and relationship between tasks. This analysis will enable us to see if the relationship between the Piagetian tasks obtained both by Goodnow and from this study is peculiar to subjects in Hong Kong or whether the same relationships hold for whites also.

In the light of the literature reviewed and the general purposes of this study, Piagetian tasks were selected to permit comparisons with Goodnow's findings and to allow an assessment of the role of field-dependency. This required that tasks be selected that derive some of their difficulty from the presence of misleading cues. Other tests were selected to provide measures of field-dependency and achievement motivation that could be related to performance on the Piagetian tasks.
The following tests were chosen for use in this study. The Piagetian tests chosen were: Conservation of Substance, Conservation of Weight and the Water Level Test. These particular tests were selected because good performance on all three tasks requires the overcoming of misleading perceptual cues. In Conservation of Substance, the S is required to deduce the invariance of substance in the face of changes in the shape of the plasticine from a ball to a sausage. In Conservation of Weight, the S must deduce the invariance of weight as the shape of the plasticine is being changed from a ball to a pancake. Finally, in the Water Level Test, the S has to overcome the misleading cues of the walls and the bottom of the bottle before he can arrive at the correct response.

Piaget has found that conservation of substance is achieved before conservation of weight. Whether this hierarchy of difficulty between these tasks can be replicated with Ss from another culture, specifically, Ss from Hong Kong, remains to be determined. It has also been found that in the Water Level Test, items vary in difficulty depending on the position of the bottle in relation to the horizontal axis (Piaget, 1956). Because differences in difficulty in items in the Water Level Test have been given developmental implications, their replicability in another culture is of some interest.

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^For a detailed analysis of the Water Level Test, see Appendix 1.
Karp and Konstadt's (1963) Children's Embedded Figure Test (CEFT) was chosen as a measure of field-dependency. In this test, simple figures are hidden inside complex figures, and the subjects' task is to trace the outline and to identify the simple figure within each complex figure. The measure of achievement motivation selected was the Thematic Apperception Test (TAT). Three pictures were chosen for use -- 1, 13B, 8BM. The S is asked after each picture is shown, to create imaginative stories in response to the picture. The contents of the stories are scored for need achievement (n Achievement) according to the scoring criteria of McClelland, et al. (1958).

In terms of the tests described above, the hypotheses for the study are as follows:

1. The performance of Chinese and white Ss on Piagetian tasks of Conservation of Substance, Conservation of Weight and The Water Level Test will correlate with their performance on the Children's Embedded Figure Test. Those who obtain high scores on the Children's Embedded Figure Test (i.e. the less field-dependent) will show a higher proportion of correct responses on the Piagetian tasks than those who obtain low scores.

2. The performance of Chinese Ss on Piagetian tasks of Conservation of Substance, Conservation of Weight, and the Water Level Test will correlate with their performance on n Achievement, as measured by the TAT.
Those who obtain high scores on n Achievement will show a higher proportion of correct responses on the Piagetian tasks than those who obtain low scores.

3. A greater proportion of Chinese and white Ss will achieve Conservation of Substance than Conservation of Weight. Furthermore, no S will achieve Conservation of Weight without achieving Conservation of Substance as well.

4. Chinese and white Ss will show the same developmental sequence of response for the Water Level Test as suggested by Piaget and Inhelder in 'The Child's Conception of Space'. The Ss will show the highest proportion of correct responses with the bottle in the vertical position. The next highest proportion of correct responses with the bottle will be associated with the bottle in the horizontal position; and the lowest proportion of correct responses will be associated with the bottle in the tilted position.

5. For each position of the bottle on the Water Level Test, Chinese Ss who obtain low scores on the Children's Embedded Figure Test will show a higher proportion of more 'primitive' responses; -- that is, responses classified as occurring in one of the earlier developmental stages, than subjects who obtain high scores.

6. The performance of Chinese Ss from Hong Kong on Piagetian tasks of Conservation of Substance, Conservation of Weight, and the Water Level Test will not differ significantly from the performance of a
comparable group of white Ss on equivalent tasks.

7. The performance of Chinese Ss from Hong Kong on the Children's Embedded Figure Test will not differ significantly from the performance of a comparable group of white Ss on the same task.
Subjects

A total of 39 Chinese primary school children from three different schools were selected as Ss. Ss were all Chinese-speaking. As far as E was aware, none of the Ss had any testing experiences prior to the study. The distribution of the Ss on age and sex is summarized in Table 1.

School 1 was a private co-educational school with approximately 1000 students. The majority of the students came from middle and upper middle socio-economic backgrounds. Ss were selected from primary 3 and 4 which corresponds to Grade 3 and 4 from a list given to E by the vice-principal. Each student was given an academic rating of either low, middle or high by the vice-principal. Selection of Ss was determined primarily by the need to choose an equal number of Ss falling into each academic category. As far as possible, an equal number of males and females were chosen as Ss. The distribution of Ss on age and sex is summarized in Table 2.

School 2 was a church run school situated in a low income area. The school was poorly equipped and staffed, and was situated within the church itself. The students came from low socio-economic backgrounds. Many of the students were children who could not pass the entrance exams into one of the government run schools, which were considered to have higher academic standing. Selection of Ss was based on the
**TABLE 1**

Age and Sex Distribution of Ss

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<th>Sex</th>
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<td>8</td>
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<td>Male</td>
<td>9</td>
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<tr>
<td>Female</td>
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**TABLE 2**

Age and Sex Distribution of Ss from School 1

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<td>8</td>
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<tr>
<td>Male</td>
<td>6</td>
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<tr>
<td>Female</td>
<td>2</td>
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same criterion as in School 1. The distribution of Ss on age and sex is summarized in Table 3.

School 3 was a private school which was subsidized by the government. The school was efficiently run and well equipped. The students in this school belonged to the middle, lower-middle, and lower socio-economic classes. Selection of Ss was based on the same criterion as in Schools 1 and 2. Due to insufficient time, only a small number of Ss were tested. The distribution of Ss on age and sex is summarized in Table 4.

General Setting

All testing was conducted in Chinese. E was Chinese and bi-lingual and therefore did not experience any difficulty in communicating the instructions to the Ss. Furthermore, E found little difficulty in translating the instructions from English into Chinese as the instructions were relatively simple and straightforward. Ss appeared to understand the instructions well. E emphasized to each S at the beginning of testing to be sure to ask if there was anything in the instructions that wasn't clear. In general, most of the Ss were eager to cooperate because the testing situation was a novel one for them.

School 1 gave E the use of the school library for testing. However, students were constantly passing by during testing which resulted in several interruptions. School 2 provided a small room in the attic for testing, while School 3 provided a room for testing which was away
### TABLE 3

*Age and Sex Distribution of Ss from School 2*

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<tbody>
<tr>
<td>Male</td>
<td></td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

### TABLE 4

*Age and Sex Distribution of Ss from School 3*

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
from the classrooms and testing was not interrupted by
noise or other distractions.

Both group and individual testing were used. Ss were
tested individually in two sessions on the following tests
in order of administration. During Session 1 Conservation
of Substance, Conservation of Weight, the class inclusion
test and Abelson Figures were given. The Children's
Embedded Figure Test and the Water Level Test were given
in the second session. Each session lasted about 20 minutes.
Group testing was used for the Thematic Apperception Test
which was given after individual testing was completed.

Test Instructions and Scoring

Procedure, instructions and scoring criteria for each
test will be described in order of their administration.

As each Ss came into the room he was told by E to sit
down in a chair with a desk in front. E sat on the other
side of the desk directly facing S. E informed S that E
had some games for S and wanted S to try them. E also talked
to each S for a short while to relax him as E was a total
stranger to S. E then introduced the first item by saying
"Now, let's try the first game".

Conservation of Substance. E took two blocks of plasticine
and made them into two balls about the size of walnuts and
handed one ball to S and said:

2 Instructions and results for the Class Inclusion Test
and Abelson Figures are not reported as these tests
were not directly relevant to the purposes of this
study.
"See these two balls, they are made of plasticine. Now I want you to look at them carefully and then tell me whether you think one ball has more plasticine than the other or whether you think the two balls contain the same amount of plasticine."

If S replied that they contained the same amount, E went on to the next question. If S replied that either ball had more plasticine than the other, E subtracted or added onto either ball until S was satisfied that they contained the same amount of plasticine. E took care to keep the shape of the plasticine in the shape of a ball at all times. E then said to S, "Watch what I am going to do to my ball now". E then stretched out the plasticine in her hand into the shape of a sausage and said:

"Now, do you think that you and I still have the same amount of plasticine, or do you think that one of us has more plasticine than the other?"

If S replied the same amount, E asked why. If S replied that either person had more plasticine, E also asked for the reason. All the Ss' responses were recorded. After some encouragement and praise, E went on to the next test.

The scoring consisted of two parts. The first part was based on the correctness of the response which included such answers as "they are the same", "they are more or less the same", "both have the same amount", or "they both have the same amount of plasticine". A correct response was given a score of 1. The second part was based on the explanation given for the answer in response to E's inquiry. Adequate explanations were given a score of 1 and included
such answers as "you started off with the same amount", "nothing has been taken away or added", "you only made one flatter", "you have just changed the shape".

**Conservation of Weight.** E took two round balls of plasticine about the size of a large walnut, E then said:

"I am going to weight these first just to check that they are the same weight. You know that when this needle is straight up or almost straight the two pieces weigh the same."

With the two pieces on each side of the balance, E then asked:

"Weigh the same?"

If S showed much hesitation or said "No", E added:

"Are they almost the same? A little bit doesn't matter to this game."

When S agreed that the two pieces were equal in weight, E said:

"Now I take one piece and make it like this (pressing one piece flat into the shape of a pancake). Now if I put the two pieces on the scale again, would they weigh the same, or would one be heavier than the other?"

E then asked (if appropriate):

"Which one would be heavier? Can you tell me why?"

If S could not say why, E took a small piece away from the flat shaped clay and asked again.³

The basis for scoring the responses was identical to that used in the Conservation of Substance. The first part

³Instructions for the test were based on those used by Goodnow (1962), translated into Chinese.
was based on the correctness of the response which included such answers as "they weigh the same", "there is no difference in weight", or "they weight just about the same". A correct response was given a score of 1. The second part was based on the explanation given for the response. Adequate explanations were given a score of 1 and included such answers as "you started off with the same amount", "nothing has been taken away or added", or "you have only changed the shape".

Children's Embedded Figure Test.

The stimuli from Karp and Kondstadt (1963) Children's Embedded Figure Test (CEFT) were used. These included a number of figures which are used for training purposes as well as the test figures proper.

The procedure followed in the test was based on that described by Karp and Kondstadt (1963). The only modification to the procedure concerned the stop rules for the test. When the child did not give any answer he was encouraged to give one. E waited for at least 60 seconds after presentation of the item before stopping testing of the item. E never waited for more than 90 seconds. Finally, because the CEFT was given before the Water Level Test in the same session, it was important that the S did not lose all his motivation due to frustration. Testing was therefore stopped if S failed four consecutive items on the HOUSE series and appeared to E to be uneasy or discouraged because of his failure.

The responses were scored according to the instructions
given by Karp and Kondstadt (1963). The scores were made up of two separate series: the 'TENT' and the 'HOUSE'. The scores for the 'TENT' series ranged from 0 - 11; and for the 'HOUSE' series, the scores ranged from 0 - 14. The total score therefore ranged from 0 - 25.

Water Level Test

E held flat-bottomed flask with colored liquid in hand and said to the S:

watch this flask. I want you to look at the colored water carefully. I am going to turn the flask slowly, and I want you to watch what happens to the water carefully, as I turn the flask. Are you ready? Now I will begin.

E then began to rotate the flask slowly, starting from the vertical upright position, turning it slowly in one direction through 360 degrees until the flask had turned a full circle and was returned to its original position. E made sure that S could see the water level clearly as the flask was being turned. E then put the flask down and picked up the beaker saying,

See this beaker? There is no water in it, and it looks like the beaker drawn in your booklet (pointing to figure on first page). Now, I want you to pretend that there is some water in the beaker. Now, I want you to draw a line inside this beaker on this page to show me where the water would be. It doesn't matter how much water you want to put inside the beaker, so you can draw the line anywhere inside the beaker that you want.

When S had completed this, E continued,

Now, I would like you to put a cross to show me whether the water is in this part of the beaker (pointing to below the water mark) or in this part of the beaker (pointing to above the water mark).
When this was done, E said,

Now turn the page. Here's another bottle (pointing to bottle), I want you to draw a line to show me where the water would be this time, and after you have done this, I want you to again put a cross to show me where the water would be.

After S had done this, E continued,

I would like you to continue doing this for every bottle in the book until you come to the last page. If there is anything that you do not understand, just ask me. You can begin right now.

Scoring for Water Level Test

A response was scored as correct and was given a score of 1 if the following two criteria were satisfied:

a) Degree of deviation from the horizontal axis. A response that was $\pm 0 - 6^\circ$ from the horizontal was considered as correct.

b) Location of water. A cross that was placed below the water line to indicate the location of the water was considered as correct.

Each S was given a total score depending on the number of correct responses obtained. This ranged from 0 - 13. In order to determine the boundaries between each stage of the developmental sequence suggested by Piaget and Inhelder (1956), the following criteria in terms of degrees of deviation, direction of deviation (positive or negative) from the horizontal, and the location of the water were applied. These criteria generate a series of "steps". These "steps" can be developmentally ordered, but do not constitute by themselves, "stages" in the sense given to this word by Piaget (Flavell, 1963, p. 19). These formal criteria or steps have been described for every class of item belonging to the Water Level Test and are summarized in Tables 5, 6 and 7.
### TABLE 5

**Types of Responses Classified into Developmental Steps with the Bottle in the Inverted Vertical Position**

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of deviation from the horizontal</td>
<td>0-6</td>
<td>0-6</td>
<td>71-90</td>
<td>6-70</td>
<td>0-6</td>
</tr>
<tr>
<td>Location of water (above or below water line)</td>
<td>above</td>
<td>below</td>
<td>above</td>
<td>below</td>
<td>or below</td>
</tr>
</tbody>
</table>

Step 1 responses are the most 'primitive' developmentally. Step 5 responses constitute the correct response.

### TABLE 6

**Types of Responses Classified into Developmental Steps with the Bottle in the Horizontal Position**

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of deviation from the horizontal</td>
<td>71-90</td>
<td>0-70</td>
<td>7-70</td>
<td>0-6</td>
</tr>
<tr>
<td>Location of water (above or below water line)</td>
<td>either side</td>
<td>above</td>
<td>below</td>
<td>below</td>
</tr>
</tbody>
</table>

Step 1 responses are the most 'primitive' developmentally. Step 4 responses constitute the correct response.
<table>
<thead>
<tr>
<th>Steps</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of deviation from the horizontal</td>
<td>31-70 31-70 31-70 31-70 31-70 31-70 71-90 7-30 0-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign of deviation (+ or -)</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
| Direction Upright                  | Tilted left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left 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left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left left左
Every response was classified into one of the developmental steps relative to the position of the bottle. In measuring both the angle and direction (+ or -) of the response from the horizontal the measures were taken always from the left to the right of the line.  

Thematic Apperception Test. School 1.  

Ss were brought to a large room in which a projector and screen was set up for group testing. Ss were seated and were then told that they were to be shown some slides on the screen. E began by saying:

This is a test of your imagination. Three pictures will be projected on the screen. You will have about 30 seconds to look at each picture and then about 5 minutes to write a story about it. When you write the story, I want you to try to answer four questions. I am going to read the questions one by one slowly, and I want you to write them down on the first page of your booklet. Remember to try and answer all these questions when you write each story. These questions need not be answered in any particular order. The questions are as follows:  
What is happening in the picture?  
What is the boy thinking?  
What would the boy like to happen?  
What will happen?  
There are no right or wrong answers so you can make up any sort of story about the picture that you want to. The more vivid and dramatic, the better. Remember this is a test of your imagination. Do not merely describe the picture, make up a story about it, and make it as interesting as possible - feel free to make up any kind of story at all. You may start writing as soon as you like after the picture is projected. The light will be  

For a detailed description of the developmental stages described by Piaget (Piaget and Inhelder, 1956) and the way in which they relate empirically to these sets of different steps, see Appendix. See Appendix 1 also for the method by which responses were classified into these different steps.
turned on after 30 seconds. Try to start writing at once, otherwise you may not have enough time to do a complete job. Are there any questions? Please ask me now if there is anything that you are not clear about. No questions will be answered after we start. Also please do not say anything when the pictures are shown.

Ss were given more than 5 minutes to write the stories, as it was found that in general, it took longer to write the Chinese characters, and the Ss being in grade 2 or 3, often had difficulty in remembering how to write out a character. This slowed down the rate of writing.

Schools 2 and 3

These schools were unable to provide E with a single room large enough to test all the children at once. As a result, testing was conducted in groups of three in the small room in which individual testing was done. The procedure employed was similar to that used in testing School 1, with the exception that the E held up each TAT card in front of the three Ss and then gave them approximately 5 minutes to write out each story. Instructions given were the same as those for School 1. Relevant changes were made only regarding the projection of the pictures. Ss were told instead, that they were to be shown three pictures consecutively by the E and that they could begin writing their stories as soon as each picture was shown.

Scoring. Each TAT story was scored for n Achievement according to the scoring system devised by McClelland, Atkinson, Clark and Lowell (Atkinson, 1958).

White Ss. Scores were available from a previously tested
sample of white Canadian Ss from Provincial schools in Vancouver for some of the tests employed with Chinese Ss. The tests which were common to the two groups of Ss were: Conservation of Substance, Conservation of Weight, and the CEFT. Scores of these Ss on these tests were used in comparison to scores of the Chinese Ss on the same tests. The Canadian Ss were from predominantly middle class homes. The distribution of Ss on age and sex is summarized in Table 8.

**TABLE 8**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age 8</th>
<th>Age 9</th>
<th>Age 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>
CHAPTER III

RESULTS

The results of the study are examined as they relate to the hypothesis presented in the introduction.

Hypothesis I:

Relationship between performance on Piagetian tasks and CEFT

Chinese: There was a low correlation between the Ss scores on the CEFT and Conservation of Substance (tau = .16, p = .08). However, this was not significant at the .05 level. No correlation was found between the Ss' scores on the CEFT and Conservation of Weight (tau = .08, n.s.). A low correlation was found between the Ss' total Conservation scores (sum of scores on Conservation of Substance and Conservation of Weight) and CEFT scores (tau = .166, p = .08). But again, this was not significant at the .05 level. A significant positive correlation (tau = .346, p < .001) was found between performance on the CEFT and performance on the Water Level Test. The Kendall Tau correlations between performance on the CEFT and performance on the Piagetian tasks are presented in Table 9.

| Kendall Tau Correlations between CEFT and Conservation of Substance, Conservation of Weight, Total Conservation and Water Level Test |
|---|---|---|---|---|
| **Chinese Sample** | Conservation of Substance | Conservation of Weight | Total Conservation | Water Level Test |
| CEFT | P = .08 | n.s. | p = .08 | P < .001 |
| tau = .16 | tau = .08 | tau = .166 | tau = .046 |

- 33 -
Whites: There was no significant correlation between performance on the CEFT and performance on either Conservation of Substance (\(\tau = .14\)) or Weight (\(\tau = .09\)). A positive correlation was found between scores on the CEFT and total Conservation score (\(\tau = .19, p = .054\)). A significant positive correlation was obtained between performance on the CEFT and performance on the Water Level Test (\(\tau = .25, p < .02\)). The Kendall Tau correlations between performance on the CEFT and performance on the Piagetian tasks are summarized in Table 10.

**TABLE 10**

<table>
<thead>
<tr>
<th>White Sample</th>
<th>Conservation of Substance</th>
<th>Conservation of Weight</th>
<th>Total Conservation</th>
<th>Water Level Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFT</td>
<td>n.s.</td>
<td>n.s.</td>
<td>(p = .054)</td>
<td>(p &lt; .05)</td>
</tr>
<tr>
<td>(\tau = .14)</td>
<td>(\tau = +.09)</td>
<td>(\tau = +.19)</td>
<td>(\tau = +.25)</td>
<td></td>
</tr>
</tbody>
</table>

**Hypothesis 2:**

Relationship between \(n\) Achievement and Piagetian tasks

Chinese: There was no significant correlation between scores on \(n\) Achievement and performance on the Piagetian tasks of Conservation of Substance (\(\tau = -.04, n.s.\)) and Weight (\(\tau = .18, p = .07\)) and the Water Level Test (\(\tau = .09, n.s.\)). There was some indication of a negative relationship between performance on Conservation of Weight
and n Achievement. However, this was not significant at the .05 level ($p = .07$).

The Kendall Tau Correlations between scores on n Achievement and performance on the Piagetian tasks are summarized in Table 11.

**TABLE 11**

Kendall Tau Correlations between n Achievement and Conservation of Substance, Conservation of Weight, Total Conservation and the Water Level Test.

<table>
<thead>
<tr>
<th></th>
<th>Conservation of Substance</th>
<th>Conservation of Weight</th>
<th>Total Conservation</th>
<th>Water Level Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese Sample</td>
<td>n.s.</td>
<td>$p = .07$</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>n achievement</td>
<td>$\tau = - .045$</td>
<td>$\tau = - .184$</td>
<td>$\tau = - .127$</td>
<td>$\tau = .091$</td>
</tr>
</tbody>
</table>

The TAT was not given to the White Ss, therefore it was not possible to determine relationship of n Achievement to Piagetian tasks for the White Ss.

**Hypothesis 3**

Relationship between Conservation of Substance and Weight

**Chinese:** Twelve out of thirty-nine Ss gave correct responses on Conservation of Substance and eleven out of thirty-nine gave correct responses on Conservation of Weight. Five Ss achieved Conservation of Weight without achieving Conservation of Substance. The distribution of Ss on both tests is summarized in Table 12.
TABLE 12
Distribution of Responses of Chinese Ss Conservation of Substance and Weight

<table>
<thead>
<tr>
<th>Conservation of Weight</th>
<th>+</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation of Substance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>-</td>
<td>5</td>
<td>22</td>
</tr>
</tbody>
</table>

White: Twenty-five out of 32 Ss gave correct responses on Conservation of Substance and fifteen out of thirty-two gave correct responses on Conservation of Weight. Only one achieved Conservation of Weight without achieving Conservation of Substance. The distribution of responses on both tests is summarized in Table 13.

TABLE 13
Distribution of Responses of White Ss on Conservation of Substance and Weight

<table>
<thead>
<tr>
<th>Conservation of Weight</th>
<th>+</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation of Substance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>-</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Hypothesis 4:

**Developmental sequence of response for the Water Level Test**

Chinese: The distribution of the number of correct responses with the bottle in the different position is given in Table 14.
### TABLE 14

Distribution of the number of correct responses for the bottle in the vertical, horizontal and tilted positions

**Chinese Sample (N = 39)**

<table>
<thead>
<tr>
<th>Position of Bottle</th>
<th>VERTICAL</th>
<th>HORIZONTAL</th>
<th>TILTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item No.</td>
<td>9</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>No. of Correct Responses</td>
<td>31</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Sign Tests were performed between each horizontal and vertical item. More Ss were correct on vertical than on horizontal items. The comparisons between item 13 and 4; 13 and 2; 9 and 2; 9 and 4 were all significant at the .05 level. However, the comparisons between item 13 and 12; 9 and 12 were not significant. Sign tests were also performed between each horizontal and each tilted item. All of these comparisons were significant at the .05 level. Significantly more Ss were correct on horizontal than on tilted items.

**White:** The distribution of the number of correct responses with the bottle in the different positions is summarized in Table 15.
TABLE 15

Distribution of the Number of Correct Responses for the Bottle in the Vertical, Horizontal and Tilted Position

White Sample (N = 32)

<table>
<thead>
<tr>
<th>Position of Bottle</th>
<th>VERTICAL</th>
<th>HORIZONTAL</th>
<th>TILTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item No.</td>
<td>20 8 2 8 6 17 16 9 7 8 19 5 11,14 4 10 3 13 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Correct Responses</td>
<td>30 29 29 29 27 25 26 12 11 10 10 8 7 7 6 6 5 5 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sign Tests were performed between each vertical and horizontal item. None of these comparisons were significant. Thus, though more Ss were correct on vertical than horizontal items, the difference in performance was not significant. Sign Tests were also performed between each horizontal item and each tilted item. Each of these comparisons was significant at the .05 level. Significantly more Ss were correct on the horizontal than on the tilted items.

Hypothesis 5:

Comparisons between F.I. and F.D. Ss on the Water Level Test.

Chinese Ss were again divided into high and low-field dependency, (median split) and the performance of these two groups was compared in terms of the total number of response in each developmental step. In all cases, Step 1 represents the most primitive response developmentally and Steps 4, 5, and 6 represent the most advanced (in fact, the correct response) for the bottle in the vertical, horizontal and tilted positions respectively. The distribution of responses is given in Tables 16, 17 and 18.
TABLE 16

Distribution of responses of F.I. and F.D. Chinese Ss by developmental steps with the bottle in the vertical position

<table>
<thead>
<tr>
<th>Step</th>
<th>F.I.</th>
<th>F.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>

TABLE 17

Distribution of responses of F.I. and F.D. Chinese Ss by developmental steps with the bottle in the horizontal position

<table>
<thead>
<tr>
<th>Step</th>
<th>F.I.</th>
<th>F.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>42</td>
<td>27</td>
</tr>
</tbody>
</table>

TABLE 18

Distribution of responses of F.I. and F.D. Chinese Ss by developmental steps with the bottle in the tilted position

<table>
<thead>
<tr>
<th>Step</th>
<th>F.I.</th>
<th>F.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>66</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>12</td>
</tr>
</tbody>
</table>

The results showed that for all three positions of the
bottle, F.D. Ss obtained a higher number of responses classified into steps 1, 2, and 3 (i.e. responses that are more primitive developmentally). F.I. Ss, on the other hand, obtained a higher number of correct responses - steps 5, 4, and 6 responses; with the bottle in the vertical, horizontal and tilted positions respectively.

**Hypothesis 6:**

**Comparison between Chinese and White Ss on Conservation of Substance, Conservation of Weight and the Water Level Test.**

Twelve out of thirty-nine Chinese Ss gave correct responses on Conservation of Weight. Twenty-five out of thirty-two gave correct responses on the same task. The distribution of Chinese and White Ss on Conservation of Substance is summarized in Table 19.

<table>
<thead>
<tr>
<th>Conservation of Substance</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>White</td>
<td>25</td>
<td>7</td>
</tr>
</tbody>
</table>

The difference in performance between Chinese and White Ss was found to be significant ($\chi^2 = 13.3, p < .001$). White Ss obtained significantly more correct responses on Conservation of Substance.

Eleven out of thirty-nine Chinese Ss gave correct
responses on this task. The distribution of Chinese and White Ss on Conservation of Weight is summarized in Table 20.

**TABLE 20**

**Distribution of responses for Chinese and White Ss on Conservation of Weight**

<table>
<thead>
<tr>
<th>Conservation of Weight</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>White</td>
<td>15</td>
<td>17</td>
</tr>
</tbody>
</table>

The difference in performance between Chinese and White Ss was found to be not significant ($\chi^2 = .95$, n.s.)

Only those items which the Chinese and White Ss had in common were used for the comparison of Water Level performance in the two groups. The mean for the Chinese sample was $1.26$. The mean for the white sample was $1.31$. The difference between these means was not significant. ($t = .14$, n.s.)

**Hypothesis 7**

A Mann-Whitney $U$ was computed to test the significance of the difference between the performance of White and Chinese Ss on the CEFT. The results showed there was no significant difference in performance. ($z = -1.230$, n.s.)
The mean number of correct responses for Chinese and White Ss on the Piagetian tasks and on CEFT is summarized on Table 21.

**TABLE 21**

Mean Number of Correct Responses for Chinese and White Ss.

<table>
<thead>
<tr>
<th>TEST</th>
<th>Conservation of Substance</th>
<th>Conservation of Weight</th>
<th>Total Conservation</th>
<th>Total Water Level</th>
<th>Total CEFT</th>
<th>'Tent'</th>
<th>'House'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of Poss. Scores</td>
<td>0 - 2</td>
<td>0 - 2</td>
<td>0 - 4</td>
<td>0 - 5</td>
<td>0 - 25</td>
<td>0 - 11</td>
<td>0 - 14</td>
</tr>
<tr>
<td>White</td>
<td>1.63</td>
<td>.94</td>
<td>2.6</td>
<td>1.31</td>
<td>16.75</td>
<td>8.66</td>
<td>8.09</td>
</tr>
<tr>
<td>Chinese</td>
<td>.79</td>
<td>.82</td>
<td>1.5</td>
<td>1.26</td>
<td>14.8</td>
<td>8.4</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Only the scores for those five tilted bottles which were common to both the White and the Chinese Ss were used for computing the mean.
CHAPTER IV
DISCUSSION

There was no significant difference in performance between Chinese and white Ss on Conservation of Weight, the Water Level Test, and the CEFT. However, the white Ss obtained higher scores on all three tests. A significant difference was found between the performance of white and Chinese Ss on Conservation of Substance. The white Ss performed significantly better than the Chinese Ss.

The results showed a clear sequence for the white Ss with regard to achievement on Conservation of Substance and Weight. Twenty-five white Ss achieved Conservation of Substance, 15 achieved Conservation of Weight. Of the 15 Ss who achieved Conservation of Weight, only one was without Conservation of Substance. For the Chinese Ss, however, the sequence was not clear. Twelve Ss achieved Conservation of Substance and 11 achieved Conservation of Weight. Five Ss achieved Conservation of Weight without Conservation of Substance. The sequence of response for the Water Level Test was clear for both white and Chinese Ss. Both groups gave the highest number of correct responses with the bottle in the vertical position; the next highest number of correct responses was obtained with the bottle in the horizontal position; and the lowest number of correct responses with the bottle in the tilted position. Furthermore, F.D. Chinese Ss obtained a higher
number of developmentally more primitive responses than F.I. Chinese Ss.

The relationship obtained between Piagetian tasks and the CEFT were similar for both white and Chinese Ss. For both groups, there was no significant correlation between performance on either Conservation of Substance or Weight and performance on the CEFT. In both cases, the correlation with Conservation of Substance was slightly higher than with Conservation of Weight. For both Chinese and white Ss a significant correlation was found between performance on the Water Level Test and performance on the CEFT. The correlation was slightly higher with the Chinese group.

The results with n Achievement showed that n Achievement scores were not correlated with performance on Conservation of Substance or the Water Level Test. There was a low negative correlation with Conservation of Weight. However, this was not significant at the .05 level.

On all the tests in which the performance of white and Chinese Ss were compared, the only test in which the white Ss performed significantly better than the Chinese Ss was Conservation of Substance. On all the other tests, there were no significant differences in performance.

What was responsible for the difference between white and Chinese Ss in Conservation of Substance? The performance of the Chinese Ss from the three different schools were examined separately. The mean number of correct responses for the Chinese Ss from Schools 1, 2, and 3 on Conservation of Substance, Conservation of Weight, Water Level Test, and the CEFT is presented in Table 22.
Table 22 shows that Ss from School 3 performed unexpectedly poorer on the Conservation tasks than Ss from Schools 1 and 2. But, on the other tasks, performance of Ss from all three schools remained close. This finding suggested that it was the performance of Ss from School 3 which resulted in the significant difference between white and Chinese Ss on Conservation of Substance. The performance of white Ss on Conservation of Substance was therefore compared to the performance of Chinese Ss from Schools 1 and 2 only on the same task. No significant difference was found between the

**TABLE 22**

Mean Number of Correct Responses for Chinese Ss From Schools 1, 2, and 3 on Conservation of Substance, Conservation of Weight, Water Level Test and the CEFT

<table>
<thead>
<tr>
<th>Task</th>
<th>Possible Range</th>
<th>Schools 1, 2, 3 (N=19)</th>
<th>School 1 (N=5)</th>
<th>School 2 (N=15)</th>
<th>School 3 (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conserv. of Substance</td>
<td>0-2</td>
<td>.79</td>
<td>1.2</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Conserv. of Weight</td>
<td>0-2</td>
<td>.82</td>
<td>.92</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td>Total Conservation</td>
<td>0-4</td>
<td>1.5</td>
<td>2.2</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Water Level Test*</td>
<td>7</td>
<td>4.6</td>
<td>4.7</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>C(Total Score 0-25)</td>
<td></td>
<td>14.8</td>
<td>16.6</td>
<td>13.8</td>
<td>13</td>
</tr>
<tr>
<td>E('TENT')</td>
<td>0-11</td>
<td>8.4</td>
<td>9.2</td>
<td>8.6</td>
<td>7.4</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T('HOUSE')</td>
<td>0-14</td>
<td>6.5</td>
<td>7.4</td>
<td>5.4</td>
<td>5.6</td>
</tr>
</tbody>
</table>

* Only the tilted bottles were used to compute the mean number of correct responses
performance of the two groups. \(X^2 = 2.7, \text{n.s.}\).

On the whole, it can be said that the findings of the study were generally consistent with the hypotheses that there should be no significant difference in performance between white and Chinese Ss on the Piagetian tasks or the CEFT. The results from this study are similar to those obtained by Goodnow (1962) in Hong Kong. Goodnow found more similarities than differences between the performance of white and Chinese Ss on Piagetian tasks of Conservation of Space, Weight and Volume. However, she also found that on every task the level of performance of the white Ss was higher than the Chinese Ss.

The gap in performance between Ss from Schools 1, 2 and Ss from School 3 required explanation. Ss from Schools 1 and 2 came from predominantly middle and upper-middle class environments, while Ss from School 3 came from lower class homes. The differences in environment between children from lower class and middle class homes in a place such as Hong Kong is vast. There are many variables associated with socio-economic background which may account for the poorer performance of these Ss on the Conservation task. Verbal ability is one such factor. The Conservation tasks require that the child verbalize his response and justification for it, while the Water Level Test does not. It is also possible that personality or attitudinal traits associated with lower class life in Hong Kong account for the performance of Ss in School 3.
Children from lower class homes have to fend for themselves at a very early age, and learn the 'realities of life' much sooner than middle class children. Because of this, these children may have a stronger tendency to look for 'traps' or 'tricks' in any situation. On a task such as Conservation they may be more inclined to view it as one that contained a 'trap' to challenge their intellect. Since the two pieces of plasticine appeared to be 'obviously' equal, the child may choose instead the unobvious response—that of inequality. Obviously no final explanation of the difference in performance between Ss from these schools can be provided here. It is interesting to note that this finding is consistent to Goodnow's (1962) results. Goodnow found that Chinese Ss in Hong Kong from low socio-economic homes who were receiving full schooling scored the lowest on the Conservation tasks.

The second area of interest was in the cross-cultural replicability of Piaget's results—both in terms of developmental levels of difficulty within a specific task and the hierarchy of difficulty between tasks. There was good replicability regarding the developmental levels of difficulty within the Water Level Test for both white and Chinese Ss. Both groups obtained the highest number of correct responses with the bottle in the vertical position. The next highest number of correct responses was obtained with the bottle in the horizontal position and the lowest number of correct responses was associated with the bottle in the tilted positions.
According to Piaget and Inhelder (1956), task difficulty in the Water Level Test is a function of the position of the bottle in relation to the horizontal axis. Task difficulty increases from the bottle being in the vertical to the horizontal to the tilted position. On the basis of this, one would expect the highest proportion of correct responses to be associated with the bottle in the vertical position, this being the easiest task. The lowest proportion of correct responses will be associated with the most difficult task - that of the bottle in a tilted position. The findings from this study give further empirical support from a different subject population to Piaget's and Inhelder's analysis of the Water Level Test. The findings were also consistent with the results obtained by Smedslund (1962).

Within each specific position of the bottle, F.D. Chinese Ss were found to produce a greater number of developmentally more primitive responses than F.I. Ss. This finding lends further support to the notion that a correlation exists between performance on the CEFT and performance on the Water Level Test. Categorization of responses into developmental steps represents a quantitative mode of analysis and allows for a finer differentiation of performance of the F.I. and F.D. Ss than by using the criteria of correct and incorrect only. This analysis showed that F.D. Ss not only had a higher number of incorrect responses than F.I. Ss but that these Ss were also further away developmentally from the correct responses than F.I. Ss.
The Sequence predicted by Piaget (1962) regarding Conservation of Substance and Conservation of Weight was replicated with the white sample. Piaget predicted that achievement on Conservation of Weight implied achievement on Conservation of Substance. The results showed that only one out of fifteen white Ss who achieved Conservation of Weight was without Conservation of Substance. However, the sequence for the Chinese Ss was not as clear. Since the number of Ss tested was small, and since the majority of Chinese Ss showed neither Conservation of Substance nor Conservation of Weight, it is difficult to test the hypothesis that Conservation of Substance precedes Conservation of Weight for this group. Five out of the 11 Chinese Ss who showed Conservation of Weight were without Conservation of Substance. This finding also calls into question the validity of the Conservation tests as administered to the Chinese Ss as a reflection of the cognitive structures assumed by Piaget to underly Conservation, since the developmental priority of Conservation of Substance to Conservation of Weight has been repeatedly found (e.g. Stacey, 1967, Smedslund, 1964) and is one of the more stable and dependable Piagetian phenomena. In view of this finding, all the other results reported here which relate Conservation performance of Chinese Ss to other variables should be regarded as especially tentative.

The findings that there were no significant relationships between performance on Piagetian tasks of Conserva-
tion of Substance and Weight and scores on the CEFT for both white and Chinese Ss was inconsistent with the results obtained by Pascual-Leone (1966) who predicted and found a highly significant relationship between performance on the CEFT and on both Conservation tasks. Several factors may have contributed to the findings in this study. We have suggested above that the failure of data from Chinese Ss to give a clear implication relationship between Conservation of Substance and Weight is an indication that the Conservation tasks as administered here may not give results comparable to previous studies. Another possible source of error may have been the fact that only one item was given to each Chinese S on both Conservation of Substance and Conservation of Weight, providing a less reliable measure. Furthermore, although the white Ss were given three items in each Conservation task, only the scores from the first item were used for comparison with the Chinese Ss. In Pascual-Leone's (1966) study, three items were given in each Conservation task. The findings from his study are probably more reliable than those from this study.

Another possible factor which may have accounted for the lack of relationship was revealed when the performance of F.I. and F.D. Chinese Ss from the three different schools were compared. Because only five Ss were from School 2, the results from this school were grouped with those of School 1. The distribution of responses on Conservation of Substance for F.I. and F.D. Ss. from Schools 1 and 2 is given in Table 23.
Table 23 shows that nine out of thirteen F.I. Ss from Schools 1 and 2 gave correct responses on Conservation of Substance; while three out of ten F.D. Ss gave correct responses on this same task. The difference in performance was found to be significant (Fisher's Exact Probability, p .05).

The distribution of responses on Conservation of Substance for F.I. and F.D. Ss from School 3 is given in Table 24.

Table 24 shows that none of six F.I. Ss from School 3 gave a correct response on Conservation of Substance.
while one out of nine F.D. Ss gave a correct response on the same task. No significant difference was found between the performance of F.I. and F.D. Ss from School 3 on Conservation of Substance (Fisher's Exact Probability, p = .6). The low level of performance in School 3, regardless of field independence may have been partly responsible for the lack of significant relationship between performance on Conservation of Substance and the CEFT.

The performance of F.I. and F.D. Ss from Schools 1 and 2 and School 3 on Conservation of Weight was also separately compared. The distribution of responses on Conservation of Weight for F.I. and F.D. Ss from Schools 1 and 2 is given in Table 25.

<table>
<thead>
<tr>
<th>Conservation of Weight</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>F.I.</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>F.D.</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

No significant difference in performance between F.I. and F.D. Ss from Schools 1 and 2 was found (Fisher's Exact Probability, p = .09).

The distribution of responses on Conservation of Weight for F.I. and F.D. Ss from School 3 is given in Table 26.
TABLE 26

Distribution of Responses on Conservation of Weight for F.I. and F.D. Ss from School 3

<table>
<thead>
<tr>
<th>Conservation of Weight</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>F.I.</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>F.D.</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

No significant difference in performance between F.I. and F.D. Ss from School 3 was found (Fisher's Exact Probability, $p = .3$).

There was some indication of difference in performance between F.I. and F.D. Ss from Schools 1 and 2 on Conservation of Weight, although this was not significant at the .05 level. There is some basis therefore, for suggesting that again, it may have been the lack of differentiation in performance between F.I. and F.D. Ss from School 3 on both Conservation tasks that resulted in no significant relationships between Conservation of Substance and Weight and the CEFT for the Chinese Ss.

An examination of the relationship between performance of white Ss on Conservation of Substance and Conservation of Weight with scores on the CEFT revealed the following. Although there was no significant relationship between performance on each of the Conservation tasks separately and scores on the CEFT, ($\tau = +.14$, n.s.; $\tau = -.09$, n.s.); a significant relationship was obtained between the total Conservation score and the CEFT scores ($\tau = +.19$, $p < .05$).
One possible explanation for this finding may be that because the possible range of scores on both Conservation of Substance and Weight ranged only from 0 - 2, this reduced the extent to which Ss could be differentiated on these tasks, which in turn, restricted both the possibility and the size of a correlation with another variable. However, when scores on these two tasks were combined, the range was increased to 0 - 4, and this allowed for greater differentiation of the Ss on these tasks, resulting in a higher correlation with another variable.

Since only the scores from the first of the three tasks given in each Conservation task were used in computing the correlation between Conservation scores, and the CEFT for the white Ss, this again raised the question of the reliability of the Conservation scores. To clarify this, each S was given a new Conservation of Substance and Conservation of Weight score, based on the S's performance on all three items in each test. The relationship between Conservation of Substance and Weight based on these scores and performance on the CEFT was investigated. A low but significant positive correlation was obtained between performance of white Ss on Conservation of Substance and the CEFT. (τ = +.20, p = .05). A positive correlation was found between performance on Conservation of Weight and the CEFT. However, this just failed to be significant at the .05 level (τ = +.17, p = .085). The findings showed that using the Conservation scores based on three items in each test increased correlation with the CEFT for both tests.
Though the predicted significant relationships were not obtained with both white and Chinese Ss, there were some indications that the expected relationships may have been obtained if more items had been given on the Conservation tasks. This would have increased both the reliability and the range of the test and the chances of finding significant relationships would have been higher. This possibility was confirmed with the results of the white Ss. Furthermore, if the performance of the Chinese Ss from School 3 had not been so unexpectedly low, the results for the Chinese Ss may have been in line with the predictions also.

Pascual-Leone (1966) suggested that performance on certain Piagetian tasks which are within the intellectual capacity of the individual will be determined in part by the variable of field-dependency. One would expect on the basis of this that performance on tests which are more difficult, and which may be, in fact, beyond the individual's intellectual capacity, will not be as strongly influenced by this dimension. A higher correlation will therefore be obtained between Conservation of Substance and the CEFT than that between Conservation of Weight and the CEFT. The trends from both Chinese and white samples were consistent with this prediction. Both groups obtained higher correlations between Conservation of Substance and the CEFT than Conservation of Weight and the CEFT.

Results for both white and Chinese Ss on the Water Level Test supported the prediction that a significant
existence of a correlation between performance on the Water Level Test and scores on the CEFT. Significant correlations were obtained for both the white and the Chinese Ss. However, the correlation for both groups was low.

The original hypothesis, therefore, was confirmed for the Water Level Test but not for the Conservation tasks. This may reflect only the greater reliability of the Water Level scores, which are based on 12 items. It may reflect differences in the nature of the tasks and the criteria required to be met for correct performance.

In both the CEFT and the Water Level Test, the S is required to extract the relevant information from a number of misleading cues - the colors and the lines in the complex figure in the CEFT, the walls and the position of the bottle in the Water Level Test. However, there is no one specific stimulus cue which is predominantly misleading and which the individual has to contend with before he can arrive at the correct response. Furthermore, the misleading cues in both tests do not change during the course of the experiment. In the Conservation task, on the other hand, one perceptual cue is dominant, the shape of the plasticine. Furthermore, this perceptual cue is changed during the experiment, and the S is required to reason out invariance of substance and weight in the face of this particular perceptual change. Thus, the Conservation tasks differ from both the CEFT and the Water Level Test with regard to the nature of the perceptual cues present in the test situation. Furthermore, in the CEFT and Water Level Test the child is not
required to verbalize his responses. In the CEFT, he has
to point out the simple figure and in the Water Level Test
he is required to draw the water line. However, in the
Conservation tasks, the S not only has to reason out the
fact of invariance, he is further asked to verbalize the
justification for it. Therefore, in terms of the criterion
used for scoring, a response as correct, the Conservation
tasks again differ, from both the Water Level Test and the
CEFT. Because of the greater similarity between the Water
Level Test and the CEFT in these respects, this similarity
may have resulted in a higher correlation between the Water
Level Test and the CEFT than between the Conservation task
and the CEFT.

No significant relationship was found between perfor­
mance on Piagetian tasks and in Achievement scores. One
possible explanation for this lack of relationship may again
simply be because some of the tests were beyond the intellec­
tual capacity of the individual and therefore differences in
achievement motivation would make no difference to perfor­
mance on these tasks. This would lend one again to predict
that performance on the easier tasks would show a higher
correlation with n achievement scores, but that the correla­
tion will break down with the more difficult tasks. The
results showed that the correlation between Conservation of
Substance and n Achievement scores was lower (tau = -.045)
than that between Conservation of Weight and n Achievement
scores (tau = -.184). This finding is inconsistent with
the reasoning above. The relationship between performance
on the horizontal items in the Water Level Test (the easier
tasks) and n achievement scores, and performance on the tilted items (the more difficult task) was examined. A higher correlation was obtained between performance on the horizontal items and n Achievement (tau = .194) than between tilted items and n achievement (tau = -.022). This finding lends support to the prediction. The evidence for this explanation of the lack of correlation between n Achievement and the Piagetian task then, is inconsistent.

It may be that the procedure and methods for eliciting and the scoring for n Achievement are not applicable to the Chinese. This would provide another possible reason for the failure to find a significant relationship between n Achievement and performance on the Piagetian tasks. However, Hayashi, Tamatsa and Havu (1962) have established that n Achievement as measured by the TAT significantly differentiates between the performance of low and high ego 'involvement' situations with Japanese Ss from Tokyo. There is, therefore, some cross-cultural evidence to suggest that the instrument for measuring achievement motivation is an appropriate one. On the other hand, a review of the relevant literature showed that as yet, no study with white Ss has been conducted relating performance on Piagetian tasks and n Achievement scores. Therefore, there is no direct evidence that such a relationship exists. Thus, to look for a relationship in a culture which is different from that for which both tests were devised, may have been premature. For all these reasons, this
finding should be regarded as especially inconclusive.

Although the relationship obtained between Piagetian tasks and the CEFT offer some support for the hypothesis that performance on Piagetian tasks correlated with scores on the CEFT, the relationships obtained were not strong. Even when a correlation was found it was only a low one, the results relating n Achievement scores and Piagetian tasks offered no support for the hypothesis that performance on n Achievement correlates with performance on Piagetian tasks. In view of the general results, there was little basis for offering these hypotheses as alternative interpretations to Goodnow's finding (1962) in Hong Kong. However, if the unexpected finding that performance on the CEFT correlated more with performance on the Water Level Test than with performance on the Conservation task is taken to be reliable, another possible interpretation to Goodnow's finding can be suggested. However, this interpretation is relevant to only parts of Goodnow's results.

The relationship between the Piagetian tasks that Goodnow used was similar to that between the Piagetian tasks used in this study. In both Conservation of Weight and Volume, one salient perceptual feature was dominant and misleading; and in Conservation of Space, Substance and Weight, the S was required to reason out the fact of invariance and to verbalize the justification for the response. However, in the combinational task, the S did not have to overcome a specific misleading perceptual cue. Furthermore, there
was no change in the perceptual stimuli during the course of the experiment. Finally, the S was not required to verbalize the justification for the response. In the Raven's Progressive Matrices, the individual was required to classify and group objects according to principles. Individuals were also required to fit objects into their appropriate spaces on fur - boards. Thus, in this test, there was no one perceptual cue which was dominant and misleading; there was no change in stimuli during the experiment; and no verbalization was required from the S. Thus, the Raven's Progressive Matrices is more similar to the Cominational tasks than to the Conservation tasks, in terms of its stimulus characteristics, the testing situation, and the response required of the S. This may have accounted in part for the combinational task being sensitive to Matrices score and not the Conservation tasks. Whether this hypothesis is in fact feasible, and holds true for other groups as well, remains to be determined empirically.
CHAPTER V
SUMMARY AND CONCLUSION

The major purpose of this study was to relate the performance of Chinese Ss in Hong Kong on Piagetian tasks to two factors: first, to a cognitive style variable, and secondly to achievement motivation. It was hoped that the results from this study would offer some interpretations to Goodnow's (1962) findings in Hong Kong. This study also provided an opportunity to determine if Piaget's results concerning the order of acquisition of tasks, as well as levels of difficulty within tasks can be replicated with Ss from another culture. Finally, the performance of a comparable group of white Canadian children was compared to the Chinese Ss both in terms of achievement on the tasks and relationship between the tasks.

It was hypothesized that performance on Piagetian tasks would correlate with scores on the CEFT and both scores on Achievement. Furthermore, it was believed that the responses predicted by Piaget regarding the order of achievement on the Conservation tasks as well as the levels of difficulty within the Water Level Test will be replicated with Ss from Hong Kong. Finally, it was expected that there would be no significant difference in performance between white and Chinese Ss.

Thirteen Ss from three different schools in Hong Kong were tested individually on the following tests: Conservation of Substance, Conservation of Weight, the Water Level Test, and the CEFT. Group testing was used for administer-
ing the TAT. Scores from a group of previously tested white Ss on Conservation of Substance, Conservation of Weight, the Water Level Test and the CEFT were used for comparison with the Chinese Ss.

Results for both white and Chinese Ss showed that there was no significant relationship between performance on the Conservation tasks and the CEFT. However, correlation between Conservation of Substance and the CEFT was higher for both white and Chinese Ss. A significant but low correlation was obtained between performance on the Water Level Test and the CEFT on both white and Chinese Ss. Thus, in terms of relationships between Piagetian tasks and the CEFT, the findings were similar for white and Chinese Ss.

There was no significant difference in performance between Chinese and white Ss on Conservation of Weight, the Water Level Test and the CEFT, though the white Ss obtained higher scores on all the tests compared. The white Ss performed significantly better on Conservation of Substance than the Chinese Ss. The order of achievement on the Conservation tasks predicted by Piaget was replicated with the white Ss, but the order was not clear for the Chinese sample. Developmental levels of difficulty within the Water Level Test predicted by Piaget and Inhelder were supported by the findings for both white and Chinese Ss.

No significant relationships were found for the Chinese Ss between performance on any Piagetian task and n
Achievement. There was some indication of a low negative relationship between Conservation of Weight and Achievement but this failed to reach significance at the .05 level.

Due to the fact that only one item was given in each Conservation task, the scores from these tests may not have been reliable. Therefore, any finding related to the Conservation tasks should be regarded as only tentative. If more items had been given on the Conservation tasks, the findings might have been interpreted with more confidence. Similarly, because the aspect of the study relating Achievement to Piagetian tasks was highly explanatory in nature the implications of the results were mainly inconclusive.
BIBLIOGRAPHY


The Water Level Test is used by Piaget and Inhelder to investigate the development of a horizontal axis. This development is analyzed in terms of stages of development of the response. During Stage 1, the child is unable to replicate the water as a plane surface. At Stage II, spatial orientation is determined.

"By the particular configuration represented, rather than by an external system of reference" (Piaget and Inhelder, 1956, p. 382). Stage II is further divided into sub-stages. At Stage IIA, the child draws the water line without regard to any external reference system. His response is guided by the base of the jar and he draws the water line as parallel to this. At Stage IIB, the child realizes that the water is no longer necessarily parallel to the base of the jar. However, he still cannot coordinate his predictions with any fixed external reference system (i.e. the horizontal plane on which the jar stands). Therefore, when the jar is in a tilted position, he is not able to draw the water line as horizontal. The child then reaches a transitional stage between Stage IIB and IIIA. Here the child is able to predict the level of the liquid when the jar is inverted or lying on its side, but not when the jar is in a tilted position. Finally, Stage III is reached. At this stage, the child is able to relate his responses to an external figure of reference, namely, the horizontal plane on which the jar stands. He begins to
Appendix 1 (cont'd)

draw the water line as parallel to the horizontal plane regardless of the position of the jar. Stage III is further divided into five sub-stages. The first stage lasts from 7-8-9, during which the principle of a horizontal axis comes gradually to be applied to situations. At about age 9, sub-stage IIIIB begins, bringing with it, full understanding of the notion of the horizontal axis.

It follows from Piaget and Inhelder's (1956) analysis that within the Water Level Test, the easiest task was associated with the bottle in the vertical position, the more difficult task was associated with the bottle in the horizontal position and the most difficult task being associated with the bottle in a tilted position.

In order to give a clear understanding of the value of the responses associated with each developmental stage, the responses for each position of the bottle were examined separately. Developmental steps were derived based on the work of Pascual-Leone (1967), which were empirically related to but were not identical to, the developmental stages of Piaget and Inhelder. These developmental steps provide for a detailed analysis of the responses. Boundaries were established in terms of degree and direction of deviation from the horizontal axis between each developmental step. The angle of deviation from the horizontal was measured from the left to the right of the water line. A cross was used to denote the location of the water.
## Bottle in the Vertical Position

<table>
<thead>
<tr>
<th>Developmental Steps</th>
<th>Piaget's Stage</th>
<th>Age at which stage first appears</th>
<th>Bottle Position of deviation from Horizontal</th>
<th>Sign of Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 0.</strong> These responses are the most primitive developmentally. The child is unable to grasp the notion of a water surface.</td>
<td>Stage 0</td>
<td>3-4</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>Step 1.</strong> The child realizes the existence of a water surface. However, he does not know that the water falls to the bottom of the container. He believes the water line to be parallel to the base of the container.</td>
<td>Stage I</td>
<td>5-6</td>
<td>0-6</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>Step 2.</strong> The child realizes that the water falls to the bottom of the container. He believes the water line to be parallel to the base of the container.</td>
<td>Stage 7-8</td>
<td>0-6</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>Step 3.</strong> The child realizes that the water level does not have to be parallel to the bottom of the container.</td>
<td>Stage 8-9</td>
<td>71-90</td>
<td>![Image]</td>
<td>![Image]</td>
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<tr>
<td><strong>Step 4.</strong> The child realizes that the water level does not have to be parallel to the bottom of the container.</td>
<td>Stage 8-9</td>
<td>7-70</td>
<td>![Image]</td>
<td>![Image]</td>
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<tr>
<td><strong>Step 5.</strong> The child draws the water line parallel to the horizontal plane, with the water located at the bottom of the container. This is the correct response.</td>
<td>Stage 9-10</td>
<td>0-6</td>
<td>![Image]</td>
<td>![Image]</td>
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</tbody>
</table>
### Bottle in the Horizontal Position

<table>
<thead>
<tr>
<th>Developmental Steps</th>
<th>Piaget's Stage</th>
<th>Age at which stage first appears</th>
<th>Bottle Position of deviation from Horizontal</th>
<th>Sign of Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 0.</strong> The child is unable to grasp the notion of a water surface.</td>
<td>Stage 0</td>
<td>3-4</td>
<td><img src="image" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td><strong>Step 1.</strong> The child draws the water line parallel to the base of the container</td>
<td>Stage I</td>
<td>5-6</td>
<td><img src="image" alt="Diagram" /></td>
<td>71-90</td>
</tr>
<tr>
<td><strong>Step 2.</strong> The child realizes the water line need not be parallel to the bottom of the container, However, he does not realize that the water falls to the bottom of the container.</td>
<td>Stage II A</td>
<td>7</td>
<td><img src="image" alt="Diagram" /></td>
<td>7-70</td>
</tr>
<tr>
<td><strong>Step 3.</strong> The child realizes that the water falls to the bottom of the container.</td>
<td>Stage II A</td>
<td>8</td>
<td><img src="image" alt="Diagram" /></td>
<td>7-70</td>
</tr>
<tr>
<td><strong>Step 4.</strong> The child draws the water line parallel to the horizontal plane with the water located at the bottom of the container. This is the correct response.</td>
<td>Stage III</td>
<td>9-10</td>
<td><img src="image" alt="Diagram" /></td>
<td>0-6</td>
</tr>
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</table>
### Bottle in the Tilted Position

<table>
<thead>
<tr>
<th>Developmental Steps</th>
<th>Piaget's Stage</th>
<th>Age at which stage first appears</th>
<th>Bottle Position of deviation from Horizontal Position</th>
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</thead>
<tbody>
<tr>
<td><strong>Step 0.</strong> The child is unable to grasp the notion of a water surface</td>
<td>Stage 0</td>
<td>3-4</td>
<td>31-70</td>
</tr>
<tr>
<td><strong>Step 1.</strong> The child believes the water line to be parallel to the bottom of the bottle. He does not realize that the water falls to the bottom of the container.</td>
<td>Stage I</td>
<td>5-6</td>
<td>31-70</td>
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<tr>
<td><strong>Step 2.</strong> The child realizes that the water need not be parallel to the bottom of the container. He does not realize however, that the water falls to the bottom of the container.</td>
<td>Stage II A</td>
<td>7-8</td>
<td>31-70</td>
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<tr>
<td><strong>Step 3.</strong> The child realizes that the water falls to the bottom of the container.</td>
<td>Stage II A</td>
<td>7-8</td>
<td>31-70</td>
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<tr>
<td></td>
<td>Stage II B</td>
<td>8-9</td>
<td>31-70</td>
</tr>
<tr>
<td>Developmental Steps</td>
<td>Piaget's Stage</td>
<td>Age at which stage first appears</td>
<td>Bottle Position</td>
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<tr>
<td><strong>Step 4.</strong> These responses represent a resolution of the tendency to draw parallel to the vertical or horizontal walls of the container.</td>
<td>Stage II</td>
<td>8-9</td>
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<tr>
<td><strong>Step 5.</strong> These responses also represent a resolution of the tendency to draw parallel to the vertical or the horizontal walls of the container. But they are closer to the horizontal axis than step 4 responses.</td>
<td>Stage II</td>
<td>8-9</td>
<td>B</td>
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<tr>
<td><strong>Step 6.</strong> The child draws the water line parallel to the horizontal plane with the water located at the bottom of the container. This is the correct response</td>
<td>Stage III</td>
<td>9-10</td>
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