INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or “target” for pages apparently lacking from the document photographed is “Missing Page(s)”. If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in “sectioning” the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again — beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from “photographs” if essential to the understanding of the dissertation. Silver prints of “photographs” may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

5. PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

University Microfilms International
300 North Zeib Road
Ann Arbor, Michigan 48106 USA
St. John’s Road, Tyler’s Green
High Wycombe, Bucks, England HP10 8HR
EVANS, Donn Thomas, 1933-
A PIAGETIAN PERSPECTIVE ON ARTISTIC DEVELOPMENT.

The Ohio State University,
Ph.D., 1977
Education, art

University Microfilms International, Ann Arbor, Michigan 48106

© Copyright by
Donn Thomas Evans
1977
A PIAGETIAN PERSPECTIVE ON ARTISTIC DEVELOPMENT

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By
Donn Thomas Evans, M.Ed.

* * * * *

The Ohio State University
1977

Reading Committee:
Professor Arthur Efland
Professor Philip Clark
Professor Nancy MacGregor

Approved By

Advisor
Division of Art Education
ACKNOWLEDGEMENTS

The study presented here has been assisted immeasurably by Professor Arthur Efland, my advisor, to whom my sincere gratitude is expressed. My gratitude is also extended to my other committee members Professor Nancy MacGregor and Professor Philip Clark for steady support and prompt help. Professor George Thompson provided early inspiration for the study and I am indebted for his advice. I would also like to thank Professor Kenneth Marantz, the Art Education Department Chairman, for constant support throughout and before my doctoral program.

Thanks is extended to the Headteachers of Overdale Infants and Junior Schools, Leicester, England, for allowing me to conduct an enquiry in their schools, and to Kenneth Prater and Emmanuel Nyarkoh for their assistance as Scorers.

Finally, a special thanks is extended to my wife, Lallie Boillot, for encouragement, understanding and continuous support.
VITA

May 11, 1933 ............ Born - Swindon, England

1953-1957 ............. Bath Academy of Art, England

1955 .................... Certificate in Education, University of Bristol

1956 .................... Supplementary Certificate in Education, University of Bristol

1957-1965 ............. Teacher at Dartington College of Arts, England

1966 .................... Advanced Diploma in Primary Education, (with Distinction), Cambridge University Institute of Education, England

1966-1969 ............. Lecturer, Faculty of Teacher Training, Leicester College of Art and Design, England

1969-1976 ............. Senior Lecturer, School of Educational Studies, Leicester Polytechnic, England

1974 .................... M.Ed., Nottingham University, England

1975-1976 ............. Teaching Associate, Division of Art Education, The Ohio State University, Columbus, Ohio

1977 .................... Senior Lecturer, Centre for Post-Graduate Studies, School of Education, Leicester Polytechnic, England

FIELDS OF STUDY

Major Field: Art Education

Studies in Art Education: Professor Arthur Efland
Studies in Child Development and Cognitive Psychology, Professor George Thompson
Studies in Philosophy of Art Education, Professor Ross Norris
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ACKNOWLEDGEMENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii</td>
</tr>
<tr>
<td>VITA</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
</tbody>
</table>

## CHAPTER

### I. INTRODUCTION

[Page 1]

### II. PIAGET AND THE LITERATURE OF ART EDUCATION

- Introduction [Page 5]
- The Neglect of Piaget's Work in the Field of Art Education [Page 6]
- Art as Visual Perception: the Dominant View in Art Education [Page 10]
- Non-perceptual Views of Artistic Development [Page 17]
- Conclusion [Page 28]

### III. REVIEW OF LITERATURE CONCERNED WITH THE CONCEPT OF SPACE IN CHILDREN'S DRAWING

- Introduction [Page 30]
- Descriptive Accounts of the Development of Space in Children's Drawings [Page 30]
- Investigatory/Explanatory Accounts of the Development of Space in Children's Drawings [Page 34]
- Children's Drawings and Piaget's Account of Space Development [Page 41]
- Summary [Page 47]

### IV. PIAGETIAN SPACE

- Introduction [Page 49]
- Piaget's Account of the Development of Spatial Concepts in the Child [Page 49]
- Perceptual and Representational Space [Page 53]
- The Co-ordination of Perspectives (3-Mountain Test) [Page 58]
- Horizontal and Vertical Co-ordinates [Page 61]
- Summary [Page 65]
V. THE DESIGN OF THE STUDY ........................................ 66

   Introduction ........................................ 66
   The Drawing Measure: The Three Verbal
   Invitations to Draw. ................................ 67
   The Drawing Measure: A Defense of the
   Method Used ........................................ 85
   The Piagetian Tests ................................ 97
   Conditions of the Investigation ................. 107

VI. RESULTS ...................................................... 113

   Introduction ........................................ 113
   The Drawings ......................................... 114
   The Scoring Consistency of the Drawing Test. 132
   The Horizontal/Vertical Co-ordinates ........... 136
   The 3-Mountain Test ................................ 139
   Statistical Results ................................. 145
   Conclusion ........................................... 147

VII. CONCLUSIONS AND IMPLICATIONS. .................... 149

BIBLIOGRAPHY .................................................. 153
**LIST OF TABLES**

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Drawing Measure: Guide to Scoring the 3 Invitations. Credit given for steps-in-space by indications of space and volume.</td>
<td>96</td>
</tr>
<tr>
<td>2. Basic equipment, examples of questions and adopted scoring procedure in the Piagetian Tests.</td>
<td>101</td>
</tr>
<tr>
<td>3. Individual and total scores for Drawings, Co-ordinates and 3-M Test.</td>
<td>109</td>
</tr>
<tr>
<td>4. Age group solutions to selected spatial problems in Invitation I arranged in order of increasing sophistication.</td>
<td>129</td>
</tr>
<tr>
<td>5. Age group solutions to selected spatial problems in Invitation II arranged in order of increasing sophistication.</td>
<td>130</td>
</tr>
<tr>
<td>6. Age group solutions to a selected spatial problem in Invitation III arranged in order of sophistication.</td>
<td>131</td>
</tr>
<tr>
<td>7. Correlation Co-efficients with Drawings (4) as the Criterion, and Age (1), Co-ordinates (2) and the 3-M Test (3) as Predictors.</td>
<td>134</td>
</tr>
<tr>
<td>8. Correlation Co-efficients of 6+ and 10+ years only.</td>
<td>135</td>
</tr>
<tr>
<td>9. Correlations between Scorer 1 and Scorer 2 on 60 Drawings randomly selected from the 126 produced for the Drawing Test.</td>
<td>137</td>
</tr>
<tr>
<td>10. A comparison of Scorer 1 (Sc. 1) and Scorer 2 (Sc. 2) on 60 Drawings selected randomly from the total sample of 126 Drawings.</td>
<td>138</td>
</tr>
<tr>
<td>11. Correlations between Scorer 1 and Scorer 3 on 60 Drawings randomly selected and randomly numbered from the 126 Drawings produced.</td>
<td>140</td>
</tr>
</tbody>
</table>
Table

12. A Comparison of Scorer 1 (Sc. 1) and Scorer 3 (Sc. 3) on 60 Drawings randomly selected and randomly numbered from the 126 Drawings produced. ......................... 141

13. Cross Tabulation Grids showing the distribution of the 42 children according to high, middle, and low score in each task of Drawings, Co-ordinates and J-N Test. ......................... 143
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pram and baby combinations</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>Pram and baby combinations (continued)</td>
<td>71</td>
</tr>
<tr>
<td>3</td>
<td>Pram and baby combinations (continued)</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>Combinations of pram, cradle and wheels</td>
<td>74</td>
</tr>
<tr>
<td>5</td>
<td>Combinations of pram, cradle and wheels (continued)</td>
<td>75</td>
</tr>
<tr>
<td>6</td>
<td>Two examples of &quot;people sitting&quot;</td>
<td>77</td>
</tr>
<tr>
<td>7</td>
<td>Table possibilities</td>
<td>78</td>
</tr>
<tr>
<td>8</td>
<td>An Invitation III drawing showing &quot;folding over&quot;</td>
<td>82</td>
</tr>
<tr>
<td>9</td>
<td>Road and figures</td>
<td>84</td>
</tr>
<tr>
<td>10</td>
<td>Classification 0 = Flat</td>
<td>88</td>
</tr>
<tr>
<td>11</td>
<td>Classification 0 = Flat</td>
<td>89</td>
</tr>
<tr>
<td>12</td>
<td>Classification 1 = step</td>
<td>90</td>
</tr>
<tr>
<td>13</td>
<td>Classification 2 = 2 steps</td>
<td>91</td>
</tr>
<tr>
<td>14</td>
<td>Classification 3 = 3 steps</td>
<td>92</td>
</tr>
<tr>
<td>15</td>
<td>Classification 4 = 4 steps</td>
<td>93</td>
</tr>
<tr>
<td>16</td>
<td>Classification 5 = 5 steps</td>
<td>94</td>
</tr>
<tr>
<td>17</td>
<td>Classification 6 = 6 steps or more</td>
<td>95</td>
</tr>
<tr>
<td>18</td>
<td>Horizontal/vertical co-ordinates procedure (tipped bottle)</td>
<td>98</td>
</tr>
<tr>
<td>19</td>
<td>Horizontal/vertical co-ordinates procedure (plumb-line)</td>
<td>99</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>20. The Three-Mountain Test</td>
<td>(The Co-ordination of Perspectives)</td>
<td>103</td>
</tr>
<tr>
<td>21. A child arranging the cardboard cut-outs in order to represent the view &quot;seen&quot; by the toy bear.</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>22. Almost unrecognizable. Invitation III drawing, Richard V. 4+ years.</td>
<td></td>
<td>115</td>
</tr>
<tr>
<td>23. Almost unrecognizable. (Above) Invitation III drawing, Richard V. 4+ years (Below) Invitation II drawing, Catherine G. 4+ years</td>
<td></td>
<td>116</td>
</tr>
<tr>
<td>24. (Above) Accidental superimposition Invitation II drawing, Robert L. 6+ years (Below) Simple insensitive outline, Invitation I Drawing, Lorraine S. 9+ years</td>
<td></td>
<td>118</td>
</tr>
<tr>
<td>25. (Above) Silhouette response, Invitation I drawing, Christine P. 8+ years (Below) X-Ray or Transparency drawing, Invitation I response, Ruth K. 6+ years</td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>26. Opening-out and flattening. Invitation I response, Michael L. 8+ years</td>
<td></td>
<td>122</td>
</tr>
<tr>
<td>27. Indications of volume, and of relative apparent size. Invitation III response, Miranda P. 10+ years</td>
<td></td>
<td>123</td>
</tr>
<tr>
<td>28. Foreshortening and linear perspective. Invitation I responses. (Above) Johanna D. 10+ years (Below) Philip W. 10+ years</td>
<td></td>
<td>124</td>
</tr>
<tr>
<td>29. (Above) An older child with a low score (1 point) Invitation I response, Miriam K. 10+ years (Below) Humor (4 points) Invitation I response Stephen A. 10+ years</td>
<td></td>
<td>125</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Background and Purposes of the Study

Despite over fifty years of study of child and adolescent behavior, it was not until the 1960's that Piaget's work gained wide acceptance. Earlier, and particularly in the U.S.A. where psychology had a behavioral or statistical emphasis, he appeared "non-scientific" or "impressionistic". Then as the psychological pendulum began to swing towards a more cognitive and personal view of the child, the significant insights that Piaget had gained over the years took on a new relevance. His research, based upon his theory of cognitive development, has generated replication studies in many countries (Modgil, 1974), which have proved largely confirmatory. Although there remain authorities (e.g. Fleischmann et al., 1966; Wallace, 1972) in the field who are skeptical about some of his ideas or who criticize his methodology, there is general unanimity of the significance of his work for a clearer understanding of child behavior.

Piaget's insights into the thought processes of children have become the theoretical foundation of many educational implementation programs (Elkind, 1961; Smedslund, 1961; Wohlwill and Lowe, 1962; Karplus, 1965), and have been utilized in "new math" projects and "new science" curricula. It is therefore surprising to find his work
somewhat neglected in the literature of art education. Piaget's
theory of cognitive development would appear to be of some importance
to all educators, but his detailed investigations show the working of
his theory in many areas of particular concern to art educators.
Examples of these are: perception; physical causality; imitation;
dreams; thinking; imagery; memory; language; reality; and space.

Accordingly, this study is concerned with seeking an answer to the
following questions:

1. How can Piaget's significance to art education be shown?
2. What aspects of artistic development are illuminated
   by Piaget's work?
3. Can a relationship between Piagetian theory and artistic
development be demonstrated?

In order to answer these questions this study proposes to select
a topic of common interest to both Piaget and art education which
could offer material upon which a justifiable comparison could be made.
One such area is the child's developing concept of space, which is
observable in the drawings of children, and which has been the subject
of study by Piaget as part of his monumental investigations of
conceptual growth. For the art educator, the subject "space" would
represent a much utilized, much discussed topic. It is certainly well
documented, for the history of Western Art throughout the past five
hundred years can be shown as being concerned principally with the
representation of space, and this in itself is rooted in the scientific
and mathematical ideas which have formed the basis of our civilization
(White, 1970). For Piaget, his two volumes (1956, 1960), devoted to
the evolution of spatial and geometrical concepts in the child, explain how the perfection of Euclidean metric geometry and projective space can evolve from the first intuitive responses of the newborn child. These works are typical of Piaget's approach to the problem of revealing children's thought processes. They contain numerous descriptions of ingenious situations devised to shed light upon the relationship between the child's representational abilities and his cognitive development. As such they are of undoubted relevance to all teachers and of particular importance to teachers of art, especially those concerned with young children. For the study of space, the first (The Child's Conception of Space) of these volumes would be appropriate, and would therefore represent the principal Piagetian resource for this study. It contains sections on the child's growing grasp of: the projection of shadows; perpendicular and horizontal constants; projective lines and perspective; sections of solid figures; the coordination of perspectives; and the rotation and development of surfaces. In all of these situations Piaget uses children's representational ability (in many cases, drawing behavior) to indicate levels of understanding, and he has also included a section specifically devoted to the development of spontaneous drawing in children.

Having selected an area of common concern to both Piaget and the art educator, it is proposed to identify relationships and significances by two means. First, by examining a representative selection of accounts and explanations of the development of space in children's drawings which are available in the art education literature. These
will be compared and discussed in the light of their own theoretical basis and those of Piaget's. At this point, too, a full Piagetian account will be presented. Second, by conducting an empirical study where a sample of primary school children, of wide age range, would be asked to produce several drawings and also submitted to some of the situations Piaget used for his investigations of the developing space concept. The drawings would be produced in response to conditions designed by the writer to elicit what space representing abilities the children may possess. Both the Piagetian and the drawing situations will be in the form of prepared and previously used tests. The scores from these tests would then be subjected to statistical analysis in order to determine the degree of support they offer for the hypothesized relationship between children's ability to represent space in drawing and their performance on some of Piaget's tests of spatial concepts, but more generally for that between artistic development and the accounts of cognitive growth described by Piaget.

However, before embarking upon either the space literature review or the empirical investigation, it is proposed to conduct an examination of existing references to Piaget in the art education literature. The nature and contexts of these references will be discussed in the light of dominant ideas in art education, particularly those of perception.
CHAPTER II
PIAGET AND THE LITERATURE OF ART EDUCATION

Introduction

The contents of this chapter result from an examination of important art education literature. This includes all issues of the principal art education journal of research (Studies in Art Education, Washington: N.A.E.A.), as well as the most influential art education texts in use over the past fifteen years. The task was to check the number of references to Piaget and to decide the nature of those references for the purposes of determining the impact of Piaget's work upon the field of art education. The majority found made no more than passing reference to his work, principally as a "cognitive theory". More substantial references were few in number and find a place in this review.

The chapter recognizes the dominance in art education of Arnheim's perceptual account as an explanation of drawing development in the child. It also attempts to determine why its acceptance of a 'perceptual' explanation should predispose a rejection of any 'cognitive' explanations. As such, Arnheim's theory is examined in some detail, largely in the contexts of Piaget's work. Other non-perceptual theorists who in some way make use of Piaget's ideas are also studied, with the work of Gardner claiming particular attention.
Explanations are sought for the neglect of Piaget in art education, and some justification given for the study of Piaget in terms of his relevance for art education.

The Neglect of Piaget's Work in the Field of Art Education

There is little reference to Piaget in the professional journals of art education before the year 1966, and what there is makes no more than passing reference to his work. The first article dedicated exclusively to Piaget appeared that year (Lansing, 1966). Since then the number of references to Piaget has increased, but there exist surprisingly few papers devoting substantial space to the man or his ideas.

It is interesting to note that in a recent study by Clark (1975), which examined by content analysis ten important art education textbooks (produced 1960-70), only three quotes or references to Piaget in three of the texts were found. Of all theories and theorists the aesthetic and sociological predominated, with Dewey, Croce, Bell, Langer and Weitz ascendant. The lesser psychological influence was represented largely by Arnheim (and Gestalt theories) and by Freud (and psychoanalytic theories). Piaget appeared as an also-ran behind Read, Guilford, Harris, Witkin, Torrance, and Getzels and Jackson.

In the contexts of this study, then, Lansing's paper is something of a milestone. It came at a time of change and re-appraisal in art education, at the end of the Lowenfeld era when creativity research had lost some of its shine. The journal issues of the years 1963-68 show a pre-occupation with the state of art education, its direction and
purpose, at national and international levels. There were also recurring discussions on a definition, discipline and theory of art education, and on the role played by research. It was also a time when some of the ideas that have since become influential were given a good airing, for example, those on aesthetic education, perceptual training, and curriculum reform. From today's viewpoint these topics belong very much together, and so they may have appeared to some of the far-sighted writers of the time.

Piaget's name occurred in the debate (put forward, as we have seen by Lansing), but his ideas were not taken up to the extent that they have been in other educational disciplines, where his work has since contributed enormously to contemporary thinking about educational theory and practice. For example, in England the Nuffield Foundation programs of modern mathematics, science and foreign languages have a Piagetian based curriculum structure. In the U.S.A., to quote Elkind (1976, p. 20):

"The curriculum reformers, Beeberman, Karplus, Bruner, and others, have all acknowledged their large debt to Piaget. In education, therefore, the search for new educational alternatives and the need to build new curricula adapted to the thinking of the children led to the rediscovery of Piaget in the 1950's and early 1960's. Since that time his influence in education has grown steadily, so that today there is not a single recent textbook in educational psychology which does not devote a considerable portion of its pages to the research and theory of Jean Piaget."

The failure of art educators to take up Piaget's work appears surprising when one considers that Piaget wrote an article on the subject of art education at a time (1953) when the influence of his
work upon educational thinking was first being felt. In hindsight this was indeed a rare privilege, for although he has written occasionally on educational matters (e.g. 1970), it is generally agreed that the task of applying his findings has been left to others.

The article in question is a very brief contribution to the 1953 U.N.E.S.C.O. Symposium on art education. As such, it occurs soon after the completion of "The Child's Conception of Space", (first published in 1948 in French), which he wrote with Inhelder, and which provides much of the material for this study. Apart from proximity in time, there is no obvious direct link between the two. In content the U.N.E.S.C.O. article seems closer to some of his work of the 60's, for example the one already mentioned on educational matters above. In the U.N.E.S.C.O. article Piaget speaks of the roots of aesthetic behavior in the child as attempting to reconcile the two opposing poles of:

(i) "his conceptional or socialized thought"

and

(ii) his affective side: "the life lived by the ego, with its conflicts, its conscious desires, etc. .... whether it be in drawing, building or theatrical representation, the child is endeavouring simultaneously to satisfy his own needs and to adapt himself to objects and to other persons. He attempts to satisfy himself in one way, but he attempts in addition to insert what he thinks and feels into the world of objective and communicable realities which is the material and social universe" (Piaget, 1953, p. 22).

Piaget suggests that it is the task of art education to cultivate these means of expression and to ensure that school and family life have enriching rather than inhibitory effects.

If the literature of art education is any indication then there is very little response to Piaget's article. Without doubt the brevity
(barely a page) of the article was a disappointment to the art education world which may have expected a clearer indication of the potentials of his theory.

It is noticeable that Lansing's (1966) article ignored Piaget's U.N.E.S.C.O. piece, but drew heavily upon the "The Child's Conception of Space" which was first published in English in 1956. He is most indebted to the small section devoted to children's spontaneous drawings where Piaget used the examples in Luquet's (1927) account of drawing development to illustrate the child's growing powers of spatial representation, in terms of a movement through topological concepts towards projective and Euclidean concepts. From this, Lansing uses the Piagetian Stages to key with Lowenfeld's Stages. From Piaget's description of the concrete nature of children's thought up to age eleven, Lansing discouraged the use of abstract ideas in teaching art to children in the elementary school. Finally in an attempt to forge a closer link between Piaget's ideas and those of Lowenfeld's, Lansing suggested that the haptic child's inability to "co-ordinate his partial impressions to form a mental image" (Lansing, 1966, p. 42) may be remedied by the development of their spatial concepts by means of appropriate perceptual activity. This suggestion appears to fly in the face of Lowenfeld's desire (e.g. Lowenfeld and Brittain, 1964, p. 258) to protect the haptic child's apparently inherited tendency to represent his own bodily sensations and subjective experiences in preference to a measured rendering of external reality. The contents of Piaget's U.N.E.S.C.O. article would seem to go some way towards reconciling these two views. Inasmuch as he depicts the child as striving towards
equilibrium, in "endeavouring simultaneously to satisfy his own needs and to adapt himself to objects and to other persons," etc. (see above)

Art as Visual Perception: the Dominant View in Art Education

An art education text book produced by Lansing in 1969, and dedicated to the memory of Lowenfeld, contained the essence of Lansing's 1966 article in a chapter concerned with explanations of artistic growth, and appearing under the heading of concept development. The tendency to classify Piaget as a "conceptual theorist" or a "cognitive theorist" is a noticeable feature of art education literature. The juxtapositioning of conceptual, cognitive, or intellectualist theory alongside perceptual or perceptualist theory is a tendency that seems to start with Arnheim (1954), where it is equated with the "Draw-what-they-know" and "Draw-what-they-see" alternatives, and which continues through McFee (1961), Harris (1963), Kaufman (1966), Feldman (1970), and Eisner (1971). Such over-simplified categories can lead to narrower perspectives on relevant art education material.

In Piaget's case, to place him in one camp or the other would amount to a misrepresentation of his position. His theory is one of interaction in which perceptual activity is essential as the building block of intellectual activity (see the section on Perceptual and Representational Space). The world of external reality is common to all men, but perceptual activity serves to modify and extend the mental structures which in turn can make more sense of external reality.
Further, a "Draw-what-they-know" classification would appear unreasonable in view of Piaget's pre-occupation with thought. His concern is not with informational detail (as in the Draw-a-man-test) which varies from culture to culture, but with the universal processes of thinking (in its broadest sense). This is well illustrated in Piaget's autobiography (see Evans, 1973, pp. 118-19), where he described how he discovered his life-long field of research when, working with Dr. Simon in Binet's laboratory on intelligence tests, he found himself questioning subjects with the aim of discovering more about the reasoning process underlying their correct, but especially their incorrect, answers. And again, when Piaget describes a childhood discovery of a mathematician friend, who realized suddenly one day that no matter how he arranged pebbles on the ground, rows, circles, squares, or whatever, he began counting them, they always added up to ten.

"He found that the sum was independent of the order. In other words that the action of putting together is independent of the action of ordering. He discovered a property of actions and not a property of pebbles ..." (Piaget, 1964, p. 11).

Therefore to classify Piaget on a "Draw-what-they-see/Draw-what-they-know" basis is quite inappropriate. It is a very crude instrument for deciding the merit of alternative explanations of artistic growth, and one wonders how many potentially valuable ideas have been perfunctorily dismissed over the years.

Its survival has been due largely to the dominant influence of the perceptual theory of Arnheim. His theory proposes that an individual's ability to discriminate the details, properties and qualities of the environment increase with maturity. Arnheim works from a Gestalt frame
of reference and describes a perception governed artistic development which proceeds from wholes to particulars through a process of differentiation. He explains that the circle is drawn before the square because it is less differentiated, and that the characteristic simplicity of child art is due to the child seeing less than the adult; that it is due to his undeveloped perceptual abilities and not to his limited motor skills. Also that the child who draws has the difficult task of transforming the objects perceived into marks on a flat surface, with tools and materials which impose their own limitations, and that what is accomplished is achieved by creating structural equivalents in the given medium. Arnheim views drawing as a constructive act of some ingenuity and explains aspects like the lack of spatial relationships in young children's drawings as resulting from the 'local solutions' that the child employs which would tend to neglect the wider contextual aspects of drawing. One of the most significant features of his theory is his provision of an alternative for 'schema' (this word, has a variety of uses, but in this case it refers to image-based conventions the child develops to utilize in a number of ways in his drawings e.g. Lowenfeld's schemas). Arnheim would say that children's drawings are more generalized than specific. For example, in employing his 'visual concept' of a hand a child is more concerned with the spreading fingers than with ensuring that the fingers number five.

"A child's figure is no more a 'schema' than one by Rubens - it is only less differentiated" (Arnheim, 1956, p. 159).
Arnheim's work with its theoretical consistency, has been greatly used for explaining the relationship between drawing and perception. Although Arnheim's views are not experimentally grounded, a number of empirical studies (e.g. Lewis 1963, Lewis and Livson 1966, Golomb 1973) have used his notions as a point of departure.

Despite these strengths there are several aspects of his theory which give rise to questions:

(i) Arnheim attempts to distinguish between the physical act of seeing and visual perception. He claims that seeing involves the projection of images on the retina, and that many projections of an object form the basis of what he calls a 'visual concept'. It is to these 'visual concepts' that a child refers when he is drawing and not to a single retinal image. This idea has a genealogy in Art Education that can be traced from Arnheim through Schaeffer-Simmern (1949) and Britsch (1926) to ideas in Gestalt psychology which hit America in the 1920's. Despite McFee's explanation of 'visual concepts' as "derived from form and surface elements of objects as seen in space and light, as opposed to cognitive concepts of objects derived from past learning" (McFee, 1961, p. 54), the phrase does not occur in Gestalt psychology and has not been defined adequately in psychological terms. Further weaknesses have been recognized in the theory, for example, it is difficult to see how cognition can be so easily separated into 'visual' and 'cognitive' elements, and unlike the theories of Piaget and Hebb perceptual growth is assumed and not explained. For Arnheim perceptual development like the good Gestalt, is given. Or in other words Arnheim explains the changes with the concept of perceptual growth but he does not explain
perceptual growth itself.

(ii) Another point of criticism (of a Piagetian nature but not exclusively) is the heavy reliance placed upon perception by Arnheim's theory. Perception happens in the presence of stimuli. A characteristic of animal behavior and babies in their first year of life is - "out of sight, out of mind". Man's development of the symbolic function has released him from the domination of the present, and enabled him to reflect on the past and contemplate the future. Varieties of representation employ symbolic forms which permit the world to be represented in its absence. Developmentally, 'pretending' is about the earliest form of representation, but other forms are dramatic play, where some objects stand for other objects, number, words and of course drawing, and all the products of the art world. Piaget has described thought variously as "internalized actions" and as "the manipulation of representations". This goes a long way towards explaining why children are not really interested in drawing things that are present, i.e. before them whilst they draw, and from which they draw. The Life Drawing approach is typical of adult behavior where we take a good long look at phenomena, search for deeper meanings and where we can employ our analytical skills (which Piaget demonstrates begin to appear around seven years, but not at a superior level until some five years later). Many of the studies (e.g. those of Lewis 1963, Lewis and Livson 1966, Axson 1971 mentioned later in this study) generated by Arnheim's theory require children to draw present objects, peep through holes in screens with one eye, etc. In this light Arnheim's theory appears adultomorphic.
Also in this light, Arnheim's theory would seem peculiarly western, in its manner of viewing objects from one point of view, at one point in time. To this can be added the conclusions of a study by Dorethy (1973) who stated that motion parallax is of definite benefit as a means of clarifying and sharpening ability to visually analyze perceived space. This would seem to key with the views of Piaget, who has stressed time and time again that spatial representations are built up through the organization of actions performed on objects in space. He says that representations of space do not result from a "reading off" of the environment by the perceptual apparatus, but from active manipulations of the spatial environment, which cannot be achieved without movement. (This point is dealt with in more detail in the section: Perceptual and Representational Space.) Piaget demonstrates that the perception of forms is an outgrowth of movement by the eyes and hands, and claims that perceptual movement is more important than the static perceptual image in the formation of representational images. Gestalt theory speaks of all relationships being given in an immobile percept, and Arnheim uses the term percept and visual concept synonymously. Does this imply that the representational image occurs without learning? Piaget parted with Gestalt theorists on this point, i.e. that the principles of mental organization were innate which he found contrary to his observations regarding the persistent interaction of nature and nurture. Piaget says that a representational image results from perceptual movement and the co-ordination of perceptual movements, which explains why the formation of representational images lags behind that of perception or recognition.
(iii) In a study critical of Gestalt theory in the contemporary psychology of intelligence and perception, Piaget (1973) points to the weaknesses of applying Gestalt Theory outside the area of perception, in which it was perceived. Arnheim's Theory is a good example of this practice in the sense that in speaking of visual concepts he extends perception too far beyond the immediate present (see Piaget's definition of perception, below). Some of these criticisms apply to the non-additive and essentially irreversible nature of perceptions which cannot carry over into the field of thinking. Piaget (1973, p. 130) explains that the pre-operational child works from his perceptive configurations (Gestalts) whereas the operational child reasons on his transformations which lead from one configuration to another. Piaget says that these are totalities, but not Gestalt totalities.

This would serve to weaken MacGregor's (1972) view of Arnheim as one who stresses the interactive roles of perception and cognition. In this discussion MacGregor speaks of Piaget as presenting an "heirarchical structure in which perception is subordinated to intellectual levels of thought" (MacGregor, 1972, p. 11). It is true that Piaget describes perception as subordinate to intelligence in the sense that it "arises developmentally not as an autonomous mode of adaptation in its own right, but as a kind of dependent sub-system" (Flavell, 1963, p. 232), but he also sees perception as a manifestation of operative knowledge. Furth (1969, p. 263) defines operative knowledge as "the essential, generalizable structuring aspect of intelligence in so far as knowing means constructing, transforming, incorporating, etc.", which contrasts with his (p. 261) definition of Figurative Knowledge as: "Knowledge
that focuses upon the external, figural aspect of an event in a static manner. Piaget would not separate knowledge into perceptual knowledge and intellectual knowledge. For him (Furth, 1969, p. 137) there is only one kind of knowledge, which can evolve from the smallest glimmer of knowing into mature logical intelligence. Relegating perception as an autonomous substructure into a primitive period of intellectual development, is alien to Piaget's way of thinking. "Piaget only speaks of perception when the figurative aspect forms an integral part of knowing, and when the object of knowledge is immediately present to the senses" (Furth, p. 137). It would seem, then, that it is Piaget and not Arnheim, who stresses the interactive roles of perception and cognition.

However, of more obvious relevance to art educators is the weakness of Gestalt theory concerning tactile perception "for these are not simultaneous and require a continual positioning among successive facts" (Piaget 1973, p. 134). This point alone would rule out all those art education behaviors where touch is important - a serious restriction for Arnheim's theory.

Non-perceptual Views of Artistic Development

Howard Gardner, who has written (1974) authoritatively on Piaget, is interested in symbol use in the arts, and especially how the child utilizes and responds to symbols. He finds a number of philosophers saying that scientific experience is unlike aesthetic experience, and that the one is not a variety of the other. From this basis he reasons that there should be a distinct developmental history of aesthetic
behavior to investigate. He is wary of simply importing the Piagetian stages into the aesthetic realm and attempting to apply them to the way children think about art objects, though one could regard his 1976 "Three Stages of Understanding Art" as just such an attempt to do so. Gardner is anxious to point out that he is not trying to rule out a relationship between aesthetic development and Piagetian Stages, but is rather keen not to predetermine interpretation by imposing a Piagetian structure upon aesthetic activity. Gardner is also concerned that the application of a cognitive structure to the arts may miss the affective side, which he says is their distinctive feature, i.e. their power to engage feeling. Gardner claims that psychologists have largely worked on the assumption that the end-states to which development proceeds are scientific thinking (Logico-Mathematical) or the 'normal' personality, and that they have neglected the aspects of knowing and action that do not seem important for progress in these directions. He suggests participation in the arts is a more viable and comprehensive end-state from which to view development, and proposes that:

..... "this view of artistic development may be seen as supplementary to the monumental developmental framework proposed by Jean Piaget." (from the Introduction p. vi. of Gardner's 1973 "The Arts and Human Development," with my underlining to emphasize that Gardner said "supplementary" and not "alternative").

He finds Piaget's explanation of the characteristics of development inadequate when applied to artistic behavior, but with modifications, he considers it can be extended to include those people outside the scientific field, who participate in comparable intellectual activities.
Utilizing Piaget's conception of the symbolic function, Gardner describes man as principally a symbol-using creature. To this Gardner adds his own interpretation of symbol use in terms of three interacting and intertwining systems. These he calls the Perceiving System, the Feeling System, and the Making System. In this way he feels that the particular qualities of artistic development are more truly represented.

Gardner (1973, 1976) has also described stages through which children would pass in this development. However, unlike Piaget's description of development towards scientific (L.M.) thinking, he finds it not necessary for a child to pass beyond 7 or 8 years to become a participator in the artistic process. Gardner recognizes that the acquisition of logical thinking is vital for the scientist but he declares it of no special moment in the development of the creator, performer or audience member, and that what is achieved between the years 2 and 7 is sufficient for their needs. He says:

..... "there is no need for the artist, performer or audience member to master logical operations, or to pass through the cognitive landmarks that occupy Piaget" (Gardner, 1973, p. 45).

Gardner claims this view a bold one, which many may find alarming. However, several points need to be raised:

(1) What Piaget describes the child as first achieving at 7 years (i.e. concrete operations) is logical operations. Formal operational thought is a refinement or extension of it. Piaget (1958) describes formal operations as the higher of the two levels of logical thought, concrete operations being the lower one.

(11) Many authorities, Piaget included, have already recognized
the central importance of the change occurring around the years 5-7. White (1965) musters a weight of evidence from the most important and often conflicting fields in psychology, including Piaget's operational thought, the Russian "internalization of speech" school, Freud, and S-R theorists, to present a picture of a general shift in mental processes from an "associative" (animal-like) level to a "cognitive" (human-like) level around 5-7 years. This is when we acquire our distinctively human capabilities of thought. Gardner's "achieving mastery of symbol use" (1973, pp. 242-292) in the arts and sciences at the age of 7 years is no surprise.

(iii) Although Piaget tends to re-assert that his account is one of development towards an end-state of scientific, logical-mathematical thinking, his descriptions of that end-state are inadequate and do not seem to stand up to close examination. According to Piaget, someone achieving this higher level of thought will be able to isolate the variables in a problem and subject them to a combinatorial analysis which nicely exhausts the possibilities. Amongst others, Wason (e.g. 1969 and 1972) has demonstrated that this is what most adolescents and adults conspicuously fail to do. In fact, highly intelligent adults fail to treat a rule as a rule, in the sense that they do not readily grasp all the consequences which follow from it. Wason claims that Formal operations as Piaget describes them are only elicited by familiar tasks, and not by cognitive skills which can be applied to any problem whatsoever. For example, in one investigation a deceptively simple task, involving choices from partially concealed material in order to
evaluate the truth or falsity of a general statement, was presented to thirty-two graduate and undergraduate students at London University. Only two subjects were correct in their initial choices, fourteen were correct after encountering two hypothetical contradictions, twelve were correct after encountering a concrete contradiction, and four failed altogether. Wason interpreted these results as indicating either that Piaget's theory of 'formal operations' requires modification, or that some of the subjects may have temporarily regressed to more primitive modes of thinking. Gardner rejects Piaget's end-state of scientific logical thought as inappropriate for artistic development. Wason shows it is faulty anyway.

(iv) Gardner accepts the principle of operational thought inasmuch as he sees no need for artists, performers, etc. to rise above Piaget's concrete operational level. Peel (1959, 1971) also accepted the principle of operational thought, and like Wason and Gardner was dissatisfied with Piaget's account of formal reasoning. His dissatisfaction arose from attempts to apply Piaget's framework to fields outside mathematics and science. The studies were confirmatory of the details of the earlier Piagetian stages but disappointing at the formal operational stage, as there was no indication of the quality of thinking at this level. From these beginnings Peel went on to develop an analytical approach based upon a describer-explainer continuum, which represented the recognition of the most fundamental change in the adolescent period as that from describer thinking to explainer thinking following a lead in Piaget and Inhelder (1958) concerning the view that a growing awareness of possibilities marks the intellectual growth of
the adolescent (examined briefly in Chapter 18). Where Piaget had used practical science situations, Peel constructed verbal situations to test the maturity of judgment. Peel's purpose was to evoke possibilities and compare them with actualities. Understanding of the here and now may reveal itself at different levels, and explanation, an overt form of understanding can be the operational act by which understanding is assessed. It was apparent from subsequent studies that the younger adolescents may well be able to describe situations outside mathematics and the sciences but show only a limited capacity to offer explanations or form judgments co-ordinating several factors and involving imagined possibilities. On this basis, Peel recognized three levels in the emergence of adolescent judgment, Restricted, Circumstantial and Imaginative. (see Peel, 1971, for details).

In the spring of 1976 the present writer utilized Peel's structure in a Pilot Study in the area of response to paintings and photographs, using as subjects children and adolescents attending the Saturday School provided by the Department of Art Education at the Ohio State University. The results appeared to confirm Peel's observations. This work (I refer chiefly to Peel's) would indicate that response to the arts continues to develop after the concrete operational stage (there are at least 3 further levels). If this is so with the responder, what about the expressor (i.e. the artist or performer)? A responder may act in a formal operational way when judging a work of art, and in so doing may also detect formal operational qualities in the work of art. That he does so is no guarantee that the artist intended their existence but the possibility remains.
(v) Of course, a lot would depend upon what Gardner means by the word 'artist'. Some art critics, present and past, would rule out child art as an art form, and this would presumably include what Gardner means by art. Should Gardner apply as clear a notion to the term "artist" as he does to the term "scientist", he may find it necessary to revise some of his notions. He also fails to demonstrate that artistic behavior is equivalent to aesthetic behavior, or whether there are aesthetic elements in artistic behavior, and so forth. This latter point is worth raising because he tends to switch between the terms "artistic" and "aesthetic" and use them in an equivalent way.

Despite these comments what remains of Gardner's theory is worth serious thought by Art educators. Since the publication of Gardner's The Arts and Human Development which elicited most of these criticisms, he has published accounts (1976) of response to the arts which include the recognition of further development into adolescence. His theory has the merit of incorporating Piaget's theory with elements of Freudian/Eriksonian theory to provide for the affective component of artistic behavior. Gardner's suggestion that Piaget's approach is a cognitive one directed only to the intellectual underpinnings supporting competent symbol use enables Gardner to present his own theory as an affective approach where the emphasis is upon the uses to which symbolization is put, the reasons behind these uses, and the role played in the affective life of the child by the symbols utilized.

That artistic behavior is qualitatively different from scientific behavior is the sort of approach advocated by Parsons (1976) where he proposes a cognitive-developmental theory of aesthetic development in
children. He cites Gardner (1973, 1976) as one of the few recent people directly interested in developing a theory of growth in the arts. Whereas Gardner disagrees with Piaget's neglect of the affective side, Parsons also finds Piaget's theory inappropriate on the grounds that "it does not take seriously the autonomy of aesthetic experience" (Parsons, p. 306). He thinks that aesthetic objects should be treated in a special way, where their status as aesthetic objects is recognized. Although he does not say what the differences are between aesthetic and non-aesthetic objects, or how aesthetic experience differs from other experience, he claims that philosophers recognize differences between scientific and aesthetic experience and judgment. On these grounds he proposed a distinctly separate account of aesthetic development, which could be as distinct from Piaget's as that of moral development proposed by Kohlberg (1968).

Since Parsons is proposing a cognitive-developmental theory of aesthetic experience he has to deal with the affective side, favored by Gardner. He does this by pointing towards the relationship between cognition and affect which he presents as interactive. He makes the important point that affect is there to begin with (i.e., it is innate, we are endowed with it) and that it is the cognitive side that develops. Piaget would go along with this; he sees the emotions as the motivating force without which we would do nothing, and therefore an essential component of behavior. Learning theorists of the S-R school would also concur and would come up with the following equation:

\[
P = \frac{L}{\text{Performance}} \times \frac{X}{\text{Learning}} \times \frac{(I + D)}{\text{(trials)}} \]

\[
P \quad \text{Performance} \quad \text{L} \quad \text{X} \quad \text{I + D} \quad \text{(trials)}
\]
Parsons explains that it is "the ability to respond relevantly to a work of art as an aesthetic object" (Parsons, p. 306) that develops.

Parsons' model reflects Kohlberg's theory of moral development with respect to the weighting he gives to judgment and the reasons given to support judgment, i.e. its conceptualization, and also with respect to the notion of rules. Parsons describes four stages of aesthetic experience which move:

..... "from a highly egocentric response to a response that is highly sensitive to aesthetic qualities as such, i.e., to a power of highly relevant and subtle feeling" (p. 309).

Parsons' idea is well conceived and has a great deal to comment it as a framework for research in the area of artistic behavior.

In the perception section of Rouse and Hubbard's (1970) discussion of the theoretical basis for an art curriculum, reference to Piaget was made in respect of certain difficulties young children encounter in recognizing incomplete forms, especially in the closure of oblique lines or corners. In the same section they described Trabasso's (1968) study where non-conservers later improved their performance on a test of conservation after a training period devoted to giving attention to the appropriate perceptual cues. They interpreted these results as indicating that efficient perceptual performance should not be underrated as a contributing factor in cognition. Dramatic advances of this nature have been reported in a number of fields, as well as in non-Piagetian areas (e.g. the Kendlers 1959; Bruner et al., 1956) many of which have been of a temporary nature. Piaget does recognize the possibility, within broadly defined limits, of acceleration of the stages. Attempts through
the use of structured tasks have met with equivocal results, but in
general support Piaget's position on the limited effect of such training.
This is not to say that Piaget believes that nothing can be done to
enhance intellectual growth. In the first place, he recognizes the role
of experience and social transmission (along with maturation and the
process of equilibration) in cognitive development, and secondly, he is
fully aware that a lot needs to be done to stimulate children of any
age to the highest level of intellectual functioning of which they are
capable. The long range effects of continuous programs of "enrichment"
geared to the child's interests, and planned sequentially on broad
foundations for conceptual growth are as yet undetermined.

In the same study Rouse and Hubbard alluded to Piaget's (and
Bruner's) authority to delineate areas of curriculum activity which
should recognize spurts in intellectual growth. This scheme was taken
further a year later by Rouse (1971) herself, in a model for possible
sequence of art instruction which ranged from first grade to twelfth
grade. She fitted it around Piaget's developmental theory "simply
because most of what I have found confirms the validity of that theory
for such purposes" (Rouse, op.cit., p. 18). She emphasized that the
sequence was not necessarily an "age-based" or a "grade-based" model,
but a series of pre-requisites necessitating higher and higher orders
of behavior, which could be taken at the child's own pace. Keeping to
Piaget's broad structure, it started at the stage of Intuitive Thought,
as she thought that at this stage art education can first operate, and
proceeds towards and into the stage of Formal Operations. The stage of
Concrete Operations was divided into two sub-levels in recognition of the importance to art education of the changes (around 9-10 years typically) which occur in the child's concept of space (which will be dealt with in greater detail later in this study). Taken together the two studies under discussion represent a bold attempt to develop an art curriculum upon a broadly conceived psychological base.

Bingham's (1968) study was something of a reaction against the stress she felt art educators had placed upon the affective realm of aesthetic experience at the expense of the cognitive realm. She was particularly concerned about the relatively unstructured "laissez-faire" content of many art courses with their emphasis on intuitive response. She was convinced that this provided little challenge for the able student, who might turn his time and attention elsewhere, to other subjects. She proceeds to discuss the necessity for a systematic structure of art learning experiences that attempts to balance the cognitive and affective realms, and which allows media to be a means rather an end in itself. In support of this she refers to evidence to the effect that more valuable learning comes about as the result of organizing learning experiences around relationships rather than the technical details of the discipline. Piaget is referred to as a "valuable resource" (Bingham, op.cit., p. 16) for exploring concepts at the most appropriate developmental level of learning. She recognizes that Piaget's work is concerned more with exposing how a child thinks than how he feels, but also that Piaget does not try to separate feeling and thought, and she herself doubts very much that they can be separated.
Bingham makes the interesting point that before Piaget's work became available in English, cognition was thought of as conscious learning and equated with intellectual or verbal capacities. The key position of verbal learning tended to overshadow other kinds of learning (including of course, visual learning), almost to the extent that non-verbal learning was considered illogical. With Piaget's exposition of cognition as the total process of adaptation of the organism to the environment, this interpretation should have changed. One wonders to what extent the old prejudices still weigh heavily upon the attitudes of art educators.

Conclusion

In conclusion, it must be said that the neglect of Piaget in the art education world is regrettable. From the review of the literature it appears to occur for several reasons.

Some degree of blame undoubtedly lies in the nature of Piagetian writing itself. Immersion in Piagetian literature and the learning of a new vocabulary appear necessary before any understanding is reached. Some of Piaget's recent work also requires a background of formal logic to interpret. The available interpretations (e.g. Flavell, 1963; Furth, 1969) of Piagetian theory are certainly helpful, but they are not written by or for art educators. Piaget's early but only pronouncement on art education was brief and also unhelpful, in the sense that it gave little indication of the relevance of his work to art education.
A much more important reason, as Bingham clearly recognizes, is that art educators are convinced that their subject is non-cognitive. They see it as largely perceptual (as a result of Arnheim's theory and the "Draw-what-they-see/Draw-what-they-know" dictum), possibly affective, but clearly non-cognitive. This would rule out any theorist classified as cognitive, as Piaget has been by authoritative art education texts, where he has been categorized but not discussed. That this is due to a misunderstanding of the content of Piaget's work and its possible implications for explaining the development of artistic behavior has been the general drift of this chapter. The purpose of the remainder of this study is to restore some measure of understanding by demonstrating certain art educational significances in one area of Piagetian activity.
CHAPTER III
REVIEW OF LITERATURE CONCERNED WITH THE CONCEPT OF
SPACE IN CHILDREN'S DRAWINGS

Introduction

This chapter seeks to extract from the literature of art education studies which deal directly with the child's growing ability to represent space in drawing. These range from simple descriptive accounts of space rendering in drawing development, through a descriptive/explanatory account, towards explanations which are supported in some way by experimental investigation. The chapter closes with a Piagetian view of the nature of space development in children's drawings presented by the writer as an aspect of Piaget's theory of intellectual functioning.

Descriptive Accounts of the Development of Space in Children's Drawings

Descriptions of space development can be gleaned from most of the historical accounts of drawing. For example, Kerschensteiner (1905) who used the drawings of the whole school population of Munich, described four stages in his work entitled "The Development of Drawing Talent".

"The first stage of the graphic representation of space consists of either complete absence of space or the setting down of various objects alongside one another. The second stage includes drawings, which are either a conscious attempt at spatial representation, which for one reason or another
is not successful, or make the impression of being such an attempt.... we find map-like representations showing objects turned over in the plane of the page..... unsuccessful attempts at bird's eye view, simple placing of figures one over the other with continual reduction in size, marking out space by simple outlines and so on..... The third stage is that of successful but incomplete spatial representation. The child makes use of a strip of ground of greater or lesser width, and expresses his ideas of space by taking perspective foreshortening into consideration and making sparing use of the masking of one object by another. But in all these representations a definite horizon, actually represented or even suggested, is wanting. The fourth and last stage is that of faultless pictorial representation of the whole space. It makes use of all means of live and atmospheric perspective, masking, surface contours, the change in proportions with distance, and the use of shadows and reflected lights"

(from Eng's 1931 translation p. 155).

Rouma (1913) described children's growing powers of space portrayal as follows.

"At first the child draws what it knows of a thing, without thinking what is partially or completely invisible for perspective reasons. It draws the four wheels of a carriage, one behind the other, or attached to the four corners of a body, represented by a rectangle. It draws all the sides of a house side by side, and human beings are placed in rows. The second stage is characterized by the placing of several planes one over the other. More distant persons or objects are set out in a plane above the first one. Each plane forms in itself a closed whole. When connections are made between the different planes, the third stage begins. At the fourth stage, the child finally grasps intuitively the laws of perspective, and takes pains to make use of them, although it still continues to make many mistakes."

(Rouma op. cit p. 129).

Barnhart (1942) made many comments on the manner in which space was depicted by children of different ages, and detected five distinct
stages. In the first stage he observes that there is no apparent concept of the graphic portrayal of space, objects being scattered randomly over the paper surface. Association between persons or objects is shown by placing them near each other or even in juxtaposition. The concept involved seems to be one of functional relationship, rather than that of position in space. The second stage is characterized by a linear form of representation, in which objects are arranged in a row, usually upon a ground line. The third stage is a period of ranked space in which there are two or more rows. The ground lines in the background are either straight or curved to illustrate relative distance. The fourth stage consists of a transitional period which leads to the final idea of "true space", with the recognition of such factors as perspective, partial concealment of objects in the background by those in the foreground, foreshortening and the like.

In an analysis of children's artistic behaviour, which included drawing, Lowenfeld (1957) traced the development of space awareness in children aged from 4 to 17 years. He also attempted to provide explanations which were linked to their growth as individuals. He interpreted the term "space" as meaning everything outside the human body, and with this in mind he found that the youngest children were unaware of the interrelatedness of objects in space. These children were in what Lowenfeld called the Pre-Schematic Stage and produced drawings characterized by no orderly space relationships, except perhaps for an emotional bond between the individual item depicted and the child himself, such as "this is my cat". The next stage of development is the "Schematic Stage" lasting from 7 until 9 years old.
On the other hand, the haptically oriented child would be less attracted to this sort of precision but would be more pre-occupied with projecting his inner world into the picture, where manner, proportion and size might be exaggerated to achieve the appropriate emotional effect. Lowenfeld suggests that these perceptual traits are genetically determined, and hence teachers should not require visually minded individuals to produce haptic characteristics in their drawings, and vice-versa. It should be noted that the published empirical evidence for the existence of these two types of individuals has not been validated in drawing or art tasks generally but on tasks requiring the production of words and the recognition of forms. (Lowenfeld, 1945).

The topic has had a chequered career in art education, and until validation occurs the existence of haptic and visual individuals should be considered interesting speculation.

Investigatory/Explanatory Accounts of the Development of Space in Children’s Drawings

One of the earliest experimental investigations of the development of spatial representation in children’s drawings is also an outstanding example of simplicity and clarity of experiment design. This is a study of Clark (1897) who presented an apple with a hatpin stuck through it as a drawing subject to some four hundred school children aged between 6 and 16 years from four different schools. He described a gradual development from drawings showing a flat two-dimensional plate-like disc to a convincing representation 'in the round', from the visual impossibility of a pin fully visible inside the apple to one
accurately foreshortened, entering and emerging from the apple. Clark concluded that "perspective is not a simple subject but is acquired slowly through definite stages at each of which the child will stop persistently and stubbornly until ready to develop beyond it."

(Clark, 1897, p. 29)

A more recent experiment study by Lewis (1963) identified three types of spatial representation in drawing, spherical space, cubic space and spatial depth. She then devised three stimulus objects to correspond with these three types of spatial representation. In the same order, spherical space was conveyed by a green glass globe circled with a yellow band; cubic space by a four-sided flat-roofed house; and spatial depth by a model landscape in which a row of trees is flanked obliquely by two rows of fences. In addition, each stimulus object was represented by a set of five drawings each of which presented a different solution in terms of spatial representation, and which together embodied a developmental sequence as described by earlier authorities, in particular Barnhart. These drawings were then regarded as predictive of various solutions to be offered by children aged 5 to 12 subsequently employed in the investigation. Children were first asked to make drawings of the stimulus objects, and then their responses were classified according to their closeness of resemblance to one example in the appropriate set of five. Later, when children were asked to select the drawing they liked best from the five, they tended to prefer those which depicted spatial characteristics more clearly than they themselves were able to do. Lewis concluded that a relationship existed between the grade-level of pupils and the method
employed to indicate spatial characteristics in drawings, and that pupils demonstrated preference for pictures whose manner of spatial representation was somewhat superior to their own. She interpreted these findings as offering support for Arnheim's (1954) theory of the nature of developmental progress in drawing, which attempts to distinguish between the physical act of seeing and visual perception. In Piagetian terms, these results are no surprise for Piaget's account clearly demonstrates the formation of representative images lagging behind perception and recognition. (Chapter III Section 2 will deal in more detail with perception and representation.)

Lewis and Livson (1967) pursued further the study of factors that affect the developmental level in spatial representation in children's drawings. They devised an experimental task in which children aged 6-11 years were required to depict three-dimensional geometric forms on a two-dimensional plane i.e. by drawing. Four stimulus objects a cube, pyramid, pentagon and cylinder were constructed of heavy white cardboard and presented to each age group to draw. Results showed that development in drawing is characterized by successive discovery of more adequate means of depicting the essential characteristics of three-dimensional objects within the limits of a two-dimensional medium. Young children typically represented a cube by a square, one side of the figure. Older children drew a cube by showing several sides in one plane. These were in time replaced by drawings showing several sides in more than one plane, but incorrectly related. Finally the spatial relationships are shown correctly, that is corresponding closely to a photographic likeness. The developmental process culminated in
accurate spatial representation. However, progress towards this goal was not direct, in that the direction of change was from flat although correct representation, to more detailed but naturalistically incorrect representations, and finally to an accurate, three-dimensional equivalent. These results are more adequately explained in Piagetian terms as a shift from topological (proximity and order - one to many sides grouped together because they belong together) towards Euclidean spatial relationships. Piaget's account of the Drawing of Geometrical Figures (Piaget and Inhelder, 1956 pp. 52-79) and the Rotation and Development of Surfaces (pp. 271-297) deals in far greater depth with the same phenomena.

Axson's (1971) study sought to investigate the hypothesis underlying the sentence "children draw what they know rather than what they see". The dictum has been with us since the 19th century, and has earned the reputation of being a misleading over-simplification. It is closely related to what is called 'Intellectual Realism' as opposed to 'visual realism' (see in particular the work of Luquet, 1927). Axson asked children between the ages of 5 and 11 years to perform under tightly controlled experimental conditions four tasks, three of which consisted of drawing. For the three drawing tasks, children were required to draw subject-matter (clearly recognizable from earlier studies) which could be viewed from a specific angle through a peephole cut in a board. For the remaining task they were asked to make an arrangement in coloured paper of two overlapping squares. Axson was able to recognize developmental stages occurring in the child's representational ability in three of the tasks, and in the fourth, which
demanded the drawing of a model showing ducks on a pond, a gradual progression was observed in the child's ability to eliminate features of intellectual realism from his drawings. In addition, children tended to prefer drawings graded at a superior level to their own responses, as indeed they had in Lewis's (1963) study. Discussing his results Axson felt that his investigation offered general support for the concept of 'intellectual realism' in children's drawings. Despite this he saw little to confirm the theory that younger children's drawings were governed by the dictum "they draw what they know", whereas older children "draw what they see". The modification "the child does not draw what he sees but draws what he sees mediated by what he knows" Axson found more acceptable, and explained further in the following way:

"it appears that the perceptual input is filtered through conceptual knowledge to produce a representation which elaborates a cognitive structurization in which the conceptual elements take precedence over the perceptual elements" (Axson, p. 82)

Axson's study is confused and muddled. Administratively, Axson limits observation to one viewpoint (non-Piagetian) while Lewis and Livson allowed children to walk around the stimulus objects prior to drawing (Piagetian), and at the same time he clings to an Intellectual Realism - Visual Realism Shift. Theoretically, the two studies claim different points of departure. Whereas Axson's study follows the thesis:

"intellectual realism forms the basic platform of recognizable structure in children's drawings and is the point from which development starts" (Axson, p. 45)
Lewis & Livson set out to test Arnheim's view that drawing development is accountable in terms of perception, 'visual concepts' and the problems of representing the three-dimensional world on a two-dimensional plane. Nevertheless, in spite of these differences, Axson regarded his work as an extension of the Lewis and Livson study.

A much neater investigation was carried out by Freeman and Janikoun (1972). They, too, pursued the proposition "the child draws what he knows rather than what he sees", and went straight to the heart of the problem by presenting one very familiar object to children (aged 5 to 10 years) as a drawing subject. A cup was shown with the defining feature (the handle) not visible, and a non-defining feature (a painted flower) visible. A change from intellectual to visual realism occurred between 7 and 8 years of age when children tended to stop including the handle in the drawing and started including the flower (an accompanying graph-table showed the 'inclusion of flower' line crossing the 'inclusion of handle' line almost at right angles between the years 7 and 8).

Freeman and Janikoun offer two main reasons why a child includes a handle in his drawing. First because it is part of his mental image of the cup, and secondly because he fears his drawing will not be recognizable unless he puts one in. To illustrate this they quote some typical conversations, amongst which the following occur:

'Jill (produced a perfect copy) Q. "Is this how it looks?"
A. "Yes, should I do the pattern?"
   (flower)
Q. "Yes, why did you leave out the handle?"
A. "Because I could not see it."
In Piagetian terms, this is an excellent example of the achievement of operational thought, where the 7+ year old child recognizes the acceptable variables in the drawing convention, and leaves out what cannot be seen from the given viewpoint. Even though the pre-operational child may give other indications of familiarity with the drawing convention, the lack of operativity would not permit him to employ the variables aptly in the given situation.

Diana Korzenik (1972) focused upon the same age group to investigate an observed shift from ambiguous to comprehensible drawings of children between the ages of five and seven. Of course, changes in the nature of representation can be seen as part of the general movement in children's thinking around the seventh year. It has been the subject of many different authoritative accounts, most of which have been profitably reviewed by White (1965). Korzenik chose to approach the problem from the standpoint of increasing differentiation, following the lead of Werner and Kaplan (1963) and Arnheim (e.g. 1954). Her method was to ask a child to draw a picture representing a given word, and to present the resulting drawing to a second child who was asked to guess what the picture represented. More often than not, the first child found it necessary to modify the drawing, sometimes repeatedly, until the original meaning was communicated. Korzenik found that more mature communication strategies were used by older children and that
changes in the drawings themselves reflected an increasing concern for the needs of the viewer. She saw parallels between these observations and the work of the art historian Gombrich (e.g. 1960), who recognized the importance of the reciprocal relationship between the artist and the beholder, and who saw 'communication' in terms of 'making concessions to the recipient's knowledge'. Although Korzenik attributed the change in drawings to increased social awareness, she recognized that her study was concerned with children's capacity to take the role of the viewer and its consequences on their drawings.

Thus, Korzenik's study has brought us back to Piaget, to the decline of ego-centricity in the child, and in particular to the revealing circumstances of the 3-Mountain Test, which demonstrates the extent to which a child can represent another's point of view.

**Children's Drawings and Piaget's Account of Space Development**

Of course, Piaget has not written an explanation of artistic development as a process proceeding from primitive to more advanced stages, the closest he gets to describing artistic development is in Section 1 of Chapter Two of "The Child's Conception of Space" (1956), which he wrote with Inhelder. Here, he uses Luquet's (1927) description of drawing development in children as a framework for his account of how the child's changing conception of space is reflected in drawings. This is seen largely in terms of a shift from the representation of topological relationships towards projective and Euclidean relationships. However, throughout the rest of the book Piaget frequently uses drawing behaviour to indicate levels of understanding. What follows is
a rendering of Piaget's account together with some of the implications from elsewhere in the work.

According to Piaget the increase in perceptual movement occurring in the later part of the sensori-motor period brings about the formation of the representational or conceptual image, an event which signals the emergence of a new phase in development. Although the child has for some time been able to perceive topological and Euclidean spatial relationships, the lack of a stable mental image has prevented him from thinking intelligently (reflecting on the past, anticipating the future), and thus it is not until this point has been reached that drawing can begin. During this new phase, the build-up of mental images leads on to further important changes, certain plateaux of achievement in thinking ability, which are identified by the terms Pre-conceptual thought, Intuitive thought and Concrete Operational thought.

The Pre-conceptual stage lasts from about two years to four years of age. Piaget asked children of this age and older, to copy figures of varying complexity, rather in the manner of Gesell and his followers, and of Binet even earlier. Unlike his predecessors Piaget was interested in more than success and failure at the task, and the forms he chose were subtly varied to reveal the significance of all attempts to draw them. Apart from simple geometric and non-geometric shapes, with differences of angle, line, curve and size, forms could overlap or enclose each other, touch or be distinctly separate; each of these features being a challenge to the child's powers of representation and an indication of his understanding.
Children under the age of three were unable to do anything but scribble. However, between the ages of three and four years their drawings simply showed the open or closed nature of the forms being copied, and in this way squares, triangles and other Euclidean figures were drawn as roughly circular forms. Thus, the first aspects of spatial form to be conceived and drawn were topological in character, and as such parallels what we have learned to expect from the spontaneous drawings of children of that age; that is scribbling gives way to drawings composed of loops, whirls and irregular circular shapes. For example, a man might be represented by four strokes below a roughly circular "head". Similarly, smaller circles within a larger circle will represent the recognizable facial features, eyes, nose, mouth. Often at this stage these features will be poorly related, with, perhaps the ears detached, or the mouth over the nose, or with a hat far above the head. A drawing like this would reveal a child who is capable of making statements to the effect that eyes, nose, mouth are contained by the head (enclosure), that although these facial features are distinct from each other (separation) they lie in close proximity (proximity), but as yet is incapable of stating the correct order of these features (order), or depicting the continuous nature of hat, head and body (continuity). In Piagetian terms, although the topological concepts of proximity, separation and enclosure are well formed, those of order and continuity are still poor. This would seem to confirm Piaget's description of the inadequate grasp of topological concepts which exists at this stage.
The stage of Intuitive thought lasts from about four years to seven years of age. During this period topological spatial relationships are more clearly understood, and drawings reflect this. The earlier rhythmical movements which dominated drawing largely cease, to be replaced by a continuous but more careful drawing manner, which enables the straight-sided squares and triangles of Euclidean relationships to emerge. As yet these are imperfect with bent lines and bulging angles, and the features that they are employed to represent are assembled intuitively, and illogically organized. But as perceptual activity continues, drawing diversifies, and the child's knowledge of objects and events extends, a more co-ordinated idea of the world develops, which paves the way for the arrival of the next stage.

The Stage of Concrete Operations lasts from about seven years to eleven years of age. Piaget defined operations as ......

"interiorized actions, or interiorizable actions, reversible and co-ordinated in total structures"
(Piaget, 1957)

The reversibility carries the implication of stable points of reference, fixed viewpoints to which varied separate perceptions can be related, and the structure refers to the system within which experience is organized. The difference between operational space and the earlier intuitive space is that the first can embrace actions or perceptions into indefinite combinations while the second is limited to the narrow field within which the actions or perceptions were produced, without generalization to other possible situations. In drawing, the absence of a stable point of reference, or a fixed viewpoint, results in a number of irreconcilable views of an object or
situation assembled in one representation. For example, one might see the front and two sides of a house at the same time, reflecting the inability to relate features to one particular point of view. This is nowhere better illustrated than in Piaget's 3-Mountain Test, where a child is asked to reconstruct a viewpoint other than his own. Presented with this task some children will even say that things would look different from "over there", but would then proceed to reconstruct a view identical or similar to their own. While there is no need to be consciously aware of one's viewpoint in order to perceive an object accurately, representing this viewpoint by drawing necessitates a deliberate and conscious awareness of one's point of view, together with all its implications. Drawing other possible views or drawing "imaginary" views (i.e. those other than 'life', when the object is not within one's visual field) is more difficult still, for one must be able to apply a full understanding of the relationships existing in a situation to any selected view, implementing whatever transformations the viewpoint might bring about. It follows from this that many of the characteristics of child art such as those known as 'folding over', single and double base-lines, and mixtures of plan and elevation are due to the lack of conscious awareness of his own viewpoint on the part of the child artist. Likewise, 'X-ray' drawings (or "transparencies") are often a mixture of different points of view, and are merely topological concepts of enclosure. They should not be explained as cross-sectional for Piaget has shown (Piaget and Inhelder, 1956 pp. 247-270) that it is not until the age of nine years that a child is capable of conceiving a true cross-section. Similarly, the tendency
to draw a chimney at right angles to the slant of a roof, or trees placed on the side of a hill like rays on the sun, reflects the child's inability to recognize the invariance of horizontal and vertical axes. Like the understanding of cross-sections this is not achieved until nine years, as indeed is the co-ordination of perspectives. There is a corresponding decline in the number of charming but illogical features in children's drawings and an increase in 'realism', which is without doubt an indication of their clearer understanding of spatial relationships.

The Stage of Formal Operations lasts from about eleven years of age until fifteen years and beyond. Although Piaget says little about the development of spatial concepts during this period he does describe it as a time when the child or adolescent is no longer tied to what he can see, or to 'concrete operations', but is capable of thinking in terms of propositions which take account of the possible or hypothetical. The young adolescent sees more and knows more than he can draw. The simple skills associate with childhood no longer suffice. Given the opportunity, encouragement and good teaching he will continue to develop his powers of representation in Art. Drawing can become increasingly analytical, where realizing projections and recessions in depth and spacing the intervals between them can be a challenge which can also take into account the abstract qualities of line, angle, size, volume, shape, and so on. The ability to think abstractly and a concern for abstract notions (romance, greed, peace, hate, force, rhythm and mood) will tend to show in drawings. From now on, distortions of reality are explainable on quite different grounds. Known features
may be omitted or exaggerated for 'effect' and drawing style is liable to influence the appearance of items depicted. On the other hand, it is also known as a time when active interest in art declines (e.g. Burt's 'Repression' and Lowenfeld's 'Crisis of Adolescence'). In Piagetian and Brunerian terms this can be seen as a shift towards the symbol, following the waning of the image, or a move to the right along Peel's (1971) describer/explainer continuum. Difficulties inevitably accompany the increasing ability to generalize, and think outside the given situation. In drawing, for example, the classification:

'V.W. Beetle - car - vehicle - transport'
is easier to represent at one end than it is at the other. If developments in thinking outstrip the power to express thought in drawing then the problems so caused can bring about the discarding of drawing as an appropriate means of representation.

Summary

The studies reviewed in this chapter were chosen for three purposes. First, to provide a sample of studies each of which was concerned with the child's representation of space in drawings. Second, to recognize the measure of agreement existing in descriptive studies. Third, to furnish alternative Piagetian views to those (largely Arnheim oriented), that are presented. These are supported in the final section by a detailed account in Piagetian terms of the development of the concept of space in children's drawings. The last section extends the purposes of the study by demonstrating how an
area of common interest to both Piaget and art education can be illuminated by knowing the resources of each. There are, of course many other areas of common interest.
CHAPTER IV
PIAGETIAN SPACE

Introduction

It is the function of this chapter to fulfill three distinct purposes. The first is to outline Piaget's account of the development of spatial concepts in the child as a manifestation of his general theory of intelligent behavior. A second purpose is to examine in some detail Piaget's distinction between perceptual and representational space, and his description of how representational space develops out of the perception dominated sensori-motor functioning. The final purpose is to select from the range of situations described by Piaget, two which typify progress towards full operational space, one in the projective field and the other in the Euclidean field. The choice would be influenced by their suitability for use in the projected investigation.

Piaget's Account of the Development of Spatial Concepts in the Child

Piaget and Inhelder's (1956) *The Child's Conception of Space* is the first of two volumes devoted to the study of the evolution of geometrical concepts. It deals with the development from an individual's intuitions about space to the construction of Euclidean space. The
second volume "The Child’s Conception of Geometry" (Piaget, Inhelder and Szeminska, 1960) continues this study, particularly in reference to the conservation and measurement of length, area and volume.

The extensive investigations described in The Child’s Conception of Space are based upon experimental procedures which are now regarded as characteristic of Piaget and his co-workers and which are often referred to as "the clinical method" (see Claparède’s description of it in his introduction Language and Thought of the Child, (1926, 1959)). The theory which emerges from these investigations is a particular application of his general theory of intelligence, although with some interesting new additions, the most significant being the concept of sub-logical (spatio-temporal) operations.

Piaget bases his understanding of the intuition of space on a mathematical rather than psychological foundation. For the mathematician intuition is more than a system of perceptions or images, it is a basic awareness of space not yet formalized. The intuition of space is not a "reading" of the properties of an object but an action performed on them, an action first as sensori-motor activity regulating perception, and then an activity at the level of concrete operations involving reversibility and indefinite combinations which transcend the physical object. Towards the end of the study Piaget and Inhelder (1956, p. 449) note three important characteristics: first, that the order of psychological development is the same as that for formal geometrical construction; second, that initial intuitions are rational and coherent even before they have been formalized as propositions; and
third, that parallel with the concrete operations of a logico-arithmetical nature, there exists spatio-temporal or sub-logical operations which constitute our idea of space. Sub-logical operations create the objects which we see and they are therefore accompanied by images; logico-arithmetical operations arrange these images in sets or numerical collections.

Spatial perception takes place in the presence of objects, the image arises in the absence of the object and it is for this reason that perceptual space develops more rapidly than conceptual space. Spatial concepts are internalized actions - note how children are unable to visualize the simplest actions until they have seen them performed (as demonstrated in the "Knots" studies, Piaget and Inhelder 1956, pp. 104-124); the child learns how his actions are co-ordinated and how one determines another.

Piaget's account of these developing spatial concepts is divided into three main sections under the headings topological, projective and Euclidean, and which represent a progression towards a full understanding of the principal features of Geometric Space.

Topological properties include proximity, separation, enclosure, order and continuity. Projective properties refer to features which remain conceptually invariant from any viewpoint, and Euclidean properties are those familiar to us in our geometry, angularity, parallelism and distance. This order of appearance is in direct contradiction to the way in which adults normally think about space, where the physical world can be reduced in a measured way to the purest and simplest geometric forms.
Topological concepts were investigated primarily by means of drawings, "haptic" perception (by touch without vision), linear and circular order (as with beads on a string), the study of knots, and situations involving continuity, for example, the number of points on a line, the end product of indefinitely repeated bisection of a line, and the continual reduction in size of a geometric figure.

Projective concepts were investigated by the following techniques: testing children's ability to construct a straight line from a number of discrete objects; drawing a number of different perspective figures; verbal responses to questions concerning the projection of shadows; problems involving the co-ordination of perspective relationships; and tasks requiring the representation of sections through such solid figures as cylinder or cone.

Emerging Euclidean concepts were investigated in a number of ways. "Affine" transformations (those concerning the preserving of parallels) were revealed by such devices as the "lazy tongs" and its changing shapes; proportion by the comparison of figures like the triangle and rectangle; and the understanding of the horizontal and vertical referential system by means of water-levels and plumb-lines. Some situations were devised to examine both Euclidean and projective notions for example, those of orientation by the localization of position in a model landscape.
Perceptual and Representational Space

Piaget and Inhelder are careful to clarify the distinction between perceptual space, occurring in the presence of the physical stimulus, and representational space, which uses perceptual activity to build an image of an object which remains when the stimulus is no longer present. Though attention is given to perceptual development and its role here, the subject of the study is clearly that of the representation of space, and as such makes its contribution to Piaget's theory of intellectual development, and reciprocally how this account of the child's evolving intellectual powers operate upon spatial relationships. The perceptual basis of representational space is spelled out, and the active nature of perception underlined. This important perceptual activity is no mere "reading off" of spatial stimuli in the environment but takes the form of motor actions upon objects in space. These actions are later "internalized" and eventually function symbolically within operational systems. The stress upon actions as the building brick of intellectual development is central to Piagetian theory, pervading much of the literature, and nowhere is the emphasis so evident as in his studies of the development of space conception. In all probability this was done to counteract the presumption that spatial awareness was immediately given to experience, and to demonstrate that effortless seeing is the end-product of a long process of development that occurs by reference to a carefully built structure, assembled from those features of the environment which experience has proved to be fixed, stable and predictable.
The distinction between perceptual and representational space is an important one. Apart from Piaget's account of representation forming the basis of symbolic processes in general, two other implications result. First, perception in terms of visual recognition is shown to be far in advance of comparable forms of representation; and second, that the general order (topological-projective-Euclidean) in which the key features become recognizable during perceptual development is repeated later in conceptual development.

It is interesting to note first that, in defiance of any theory of recapitulation, the ontogenetic order of appearance is the reverse of the historical order (of discovery Euclidean-projective-topological), and secondly, that it is a logical order, that is from the general to the particular.

During the first four months or so after birth the child does not co-ordinate vision and grasping and he does not perceive the permanence of solid objects, nor the constancy of shape and size. He would not, for example, perceive a bottle as the same bottle when it is turned around and he fails to perceive a nearby object as being the same size when it is far away. The spatial relationships that he does detect, however, are topological in nature. The proximity or closeness of objects in the visual field or their distinct separation, the enclosed nature of food in a bowl, the successive order of fingers on hands and the continuity of a cot rail. It is interesting to note that topological spatial relationships were also the first visual elements to be perceived by Von Senden's (1960) congenitally blind patients after the removal of their cataracts.
Later, when the child begins to co-ordinate vision and grasping around four months old, sight achieves dominance and the resulting systematic investigation of objects brings about a more precise description of them. This improvement in visual and tactile exploration helps him to learn the permanence of solid objects, the constancy of shape and size, and the perception of projective and Euclidean relationships.

The perceptual recognition of an object's shape is achieved through what Piaget refers to as "tactile centrations". This involves two related functions. First, the perception of each individual centration - the fixation of the eye upon any single place of an object's surface and secondly, a related sensori-motor activity, a manipulative movement creating a change of centration. A child handling a wooden building block would build an image of the shape by such a process of creating any number of individual centrations on its surface. (This account has something in common with Hebb's (1950) Cell-Assembly theory where identification of an object is gradually learned through many fixations on its parts - and contrary to Gestalt theory where perceptual movement occurs in response to the percept).

From the time at which object conservation is achieved around seven to eight months until well into the second year, the child continues his systematic exploration. In addition to learning the shapes and dimensions of single objects, he begins to learn the relationships among those objects. He internalizes, and co-ordinates his sensory impressions and actions, the result of which is a mental or conceptual image.
The way in which the construction of space begins on the perceptual level and continues on the representational one was investigated largely by experiments concerned with the recognition of shapes by means of the sense of touch (haptic perception) in the absence of visual stimuli. Children were asked to identify each felt shape from a visible collection or a set of drawings; alternatively they were asked to draw the shape which they handled.

Unlike the perceptual mechanisms, which Piaget claim remain constant, the sensori-motor activity develops with age. At the first stage, up to the age of four, the child is passive and his centrations are haphazard, but by the age of four, and up to the age of seven the child begins to organize his perceptions. He begins to explore the extremities of objects and later to analyze specific features (e.g. angles). From an unmethodical exploration, where the object is turned over and over in one direction only, and contours are investigated with one finger, he moves to a situation where he can transpose his centrations without the necessity of synthesis; he can anticipate the nature of the object's as yet unrevealed surface. At the third stage, from about the age of seven or eight, the child makes systematic explorations; he can return to the departure point of his investigations and use it as a point of reference. In Piaget's terms the child's abstraction of shape becomes "operational", i.e. structured, flexible and reversible.

Piaget is at pains to point out that such an abstraction of shape is achieved on the basis of a co-ordination of the child's actions and not from the direct perception of the object alone. The child does not make a kind of mental "tracing" or physical space but does in fact
reconstruct space. Any such reconstruction necessitates the ability to relate qualities of objects or surfaces one to another.

"The case of the triangle provides an effective illustration of the difficulties the child encounters in trying to show the inclination of the three sides and co-ordinate the three angles with a suitable enclosure. With both drawings and matchsticks the children cannot at first manage to distinguish triangle from square, but begin with open shapes (or sometimes with closed ones) having right angles and no oblique sides... all the various figures discovered in the drawings can be paralleled by the match-stick constructions and all reveal the same difficulty of co-ordinating the inclinations and the symmetries". (Piaget and Inhelder 1956, p. 78)

For the adult the rhombus can be viewed as a square pushed on to one corner. The perceptual differences are really not very great (when compared with, for example, a map of a city center) and yet it takes a child a full two years to pass from copying the square at four years to copying the rhombus at six or seven years and this at a time when he is learning faster than he will ever learn again. It seems that "something more than a correct visual impression is required" (p. 74). For even though his perception of it is well developed, the representational schemata - the abstraction of the shape in general, straight sides, angular symmetry and most of all the slope (Olson, 1970), which must be slowly acquired through his own activity.

If spatial concepts really are internalized actions, what then is the role of the perceptual image? Piaget explains that the image originates in the processes of assimilation and accommodation, starting at the sensori-motor level as an imitation (accommodation) of the object by an action, and continuing at the conceptual or imaginal level as
delayed imitation, and internalized alongside other images and imitative schemata. This change brings about the birth of representational thought. In sensori-motor functioning, action, in the form of moment to moment responses to stimulus requires environmental support whereas in conceptual (representational) functioning the image (or symbol) can act as a substitute for the environment. Action no longer needs continuous environmental support, the world can be conjured up and manipulated in its absence, and hence the development of hindsight, foresight, and subsequently reflection and analysis. As thought becomes better organized the importance of the image as such declines. The irreversible memory images of intuitive thought simply reproduce physical actions performed earlier, and in such a role must remain inviolate and as important as action itself.

As actions and images of actions become increasingly complex, co-ordinated and structured, thought begins its ascent. By the stage of concrete operations with its reversible structures, the image is no longer indispensable, and eventually the abstract nature of formal operational thought abandons the particular rigidity of the image in favour of the general adaptability of the faceless but streamlined symbol.

The Co-ordination of Perspectives (3-Mountain Test)

It is commonplace in everyday living that we are encouraged to see an argument from another person's position, or place ourselves in someone else's shoes in order to understand a total situation, prior
to arriving at the most acceptable solution. This prospect often proves difficult for the most mature of adults. For the child, development from a naturally egocentric outlook on life to this relational standpoint is only achieved after a process of transition which is both perceptually and psychologically intricate.

The transition in terms of the child's developing awareness of the implications of different spatial viewpoints is neatly revealed in a test situation devised by Piaget for this purpose. The apparatus consisted of a model of three mountains which were clustered together on a board one metre square. The mountains were discernably different in character, size and colour, with the largest being a grey snow-capped peak, the middle-sized one being brown with a cross on its summit, and the smallest being a green hill on the top of which sits a little house. There was also a collection of colored pictures representing the mountains seen from different viewpoints. In addition there were three pieces of cardboard which were shaped and colored to closely resemble the mountains, and which could be arranged on a board to represent the mountains from a given viewpoint. Piaget sat a child in one position whilst a wooden doll was moved to a number of other positions, and it was the child's task to discover what the doll would 'see' from each position. Thus the child was presented with the problem of imagining or reconstructing by inference the changes in perspective resulting from the movement of the doll from one position to another. The child could reconstruct a view by arranging the cardboard templates appropriately. The experiment was varied by inviting the child to choose a picture which would best represent what the doll would see from a particular
position, and by asking the child to place the doll in a location where it would see a view which would correspond with a picture selected earlier.

Piaget grouped children's responses into the following categories:

**Stage 1** At this level children were not able to understand the nature of the tasks, and Piaget gave no examples of their replies to the questions asked.

**Stage II**

- **Stage II A** The child cannot go beyond reproducing his own viewpoint. As far as he is concerned the doll's viewpoint and his own are indistinguishable.
- **Sub-Stage II B** This is a transitional stage where children attempt to distinguish between different viewpoints.
- **Sub-Stage III A** At this stage the child begins to think of the inter-relatedness of the features present, and to maintain those relationships regardless of orientation. Such concepts as left and right, in front and behind, above and below are of a great help here, but there are so many factors involved that the performance lacks precision.
- **Sub-Stage III B** The child is able to achieve full co-ordination of the perspective involved.

Piaget concludes that the combined co-ordination and combination of points of view cannot develop in the child until the egocentric perceptual outlook can be overcome. The system of perspective viewpoints consists of operations which do not merely assemble perceptual data but co-ordinate it in terms of reciprocal relationships. The three-mountain
test is not a topological problem since it does not deal with proximities and enclosures, nor is it an Euclidean one since the child does not have to measure things by comparison with adjoining elements; it is almost purely a projective problem - the child does not have to link up parts of the object but must link together all the projections of it. The reason no single perception can take in every aspect of the group of mountains is not because it refers to only one small section of the whole, but because that single perception relates to single perspective projections. The perspective system is not perceptual but conceptual.

For Piaget, there is more to the child's intuition of space than meets the eye. Perceptual data is always sketchy and inadequate when compared with perceptual activity governed by the intelligence. The culmination of the child's development arrives when it can construct a framework of relationships relating to the perceptual information received. Such a framework would be incomplete without the existence of horizontal and vertical co-ordinates.

**Horizontal and Vertical Co-ordinates**

Piaget devised a number of situations which help us to understand how the child comes to grips with the problems of co-ordinating horizontal and vertical referential axes.

For the study of the horizontal constant, water level proved the most suitable. The procedure was to show children two narrow-necked bottles, one with straight, parallel sides, and the other with rounded sides, both of which were partly filled with coloured water. Children
were asked to estimate the position of the water when each bottle was filled. Alternative identical jars were made available, and on these children were invited to show with their fingers the water level at various degrees of tilt. In addition, children over 5 years old were given outline drawings of the bottles at various angles and asked to draw in the water corresponding to each position of the bottle. Follow-up procedures were also employed whereby the child could see the bottles tilted again and have the opportunity to produce a new drawing or adjust the old one if he felt it necessary.

For the study of the vertical constant, a number of fruitful situations were devised. Once more water was used, this time to provide a horizontal surface on which to float a cork with a small match-stick rising vertically from it. The jar containing the water was tilted at various angles and children asked to draw the position of the "mast" on the little "little ship" at different inclinations. An alternative method was to suspend a plumb-line in a fat jar, and ask the child to predict the line of the string when the jar was tilted at various angles. Both procedures included a follow-up demonstration which allowed a correction or a fresh drawing attempt to be made. A third method was to ask the child to plant posts (match-sticks) "nice and straight" (upright) on the slopes of a "mountain" (a pile of wet sand), on its summit and on the ground nearby. They were also asked to draw the mountain with the posts planted "nice and straight".

The children's responses were graded by Piaget accordingly:

Stage 1 Shows the child unable to distinguish surfaces or planes in the case of either fluids or solids. The liquid
inside the bottle is conceived in purely topological terms. In this case enclosure, existing simply inside the bottle and related to nothing external.

Sub-Stage 11A Reveals an ability to show liquid levels parallel to the sides or base of the jar, and trees perpendicular to the mountain side. The relationship is simply internal, relating to the container or to the plane; there is no external reference to any vertical or horizontal variant.

Sub-Stage 11 Witnesses an attempt to co-ordinate such variants - changes in the direction of water level begin to be indicated.

Sub-Stage 111A In Piaget's words, it is now "possible to see the concepts of vertical and horizontal gradually crystallizing in the actual course of the experiment".

Sub-Stage 111B He continues, "Only from the beginning of sub-stage 111B, about the age of 9 are they applied logically and consistently to all situations right from the start of the interview." (Piaget and Inhelder, 1946, p. 406).

Horizontal-vertical axes are constructed at about the same time as perspectives are co-ordinated. Projective space represents the co-ordination of viewpoints and figures considered in relation to viewpoints. It is always surprising to note how long the child persists in its inability to recognize in terms of verbalization or drawing the invariance of the vertical or horizontal axes, even when presented point-blank with liquid levels or uprights on tilted planes as 'fait accomplis'. It is clear that for Piaget this late development can be
accounted for by the fact that such ability can only come about once the development of the Euclidean and projective framework has been completed - at about the ninth year.

By the age of nine years the child has acquired a system of referential operations. Actions have become first of all internalized as images, and then abstracted or symbolized by being grouped as reversible combinations. The final equilibrium has been obtained by the growth of intellectual power. Familiar objects may now be arranged within a grid of parallel straight lines crossing each other perpendicularly in three dimensions. The process may be likened to a double or treble entry table cross-referenced with all the objects in space arranged in point for point correspondence by being entered in the appropriate columns. There can be no innate knowledge of spatial organization in a two or three dimensional frame of reference. At the outset the child has no awareness of physical notions of the vertical and horizontal because perception covers such a limited field and a referential system, by contrast, pre-supposes an operational co-ordination of several fields, one with another. This frame of reference is the product of an awareness of elementary topological relationships, and an understanding of the Euclidean concepts which link one object with another. Topological relationships remain internal to each object or pattern; Euclidean relationships are those established between numbers of objects or patterns, and serve to locate them within an organized whole to create an all-embracing system.
Summary

Piaget's approach to the study of the child's developing concept of space was indicated, together with a brief account of the structure of his investigations in this field. In addition, Piaget's distinction between perceptual and representational space was dealt with in some detail in the light of its relevance to the purposes of this study. From the range of situations investigated in Piaget and Inhelder's studies two were described which appeared suitable for use in the projected investigation. These were the co-ordination of perspectives from the projective field and the horizontal-vertical reference system from the Euclidean field.
CHAPTER V
THE DESIGN OF THE STUDY

Introduction

This chapter deals with (1) the Drawing measure, the means for scoring and qualifying the degree of space shown by the children in their drawings; (2) justifying the Drawing measure in terms of the objectives of the study; (3) the Piagetian tests, procedure and scoring; and (4) the conditions in which the investigation was carried out which include descriptions of the subjects and location, as well as the particular circumstances under which the Drawing and Piagetian tests were administered.

In pursuit of the relationship between drawing and the type of conceptual development described by Piaget, in particular his account of the manner in which the concept of space develops in children, some diverse but relevant work has been reviewed. Apart from considering children's developing concept of space, drawing development and the parallels between both, studies of an historical and experimental nature which had a bearing upon the subject were described. It is evident from the many examples of work consulted that any study planned to investigate the relationship between drawing and another field should be preceded by a careful consideration of those factors upon which a comparison is made. It would also seem prudent to choose a sufficient
number of tests or trials from both sides to ensure a fair and balanced conclusion.

On this basis it was decided to conduct the investigation in a primary school using a sample of six children from each of seven school years (4+ to 10+ years), using a Drawing test which provides problems the solution of which reveals degrees of spatial awareness, together with two Piagetian tests dealing specifically with the development of spatial concepts in the child. The scores resulting from these tests would then be subjected to statistical analysis to obtain correlations between the various measures in order to determine the degree of association between the two principal functions, i.e. children's ability to represent space, in drawing and their ability to conserve the Piagetian identified constants of horizontal/vertical referential axes and perspectives co-ordination. Two secondary functions of age and sex will also be included in the analysis, as they may offer additional supporting evidence.

**The Drawing Measure: the Three Verbal Invitations to Draw**

Invitation I  Draw a mother holding a bag and pushing a pram with a baby inside it. She has a dog on a lead.

Invitation II  Draw people sitting around a table having a party with a birthday cake and lots of food - but one little boy dropped his spoon and is looking for it under the table.
Invitation III  Draw a little girl or boy waving to an old lady on the other side of the road.

In order to maximize brief periods of contact with the sample of children, three very short descriptions of very familiar subject matter were devised. These verbal invitations described situations of such a character that should a child make a genuine attempt to draw them, obvious spatial problems would of necessity have to be resolved. Of course, it could be said that any existing phenomena will make spatial problems available for solution by the act of drawing, and reciprocally, the simplest random marks upon the paper surface can have spatial implications for those suitably disposed. In this case, keeping in mind the objectives of the study with its emphasis upon content outside the visual field of the child-artist, circumstances were so contrived that children within the age group in question were presented with major problems of representation which were evidently challenging and which allowed a wide range of alternative interpretations. The verbal invitations together with an outline of possible solutions typically provided by children follows.

Invitation I  "Draw a mother holding a bag and pushing a pram with a baby inside it. She has a dog on a lead".

All children are familiar with prams (baby carriages), and even if they have not drawn one before, they will have drawn something with similar properties, that is a hollow box on four wheels. For instance, a car or a railway engine. The interesting thing about this pram, however, is that it contains a baby. One great problem here is to show
that the baby is inside the pram. Younger children, in typically bold uncompromising manner, attempt to show the baby at all costs. Older children feel no such compulsion, and when the baby appears in the drawing it is either because a particularly revealing viewpoint is chosen or because a small portion only of the baby is shown and is regarded as sufficient to represent the whole being. For drawings of the pram the most typical and popular aspect would be the side view. Attempts to show other views, especially when made by younger children, provide interesting results. For example, although the box-like form of the pram as conceived by an adult would never show more than three sides whatever the viewpoint, young children often show more. Sometimes they even go as far as showing all sides, the final drawing having the appearance of a cardboard box which has been opened up and flattened.

Various combinations of pram and baby follow, and indicate a general increase in sophistication.

(i) The baby could be simply placed within the drawn area of the pram - a direct statement of enclosure. (Fig. 1, above).

(ii) The baby could be seen by making use of the "transparency" device either through the side of the pram (Fig. 1, above), or through the covering blankets.

(iii) Both pram and baby could be represented as distinctly separate objects, drawn in their entirety, with no overlapping (Fig. 1, middle). The child who produces this sort of drawing feels compelled to include all chief features; to lose any would rob the object of its defining characteristics.
Figure 1. Pram and baby combination.

(Top) The baby shown through the side of the pram (transparency).
(Middle) Baby and pram distinctly separate.
(Bottom) A partly visible baby.
Figure 2. Pram and baby combinations (continued)

(Above) A pram in profile but no baby
(Below) The baby viewed from a selected angle.
The baby could be only partly visible, with only head, arms, and shoulders showing, or just a hand holding a rattle, perhaps protruding from the bed of the pram, or appearing round the side of the hood (Fig. 5, bottom). This overlapping technique is obviously a more sophisticated solution than the previous examples described.

The baby could be left out entirely, leaving one to assume that the pram contained a baby (Fig. 2, top).

An angle could be chosen from which it would be possible to see the child in the pram (Fig. 2, bottom), looking down on it from above, or from beside the mother. The last would be a most unlikely solution for a child of primary school age. However, the example in Fig. 3 (above) is an interesting attempt.

The combination of pram cradle and wheels could also be presented in a variety of ways, for example:

(i) The pram could be drawn as a rectangle with a wheel at each corner.

(ii) The pram could be drawn with all four wheels in a row below the cradle.

(iii) The pram could be drawn in silhouette or profile with the two nearside only showing, leaving us to assume that two steps exist on the far side.

(iv) The pram could be drawn as a three-dimensional box with four wheels overlapping two others, indicating both near and far wheels.
Figure 3. Pram and baby combinations (continued)

(Above) A mixture of views.
(Below) The baby placed within the drawn area of the pram (Simple enclosure)
FIGURE 4. Combinations of pram, cradle and wheels
(Top) A rectangle with a wheel at each corner
(Bottom) A pram cradle with all four wheels in a row.
FIGURE 5. Combinations of pram, cradle and wheels

(Top) A pram in profile with two nearside wheels only showing.
(Bottom) A pram drawn three-dimensionally with two wheels overlapping two others.
The mother, handbag and dog are really extensions of these relationships, and present further opportunities to give indications of depth.

Invitation II  "Draw people sitting around a table having a party, with a birthday cake and lots of food - but one little boy has dropped his spoon and is looking for it under the table".

The key words in this invitation are "sitting", "around", "table", and "under", and each of them poses difficult spatial problems for the child to solve. The other words, such as "party", "birthday cake", "lots of food", and "spoon" are included to illustrate the occasion and to catch the imagination of the child.

(i)  "Sitting". To draw a man sitting is for the child a most difficult proposition, for it implies that both "sitter" and "seat" be shown in one convincing relationship. Younger children are likely to assemble each from their characteristic features in simple juxtaposition, or relate the sitter to the table with the seat minimally indicated, if at all (Fig. 6, bottom). Older children who chose a side view would find the problem of relating sitter to seat relatively easy, but difficulties would arise when less sophisticated children attempt to avoid overlapping. This would result, more often than not, with the figure losing contact with the chair, and floating above it. (Fig. 6, top), as the baby did above the pram, earlier. The front and back view of a seated person would present far greater difficulties. When the front view is attempted the seated figure might look as though it were still
Figure 6. Two examples of "people sitting".
FIGURE 7. Table possibilities
  (Above) from above (Middle with splayed legs
  (Below) from the side.
standing with the chair worn like a rucksac on the back. Great
difficulties would be experienced with the foreshortening of the
thighs supported by the chair seat. The back view is likely to
result in a dominant chair and a rather cut up, dispersed figure.
The invitation includes the suggestion that there are many people
sitting around this table, and therefore the opportunities to
draw people from all positions, front, side, back and those
between, exist for those who recognize them, and who can find
some means of representation.

(ii) "Around" and "table". In the context of the invitation the
words are inseparable. The figures are around the table, and
the table maintains their relationship. It is as though the
table holds the figures apart at a measured distance. The
spatial relationships are thus dominated by the table itself,
and it is likely that most of the younger children would start
by drawing the table first, and having committed themselves
adjust all subsequent drawing to its rendering. The choice of
how the table is depicted is therefore crucial. It could be
shown as seen from above or a circle or rectangle, with legs
unseen, visible, parallel or splayed in different directions.
(Fig. 7, middle). The table may be shown from the side
(Fig. 7, below), a more sophisticated choice, with two or more
legs visible, or finally as a parallelogram, or even fore­
shortened with the near legs clearly visible and the far legs
merely suggested or revealed.
(iii) "Under". The figure beneath the table adds yet another spatial problem to the many that already exist in the invitation. Those children who attempt to show it, would usually do so late in the act of drawing, and thus they would be forced to accommodate the figure to the rendering of the table. This would not trouble younger children who would feel that a large spoon, and perhaps a figure, fitted somewhere into the drawing would be sufficient to meet the demands of the invitation. Older children, with a tendency to emphasize the searcher, would consider themselves fortunate to have drawn the table from the side, where they could fit the searcher neatly between legs, whereas those who started with a top view of the table would either have to resort to transparency devices or tackle the problems posed by overlapping.

Invitation III  "Draw a little boy or girl waving to an old lady on the other side of the road".

The invitation is dominated by one great spatial problem, on which the others hinge, namely the space between the two figures. The statement "on the other side of the road" can give some idea of the distance involved, for those in a position to appreciate it, and the word "waving" suggests that the two figures are beyond the range of normal speech (one would have to shout to be heard). The space involved is on a much larger scale than in the two previous invitations, amorphous and less clearly defined or measured. In the first invitation, all the mentioned items are connected with each other, literally attached to "the mother", and everything is within her reach.
Each depicted object can be simply linked with the next, something that even the youngest children in the sample should be able to accomplish, should they recognize it, should they set out to represent it, and should they be able to keep it in mind throughout the act of drawing. In the second invitation, the dominant table keeps the figures clustered around it apart at chest height, and by so doing, maintains a stable spatial relationship. All items are related to the table, even the elusive spoon and searching boy. In the third invitation, the road has some of the table's dominance, in the sense that it does establish a relationship between the two principal characters, even if it does not say exactly where they stand. As with the table, many younger children would be tempted to commit themselves by drawing the road first. This is likely to be drawn as two lines roughly parallel to the bottom edge of the paper, and by so doing increase their problems, or at least limit the available solutions. Many older children would tend to interpret the invitation as two figures facing each other, one of whom is waving. Whereas a front view of a figure is a straightforward drawing proposition, a back view presents formidable problems, and a child needs to have attained some level of sophistication to attempt it. The less sophisticated child would feel that a drawing of a human being without its characteristic features (eyes, nose, mouth, etc) all facing front, would be an incomplete representation. This may well be a contributory factor in the occurrence of the childish "folding-over" feature with this type of subject matter. For example, the two figures might be placed either side of the road lines with their feet touching or close to the pavement edges (see Fig. 8)
FIGURE 8. An invitation III drawing by a 6 year old boy showing "folding-over".
which would enable the uppermost (and presumably more distant) figure to be depicted front view and upright, whilst the lower figure would be depicted upside down, but still front view. The feature would also be explained on the grounds that the child does not wish to give the impression that the figure is lying face down in the road, or on the grounds that the child's orientation to the dimensions of the paper changes during the act of drawing (i.e., that the top and bottom of the paper become interchangeable). The latter would denote an inability on the part of the child to view the paper surface in terms of its potential for three-dimensional illusion, together with its constants, including those of perpendicular and horizontal. Of course, in the example cited, folding the paper along the lines of the road would demonstrate the spatial realism of the solution, but it would also destroy any illusion of three-dimensional space on a two-dimensional surface. Older children would be able to choose from a variety of solutions, which would include turning the figures to the side, waving in passing (Fig. 9 above) or even selecting a convenient site at the top of a hill (Fig. 9, below). Invariably, the "old lady" would be shown on the far side of the road (a situation which may indicate the child-artist's identification with the waver) which adds a further complication to the problem, for the adults are usually bigger than the boys or girls, and children at the upper end of the sample are just beginning to recognize that objects diminish in size as they become more distant. These circumstances could suggest an almost contradictory situation for those children at an uncertain transitional phase in their
FIGURE 9. Road and figures:
(Above) A wave in passing
(Below) A conveniently chosen spot.
development, and their confusion is likely to be reflected to some extent in their drawings.

The Drawing Measure: a Defense of the Method Used

As explained earlier the three verbal invitations to draw which were extended to the children were specially devised to describe situations which contained spatial complications that were difficult to represent on a flat surface. Once the drawings had been obtained they could be studied for the ways in which the spatial problems encountered were resolved. In order to arrive at meaningful conclusions it was necessary to devise some way of appraising them in terms of the objectives of the study.

The children taking part in the investigation, which forms part of this study, were of British nationality growing up in a Western culture. All but one of the children were of British parentage, the exception having parents of West Indian origin. Thus, although other cultures and civilizations have developed their own forms of representing the three dimensional world on a two-dimensional plane it seemed appropriate to adopt Western conventions of space representation in order to assess the degree of space indicated in the drawings produced. In this connection Kellogg (1955, 1969) asserts that though young children's first marks on paper are similar no matter where they are made, be it Italy, Finland, China or Mexico, as time passes and children become older, they gradually take on more and more of the characteristics of the particular society to which they belong and this becomes increasingly
apparent in their drawings. As children mature they become more subject to the conditions of their culture, learning the meaning of its various symbols and learning to adopt a special attitude on the arts. Few would break away from these accepted modes, unless consciously encouraged by their teachers to do so. Hence the progress made by the children in acquiring western modes of space representation was deemed appropriate for this investigation.

Pictorial representation of three-dimensional space, therefore, follows the observance and acceptance of certain graphic or artistic conventions of cultural origin. The understanding of pictorial material pre-requires some familiarity with these conventions. It is this quality of spatial realism which forms the basis of the method chosen for measuring the degree of space indicated in the children's drawings used in this study. This is obvious when one considers the way in which a child works, putting a picture together bit by bit, symbolically adding the elements and properties of objects he wishes to depict. The result is bound to show some spatial inconsistency. It is far more mature to see the complete picture from the beginning as an integral whole (as would an artist trained in the traditions of Western painting). Nevertheless, children do give clear indications of depth in their drawings. It is frequently possible to say that one item depicted is in front of another item depicted.

It should be noted, however, that the steps-in-space method of classification devised for this study does not attempt to identify or grade other qualities that the drawings may possess. A drawing that
has many indications of depth is not necessarily a better drawing than one that is completely flat. The method chosen is simply one for assessing the degree of depth in children's drawings, according to the conventions and characteristics of the western conception of space.

There follow examples of children's drawings graded as suggested in categories 0 to 6, together with supporting identification of the features which determine the score.
FIGURE 10. CLASSIFICATION 0 = FLAT

This drawing is judged flat because there is no attempt to place anything beyond the picture surface. There is no overlapping of one feature by another, and no indication of depth or volume.

Drawing
Invitation III (Richard B. - 4+ years)
FIGURE 11.  

CLASSIFICATION 0 = FLAT

No points given. There is no indication of depth or volume in the drawing. The figures of the mother and the baby are flat. The pram is flattened out, with its side view and top view presented on one plane. The bag and dog are indicated minimally and flatly.

Drawing Invitation I  
(Mark C. - 5+ years)
FIGURE 12.  

CLASSIFICATION 1 = 1 STEP

Points: (1) The figure of the lady is shown as being in front of the road; that is, a road verge passes clearly behind her.

No points: The figure itself is drawn flatly with no overlapping and with no indication of volume or depth. The other figure is also drawn flatly, and is attached to the road verge, and as such is virtually on the same plane.

Drawing Invitation III (Dylan B. - 6+ years)
FIGURE 13.  

CLASSIFICATION 2 = 2 STEPS

Points:  
(1) One arm in front of the mother's body  
(2) The other arm beyond the mother's body

No Points:  
(1) The dog and mother's foot are not drawn as overlapping. They appear as a simple superimposition, where a later feature is drawn directly on top of an earlier feature.  
(2) The above interpretation is also given to the dog leash where it appears to cross the mother's dress.  
(3) The remainder of the drawing is flatly rendered.

Drawing  
Invitation I  
(Rachel H. - 8+ years)
FIGURE 14.  CLASSIFICATION 3 = 3 STEPS

Points:  
1. The baby's face is shown as beyond the side of the pram and pram hood.
2. Overlapping indicated with near and far wheels.
3. Given the baby beyond the pram side, the doll is shown as hanging in front of the pram side.

No Points:  
1. The bag contents are shown as transparencies or as a Piaget "enclosure"
2. The dog is a simple superimposition.

Drawing  
Invitation I  
(Mandy L. - 7+ years)
FIGURE 15.

CLASSIFICATION 4 = 4 STEPS

Points:
1. Figure and chair beyond the table
2. Figures in front of the table
3. Depth of table indicated by oblique side
4. Near arm of side figure.

No points for the chairs which give slight but ambiguous indications of depth.

Drawing
Invitation II
(David W. - 9+ years)
FIGURE 16.  

CLASSIFICATION 5 = 5 STEPS

Points:
1. Baby partly concealed in pram
2. 3D dog
3. Mother in front of road
4. Near and far arm of mother
5. Objects protruding from the basket.

Drawing
Invitation I

(Denise R - 9+ years)
FIGURE 17. CLASSIFICATION 6 = 6 STEPS OR MORE

Points:

1. Figures beyond the table
2. Oblique table
3. Oblique chairs
4. Near and far table legs
5. Near and far chair legs
6. Figures in front of the table
7. Chair back overlapping girl's legs.

Drawing
Invitation II (Johanna D. - 10+ years)
Table 1. The Drawing Measure: Guide to Scoring the 3 Invitations

Credit given for steps-in-space by indications of space and volume.

<table>
<thead>
<tr>
<th>Items</th>
<th>Descriptions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlap</td>
<td>The partially obscuring of one feature by another, so that a spatial plane is created. No extra credit given for parallel features</td>
<td>Far edge of table obscuring the lower half of figure beyond. No extra credit given for many figures shown beyond table edge.</td>
</tr>
</tbody>
</table>
| Linear Perspective   | Depth indicated by receding planes or converging lines                         | 1. Trapezoid or elliptical tables  
2. Prams with receding sides                                                                 |
| Aerial Perspective   | Atmospheric depth suggested by diminished definition of distant items         | Lightly drawn figures at far end of table                                                      |
| Relative Apparent Size | Size diminution with increasing distance                                      | Adult on far side of road drawn smaller than child on near side                                |
| Feature Orientation  | Implied space by suggestive positioning of represented objects               | Back of a head on near side of street, with another head facing front on far side of street    |
| Pattern              | Volume suggested by manipulation of patterned surface                         | Mother wearing a check patterned coat which shows the roundness of her arms.                   |
| Texture              | Volume indicated by varied use of marks, dots or lines                        | Drawing of hair by strokes which are heavier on one side of the head                           |
| Shadow and/or Tone   | Grading lightness and darkness tonally in order to suggest form               | 1. Pram drawn as a box with sides tone _light to dark  
2. Figures with shadows                                                                    |
The Piagetian Tests

a) The Horizontal/Vertical Co-ordinates

The tests concerned with the understanding of the use of systems of horizontal and vertical referential axes used materials which were based upon those described by Piaget, and which were referred to earlier. For examining the horizontal constant two tall straight-sided identical vinegar bottles made of uncoloured untextured glass were used. Both were stoppered, one was empty whilst the other was half filled with red water. In addition, there was an adjustable easel, some thick-tipped red felt pens, a half imperial drawing board, and a stack of cartridge paper measuring twelve by fifteen inches (Figure 18). On each of some 50 sheets of cartridge paper was a simple outline drawing of the empty bottle inclined at an angle of 45° to a line drawn horizontally across the paper from side to side. There was an equal number of drawings of the bottle lying horizontally with one of its sides in contact with the ground line. For the study of the vertical constant, two fat sweet jars made of uncoloured, untextured glass were used. Both possessed large screw-top lids, and from the middle of one of these was suspended a plumb-line, in this case a small bell clapper attached by a short length of black twine (Figure 19). The other jar was empty. There were also some thick-tipped black felt pens, and a supply of blanks with outline drawings of the empty fat jars inclined at an angle of 45° to the ground line.

The standard procedure for studying the horizontal constant, was to show the child the bottle containing red water, and to bring his
Figure 18. Horizontal/Vertical co-ordinates procedure (tipped bottle)
© Jar containing plumpline shown.

2 Identical jar without plumpline shown tipped and held at 45°

3 Child given outline drawing of empty tilted jar and asked to draw in plumpline.

Figure 19. Horizontal/Vertical co-ordinates procedure (plumb-line)
attention to the red water in the bottle. It was picked up and shown to him in such a way that the hand did not mask the coloured water, and in so doing he would be able to observe the relationship between the water and the bottle. The bottle was then removed and the empty bottle substituted. This was grasped in the same manner, tipped to 45° and held. In the meantime an outline drawing of an inclined bottle was pinned to the drawing board, and the child was asked to add the water, as a red tipped felt pen was handed to him. The following words were used on each occasion as final instructions:

"What would the red water look like now? Draw where the water would be".

When the child announced that he had finished, his name was added and the drawing was filed for scoring later. For the second part of the test the procedure was identical, except that the empty bottle was held horizontally instead of tipped, and that the blank contained an outline drawing of a horizontal bottle and not a tipped one. Both attempts were scored in the following way, and correspond closely to Piaget's grading (and to Beard's 1964 scoring). No mark was awarded for a confused mass of red lines or scribbling. When the water level was drawn approximately parallel to the base or the side of the bottle, it was awarded 1 point; a compromise between base and horizontal was awarded 2 points; when it was within 5° of horizontal it was awarded 3 points; and an exactly horizontal water level would earn the maximum score of 4 points.

The procedure for the third part of the test - the study of the vertical constant - was very similar to that employed in the first two
Table 2. Basic equipment, examples of questions and adopted scoring procedure in the Piagetian Tests. (See Beard, 1964; Fogelman, 1970)

<table>
<thead>
<tr>
<th>Type</th>
<th>Basic Equipment and Examples of the Question/Problems</th>
<th>Critical Stages</th>
<th>Adopted Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Bottles, 1 with red water, 1 empty. Tip empty one 45°, provide blank.</td>
<td>7-11 years</td>
<td>0 Confused mass</td>
</tr>
<tr>
<td></td>
<td>&quot;What would the red water look like now?&quot;</td>
<td></td>
<td>1 Parallel to base or side</td>
</tr>
<tr>
<td></td>
<td>Vertical Co-ordinates</td>
<td></td>
<td>2 Compromise base/horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 Confused mass</td>
<td>3 Within 5 of horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Parallel to base</td>
<td>4 Exactly horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7-8 years: Erratic or uncertain egocentric</td>
<td>3 Within 10 vertical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8-9 years: Transitional (next door)</td>
<td>4 Exactly vertical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 years: Correct</td>
<td>Co-ordination</td>
</tr>
</tbody>
</table>

3 - Mountain Test (Model + cut-outs + drawings) (1) child asked to reconstruct or draw his own view then others (2) child asked to locate view from drawing of it.
parts of the test. The fat jar containing the plumb-line was introduced to the child, and his attention was brought to the plumb-line. He was asked what he thought it was, and it was suggested that he called it 'a plumb-line'. The empty jar was then substituted and held at an angle of $45^\circ$. An outline drawing of the inclined jar was pinned to the drawing board, a black felt pen handed to the child, and he was asked to add the plumb-line, the final instructions being:

"Can you put the plumb-line in the jar?"

On completion his drawing was named and filed with the others. The scoring for the vertical constant was similar to that used for the horizontal constant. No credit was given for the plumb-line being drawn approximately parallel to the jar side. A slight indication of the vertical or a line bending round from the side to the vertical was awarded 1 point; a clear compromise between the side and the vertical was awarded 2 points; when the line was within $10^\circ$ of vertical 3 points were awarded; and an exactly vertical plumb-line would earn the maximum score of 4 points.

b) The Three Mountain Test

The materials used in the Three Mountain Test were kept very closely to those used by Piaget as described earlier. This consists of a papier-mâché model of three mountains nine inches high on a two foot square wooden board (Figure 20). Each mountain was made clearly distinguishable from the others by three characteristics. The largest mountain was coloured grey and was capped with snow; the middle sized mountain was brown and at its peak stood a cross; and the smallest mountain was mottled green in colour with a little red house on the summit. Three
Figure 20. The Three-Mountain Test
(The Co-ordination of Perspectives)

Model and drawings from 8 different viewpoints.
The movable cardboard cut-outs are not shown here.

1. The child is asked to reconstruct or draw his own view.
2. The child is asked to locate a view from a drawing of it.
Figure 21. A child arranging the cardboard cut-outs in order to represent the view "seen" by the toy bear.
cardboard cut-outs that closely approximate the appearance, the colour
and the size of the model mountains were made available, and these could
be maneuvered and re-arranged upon an easel-like wooden board (Figure 21).
In addition there were eight coloured drawings upon cards each measur­
ing fourteen by twenty inches, and corresponding to eight different
views of the group of mountains. Each coloured drawing was assigned a
Roman Numeral I - VIII, marked on the back and not visible to the
children which was useful to testers for checking purposes. The model
of the mountains was placed upon a low table, the top of which was no
larger than the dimensions of the board upon which the mountains stood,
and eight small chairs were gathered around it. The easel with cut­
cuts stood slightly to the left of position I and within arms reach of
any child sitting there, enabling easy re-arrangement of the cut-outs
without the necessity of moving from the seat. The coloured drawings
were pinned to a board or stuck to a wall in the three schools used.
In all cases they were about ten feet from the sight of the mountains,
arranged in no specific order, clearly visible and at about the
children's eye level.

The procedure for the test was held constant, and the only differ­
ences were those in the introduction of the test already alluded to,
and concerned with minor adjustments according to age. Each child was
introduced to the test by being shown the three mountains, and by
having his attention brought to the three distinguishing features of
each of them. For example:

"This one's the biggest. Look, it's grey and it has
snow on the top. This green mountain is the smallest,
and there is a little red house right at the top."
The brown mountain is bigger than the green one, but not as big as the grey one, is it? What's on the top of it?"

The child was then asked to recognize these features in the cardboard cut-outs and in the coloured drawings (called 'pictures'). In this way he was introduced to the idea that the cut-outs and the drawings represented the mountains. Having been asked to sit in the chair in position I, the adjustable nature of the cardboard cut-outs was demonstrated, and the child was invited to arrange the cut-outs to conform with his own view of the group of mountains. Whether he succeeded or not, he was then moved on to the first part of the test, which from this moment onwards was scored. A toy bear (a pillow, in the case of older children) was placed in position V, and the child was then asked to arrange, without moving from his seat, the cut-outs to correspond with the view 'seen' by the bear. An accurate arrangement of the view would be awarded 2 points, a close resemblance (that is, more like position IV or position VI than position V) would be awarded 1 point, and anything less accurate than this would score nil. The bear was then moved to position III and position VII for two more attempts, as the performance was discreetly scored. For the second part of the test, the bear was taken aside for a moment while the child was asked to select a coloured drawing (the one corresponding to position I was removed as too soft an option) and to show where the bear would now sit in order to 'see' the view in the chosen picture. Two different attempts were allowed, and each scored as before, with a choice of the correct position being awarded 2 points, either side of it 1 point, and other positions nil.
Conditions of the Investigation

(1) Subjects and Location

All the children in the sample, apart from those under five years of age, were in full-time attendance at a Leicestershire Primary School, administered by the local education authority in the City of Leicester. The school is situated in a largely middle-class area of the city, a neighbourhood regarded as "a good place to live" by Leicester's professional families, and this accounts for about 80% of the child population of the school. The remaining 20% is drawn from the eastern border of this neighbourhood and would come from families of factory workers and prison officers. The school itself is divided into an Infants (ages 5-7) school and a Junior (ages 7-11) school, each run separately under its own Headteacher, but situated alongside one another on the same site. The buildings are post-war with late additions, and are generally regarded as well equipped by city standards. At the time of the data collection the Infants School had 335 children, and the Junior School had 656 children on roll, with five classes of about 35 children in each school year.

The four-years old children in the sample were in attendance at a privately run Play Group in the same neighborhood, and in close proximity to the school. This Play Group catered to the more aspiring of professional parents locally. Certainly, a large proportion of University teaching staff patronized it. Some of the children would go on to the Infants School already described, but most could expect private schooling later. Four of the six four-year olds used in the sample had elder brothers or sisters at private schools.
Six children from each of seven school years were selected by the Headteachers, who understood that a balance of boys and girls was needed, but otherwise a fairly representative sample (see Table 3).

To carry out the practical side of the investigation the Junior School offered the use of the school library, and the Infants School suggested their Medical Room. These were less than half the size of the normal classrooms, but proved most suitable for the small number of children involved, for laying out the equipment and for holding the drawing sessions. The Play Group leader allowed an ante-room for the purposes, and this too proved adequate.

(ii) Procedure

Apart from the preliminary visits to discuss details with the Headteachers three afternoon sessions were arranged in the Junior school, two afternoon sessions in the Infants school and one morning session in the Play Group. During the days of the visit each child was given a cardboard conference badge on which their first name was written and to which stars were added as each of the tests were completed. This was done for several reasons. Firstly, for identification purposes. Except for the drawing sessions there were never more than three children, usually two, in the room at the same time. A badge made the task of collection children from the sand pit, or elsewhere, much easier. Secondly, the teachers liked to know who had "been done and who hadn't". The device proved very popular with the children, and it may have been one of the reasons why no withdrawals occurred after the first day. Two adults were involved in conducting the test sessions. The writer conducted the drawing sessions and administered the tests. An assistant
Table 3. Individual and Total Scores for Drawings, Co-ordinates and 3-Mountain Test.

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Age</th>
<th>Drawings</th>
<th>Co-ordinates</th>
<th>3-Mountain Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Range</td>
<td></td>
<td></td>
<td>I II III</td>
<td>I II III Total</td>
<td>I II III Total</td>
</tr>
<tr>
<td>4+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Julia T.</td>
<td>F</td>
<td>4.4</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Catherine</td>
<td>G</td>
<td>4.2</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Rachel D.</td>
<td>F</td>
<td>4.4</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 1</td>
</tr>
<tr>
<td>Richard V.</td>
<td>M</td>
<td>4.2</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Stuart R.</td>
<td>M</td>
<td>4.2</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 1 0</td>
</tr>
<tr>
<td>Richard B.</td>
<td>M</td>
<td>4.3</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 1 0</td>
</tr>
<tr>
<td>5+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark C.</td>
<td>M</td>
<td>5.8</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Alison R.</td>
<td>F</td>
<td>5.0</td>
<td>1 0 0</td>
<td>0 0 0</td>
<td>0 0 1</td>
</tr>
<tr>
<td>Rebecca B.</td>
<td>F</td>
<td>5.9</td>
<td>0 1 0</td>
<td>0 0 0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Robert F.</td>
<td>M</td>
<td>5.9</td>
<td>0 1 0</td>
<td>1 0 0</td>
<td>0 1 0</td>
</tr>
<tr>
<td>Cathryn H.</td>
<td>F</td>
<td>5.8</td>
<td>0 1 0</td>
<td>1 0 0</td>
<td>0 1 0</td>
</tr>
<tr>
<td>Richard D.</td>
<td>M</td>
<td>5.6</td>
<td>1 0 0</td>
<td>1 0 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>2 3 0</td>
<td>2 2 0</td>
<td>4 2 3</td>
</tr>
<tr>
<td>6+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucy C.</td>
<td>F</td>
<td>6.0</td>
<td>1 1 0</td>
<td>1 0 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>Robert L.</td>
<td>M</td>
<td>6.8</td>
<td>1 0 1</td>
<td>1 0 0</td>
<td>1 1 0</td>
</tr>
<tr>
<td>Dylan B.</td>
<td>F</td>
<td>6.6</td>
<td>1 1 0</td>
<td>1 0 0</td>
<td>1 1 0</td>
</tr>
<tr>
<td>Helen R.</td>
<td>F</td>
<td>6.2</td>
<td>1 1 0</td>
<td>1 0 0</td>
<td>2 1 0</td>
</tr>
<tr>
<td>Michael G.</td>
<td>M</td>
<td>6.4</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 2 0</td>
</tr>
<tr>
<td>Ruth K.</td>
<td>F</td>
<td>6.2</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0 1 0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>5 5 1</td>
<td>5 4 1</td>
<td>1 3 0</td>
</tr>
<tr>
<td>7+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paul Q.</td>
<td>M</td>
<td>7.0</td>
<td>1 3 0</td>
<td>1 2 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>James B.</td>
<td>M</td>
<td>7.1</td>
<td>1 1 0</td>
<td>0 1 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>Timothy E.</td>
<td>M</td>
<td>7.6</td>
<td>1 1 0</td>
<td>2 0 1</td>
<td>1 0 0</td>
</tr>
<tr>
<td>Candy C.</td>
<td>F</td>
<td>7.8</td>
<td>1 0 0</td>
<td>0 0 0</td>
<td>0 2 0</td>
</tr>
<tr>
<td>Lisa O.</td>
<td>F</td>
<td>7.7</td>
<td>1 1 1</td>
<td>1 0 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>Alison S.</td>
<td>F</td>
<td>7.8</td>
<td>2 2 0</td>
<td>4 3 2</td>
<td>7 1 2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>9 7 1</td>
<td>13 5 4</td>
<td>21 3 0</td>
</tr>
<tr>
<td>8+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christine B</td>
<td>F</td>
<td>8.7</td>
<td>2 1 1</td>
<td>1 3 0</td>
<td>2 2 0</td>
</tr>
<tr>
<td>Marisa L.</td>
<td>F</td>
<td>8.1</td>
<td>1 1 1</td>
<td>1 0 0</td>
<td>1 1 0</td>
</tr>
<tr>
<td>Rachel H.</td>
<td>F</td>
<td>8.4</td>
<td>1 1 1</td>
<td>1 1 0</td>
<td>1 1 0</td>
</tr>
<tr>
<td>Jonathan B.</td>
<td>M</td>
<td>8.7</td>
<td>0 1 2</td>
<td>1 3 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>Michael L.</td>
<td>M</td>
<td>8.4</td>
<td>6 4 0</td>
<td>2 3 3</td>
<td>8 2 1</td>
</tr>
<tr>
<td>Simon B.</td>
<td>M</td>
<td>8.3</td>
<td>3 0 4</td>
<td>2 3 1</td>
<td>6 1 2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>15 6 4</td>
<td>20 9 5</td>
<td>29 8 6</td>
</tr>
<tr>
<td>9+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helen A.</td>
<td>F</td>
<td>9.1</td>
<td>2 3 0</td>
<td>2 3 0</td>
<td>2 2 2</td>
</tr>
<tr>
<td>Denise R.</td>
<td>F</td>
<td>9.7</td>
<td>3 4 1</td>
<td>6 3 3</td>
<td>9 2 2</td>
</tr>
<tr>
<td>Lorraine G.</td>
<td>F</td>
<td>9.7</td>
<td>2 3 1</td>
<td>1 3 3</td>
<td>7 1 1</td>
</tr>
<tr>
<td>David T.</td>
<td>M</td>
<td>9.1</td>
<td>2 4 1</td>
<td>2 3 3</td>
<td>8 1 1</td>
</tr>
<tr>
<td>David W.</td>
<td>M</td>
<td>9.1</td>
<td>2 3 1</td>
<td>2 3 3</td>
<td>7 1 1</td>
</tr>
<tr>
<td>Philip H.</td>
<td>M</td>
<td>9.1</td>
<td>2 1 1</td>
<td>1 1 0</td>
<td>2 1 0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>18 10 10</td>
<td>15 12 19</td>
<td>31 7 5</td>
</tr>
<tr>
<td>10+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miranda T.</td>
<td>F</td>
<td>10.2</td>
<td>3 6 5</td>
<td>4 4 4</td>
<td>12 2 2</td>
</tr>
<tr>
<td>Johanna P.</td>
<td>F</td>
<td>10.6</td>
<td>6 4 16</td>
<td>4 4 4</td>
<td>12 2 2</td>
</tr>
<tr>
<td>Juriya K.</td>
<td>F</td>
<td>10.8</td>
<td>3 4 1</td>
<td>3 3 8</td>
<td>1 1 1</td>
</tr>
<tr>
<td>Stephen A.</td>
<td>F</td>
<td>10.0</td>
<td>4 6 4</td>
<td>4 4 4</td>
<td>11 2 2</td>
</tr>
<tr>
<td>Simon B.</td>
<td>M</td>
<td>10.8</td>
<td>3 2 1</td>
<td>1 3 2</td>
<td>6 1 2</td>
</tr>
<tr>
<td>Philip V.</td>
<td>M</td>
<td>10.11</td>
<td>6 6 18</td>
<td>4 4 4</td>
<td>12 2 2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>26 29 24</td>
<td>19 22 20</td>
<td>61 9 11</td>
</tr>
</tbody>
</table>
helped with materials and ensured that the correct piece of equipment was in the right place at the right time. For example, she checked that the chairs were in their correct position at the start of each 3-Mountain Test, or that the blank was pinned to the drawing board at the right moment during the progress of the Co-ordinates test.

Each session started by assembling all the children involved in the investigation (from that particular school) and asking them to produce one of the three drawings. It was thought that the drawing sessions were better spread out like this, otherwise the children might have tired of drawing before the third drawing was completed. When the drawings were completed each class was told the time of the day when they could be expected to return, two children were retained and the rest of the class was asked to stand by.

(iii) Drawing Conditions

The materials used in the drawing sessions were few and simple. Freshly sharpened soft pencils (2B and 3B equivalent to U.S. Nos. 2 and 1) were given out and two sizes (6¼" x 8" and 8" x 10") of white paper were made available. After a preliminary period of adjustment, devoted only to the business of settling down, the children were asked to listen very carefully whilst the particular Drawing Invitation details were spoken, exactly as they appear in this study. One or two children were then selected and asked to repeat what they could remember, and the omissions and mistakes corrected. Thereupon, the children were allowed, Group by Group, to choose their paper, and being assured of unlimited time they were permitted to begin drawing. There were no interferences, by class teachers or the people administering the session
whilst the drawings were in progress, and no critical or encouraging comments were given. Several questions were asked by children when the drawings were being done; amongst these were:

Q. "Can I use a rubber?" (eraser)
A. "Yes, by all means do" (Rubbers were not issued to every child, but one or two were available for use.)

Q. "Can we use crayons?"
A. "No, if you don't mind. I would like everyone to use only the pencils provided".

Q. "Can I draw the lady holding a basket instead of a bag?"
   (Invitation I)
A. "Yes, that would be alright. A basket is a sort of bag."

There was a steady increase in the time taken to complete a drawing, with from six minutes by the four year olds to up to thirty five minutes by the ten year olds. Had children of these ages been in the same drawing sessions then the problem of occupying those who finished early might have reached a critical level. However, the age division of Infants, Junior School and Play Group ensured that this situation never arose.

(iv) Piagetian Test Conditions

The test conditions were kept as constant as possible for each child. Differences were of the following nature. Younger children were allowed a longer period of adjustment before the test proper started. They were allowed to 'play' for awhile in order to settle down, and the test was begun at the most opportune moment. Fortunately the children had seen some of the larger pieces of equipment earlier during the drawing session, and were already curious. The lead-up to the
tests was varied slightly according to age. Whereas some four or five year olds might have been invitingly asked whether they would like to play with some red water or to look at the little house on the hill top it would have been ridiculous to do the same with nine or ten year olds. Similarly, moving a teddy bear from seat to seat for a ten year old boy would have proved more of an irritant than a comfort.

Although two children were allowed in the test room at the same time, the child not undergoing the test was kept fully occupied and there was no opportunity for him/her to be influenced by the other child's performance on the Piaget tests. In the Infants school the second child would be completing the third drawing, and in the Junior school the many alcoves with books and pictures provided sufficient diversion during the short waiting period. In the Play Group with only six subjects, and several available helpful adults, these difficulties were never encountered. The administering of the Co-ordinates test preceded the 3-Mountain Test.
CHAPTER VI

RESULTS

Introduction

This chapter is devoted to a discussion, an analysis and interpretation of the findings of the investigation.

The Drawings will be examined separately in terms of (1) the difficulties of applying the scoring procedure to the sample obtained; (2) age difference comparisons of scores and exceptional children; (3) any differences between the three Drawing Invitations, such as one yielding consistently higher scores; (4) any qualitative differences in respect of the type representation problems described in Chapter 5; and (5) any problem solutions that characterize age differences.

The Piagetian Tests will be examined separately for (1) age differences in response; (2) characteristic and uncharacteristic responses in terms of those Piaget had found and described; (3) exceptional children; and (4) any peculiar features of the tests revealed during the investigation.

Finally, a comparison between the principal functions of Drawing Tests and Piagetian Tests, and secondary functions of Age and Sex in terms of correlations produced by computer analysis, followed by a consideration of the degree of support they give for the hypothesized relationship between the two principal functions.
The "Steps in Space" criterion was applied to the 126 drawings obtained from the forty-two children in the sample. Some difficulties were experienced in allocating the drawings to the appropriate categories. Three of the youngest children produced drawings that were almost unrecognizable, and had it not been for the fact that they were observed during the act of drawing and questioned soon afterwards (a situation made feasible by the small number involved) these would have been deemed unclassifiable.

Typical was the drawing (Figure 22) by the four year old boy who began by drawing a line (the table) that started at the bottom left hand corner and progressed along the left hand margin towards the top left hand corner. Three-quarters of the way along, the line changed direction and swept in a great arc towards the lower right hand corner. Other strokes, topped by circular scribbles radiated from the upper edge of this line, and were grouped in twos and threes (people). Radiating from the lower edge were other lines, near the top of which were added more circular scribbles (food). Finally, at the bottom of the paper near the middle, was placed a dark ant-like shape (searching boy).

Difficulties of interpretation were not so acute in the two examples shown in Figure 23, where a knowledge of the drawing subject-matter and some familiarity with infants' drawing behavior would make the content sufficiently evident to allow classification. In the top drawing the road is clearly indicated by two horizontal lines, and the waving hand shown by enormous spreading fingers. The bottom drawing
Figure 22. Almost unrecognisable.
Invocation II drawing by Richard V.
4+ years. N.B. to be viewed from the right hand margin.
Figure 23. Almost unrecognisable.
(Above) Invitation III drawing by Richard V. 4+ years.
(Below) Invitation II drawing by Catherine G. 4+ years.
consists of a large egg-like shape (table), containing other circular shapes (food). To the table perimeter are attached five more circular forms containing dots, marks and lines. The second from the left is, apparently, the lost spoon (under the table), whilst the remainder represent people. The writer was not able to determine whether the top figure was the searching boy, as the paper was turned sideways to make this part of the drawing, and no explanation was volunteered in response to later prompting.

With the drawings of older children most difficulties arose in the form of deciding exactly what was a 'step-in-space' and what was not in individual cases, and of trying to avoid interpreting a particular aspect of a drawing as an indication of depth when no such impression was intended. For example, an arm (especially when drawn as one line) might be drawn across a previously drawn body, without the child artist intending to show that the body was more distant; the arm was simply drawn later and superimposed to suit the literal purposes of the details in the Invitation, for instance, to extend from a body (already drawn) to a spoon (already drawn). Another example (see Figure 24, above), shows a drawing in response to Invitation II where the table top was drawn as a centrally placed circular shape first of all, and all the other details added later. For this reason one should not assume that it was the child's intention to achieve a spatial overlap where arms or chairs cross the perimeter.

Further difficulties were encountered with borderline cases, particularly when the steps were small. For example, a nose on a full face, a leg below a skirt, and a neck above a collar are all cases
Figure 24.


(Below) Simple Insensitive outlining. Invitation I drawing. Lorraine S. 9+ years.
that provide opportunities for spatial rendering but the award of a point would depend upon whether the drawing exploited these opportunities. Decisions were taken on the basis of the exact relationship between the two features juxtaposed. If, for instance, the neck and collar appeared round with a carefully placed heavily drawn line, and with some indication of how one form fits into another, then it qualified for a step. If there was no such evidence then this part of the drawing was regarded as flat.

No credit was given for objects that were simply outlined with an insensitive line describing its extremities. Items so drawn would look as though they were simply cut out of paper, and thus, can be justifiably regarded as flat. Prams were frequently drawn in this way, and a good example of simple outlining occurs in Figure 24 (below). Silhouettes would be in a similar category, and many outlines of objects and figures (e.g. Figure 25, above) were filled with black pencilling to render volume. Such a treatment was judged as flat. Similarly, Piagetian 'enclosures' (transparencies, 'x'-rays), when items are drawn within the boundaries of other items to convey the idea that one contains or belongs to the other (e.g. a baby in a pram, as in Figure 25, below). In these cases the items shown are represented on the same plane and therefore merit being placed in the 'flat' category by our criterion. Closely related is what is known as "opening-out" or "flattening", when the constituent sides or parts of an object are assembled side by side or attached, parallel to the picture plane, rather than assembled in accordance with the known form of the object and, presented from one particular view, together with its projective distortions and
Figure 25.

(Above) Silhouette. Invitation I drawing. Christine P. 8+ years.

(Below) X-Ray or Transparency drawing. Invitation I response. Ruth K. 6+ years.
co-ordinated control of the visible, partly visible and unseen (i.e. the difference between an opened up box and a three-dimensional one). An example of this kind of response occurring in the sample collected is shown in Figure 26.

Credit for spatial awareness was most frequently given for clear indications of overlapping, when spatial relationships were established by placing one object in front of another so that one form partly obscures the other. Credit was also given for indications of volume. Apart from the three-dimensional aspects of figures discussed in the previous paragraph, the placing of a pattern on clothing (Figure 27) or a table cloth, or the drawing of the texture of hair on a head can give unmistakable evidence of the form beneath. Closely related is the use of light and shadow. In reality, volumes block the path of light and so create shadows. In drawing, the illusion of volume is created by grading light and dark in area or in line, with the accompanying suggestion of space. This is a rather sophisticated concept for the primary school, and no examples occurred in the sample collected. However, another sophisticated concept, the device of relative apparent size (which uses the apparent decrease in size with increase in distance from the eye) did occur, and one example appears in the doors and windows drawn in Figure 27. Foreshortening and linear perspective were recognized as unquestionable indicators of spatial awareness in drawings and occurred usually as a result of attempts to draw tables or prams (Figure 28). Aerial perspective, appearing in reality as a result of moisture or dirt in the atmosphere making distant objects less distinct and hazy, is a commonplace in drawings and painting.
Figure 26. Opening out and flattening.

Invitation I response. Michael L. 8+ years.
Figure 27. Indications of volume, and relative apparent size.

Invitation III response. Miranda P. 10+ years.
Figure 28. Foreshortening and linear perspective. Invitation I responses.
(Above) Johanna D. 10+ years
(Below) Philip W. 10+ years
Figure 29.

(Above) Older child with low score. (1 point) Invitation I response. Miriam K. 10+ years.

(Below) Humor (4 points) Invitation I response. Stephen A. 10+ years.
generally, but a rare occurrence in children's drawings, and there were no examples produced by the children in the sample.

Table 3 shows how the drawings were distributed into the seven categories according to the degree of space indicated by the 'steps-in-space' criterion. All the drawings of the six youngest children were assessed as having none of the established signs of depth. All but one of the children in the next class scored their only point in the first and second Invitations, and in the latter case entirely as a result of placing figures beyond the table. The six year olds scored an average of 1.5 points over three drawings, and these were invariably gained from overlapping in some form, figure beyond tables, baby beyond pram hood, dog in front of mother. The seven year olds, fresh from the Infant School, did a lot better, scoring an average of one point per drawing. Again these points were acquired entirely from instances of overlapping, but the considerable increase in drawn detail provided more occasions for overlaps, and explains the superior score. Although the eight year olds have a higher average (over 1.3 points) per drawing, one boy, Michael L., scored almost half the group's point total. The score of the nine-year olds shows a great leap forward with an average of 2.6 points per drawing, which represents a two-fold increase on the previous year. This is accountable mainly in terms of a vast increase in the number of overlaps, but there are also several instances of volume and recession. The six children from the top class of the Junior School produced drawings with the most detail, and between them all examples for the award of points which occurred in the sample, with an average score of 4.5 points per drawing.
There were noticeable differences in response to the three Drawing Invitations, with Invitation III yielding the least number of points (Totals: I = 75; II = 69; III = 40). The loss is sustained largely by the younger age groups. For example, only two children under eight years old scored any points on this Invitation, and these scored only one point each (total 2). This compares with an accumulated 16 points on Invitation I, and 15 points on Invitation II over the same age range. By age 10 years the scoring differences between the Drawing Invitations are negligible. The explanation for this failure on Invitation III may lay with the matter raised earlier in Chapter 5(c), where attention was drawn to the nature of the space suggested, that is a less clearly defined space in Invitation III. In Invitation I every item mentioned is physically linked and within reach of the "mother". Invitation II is less clear in these respects, but much more clear than Invitation III. The improvement in scoring on Invitation III after age seven may be seen as part of a general improvement in mental ability at this age. In this particular context the increased ability to take account of more distant factors (figures many yards distant in Invitation III, compared with proximity in terms of feet and inches in Invitation I and II) is supported by a number of available studies. For example, that of Kuenne (1946) who found that younger children were capable of only 'near' transposition, whereas older, verbally proficient children were capable of both 'near' and 'far' transposition. It may also parallel Schopler's (1964) and Zaporozhet's (1961) observations of a change from tactual to visual exploration around this age. These three studies form part of the evidence which White (1965) mustered in
recognition of a major transition occurring around seven years, and into which White has incorporated Piaget's theory.

Some instances were given earlier (Chapter 5) of the problems that existed in the Invitations, and a number of alternative interpretations were suggested, together with an outline of possible solutions in terms of drawings typically produced by children within the age group in question. Following this lead, a particularly revealing concept or group of concepts were chosen from each Invitation, and alternative solutions or interpretations were graded according to level of sophistication. The drawings of each age group were then examined for the solutions provided, and the results classified in Tables 4, 5, and 6.

A glance at each table will show a steady drift from the top left hand corner (lowest level of sophistication, and four year olds) to the bottom right hand corner (highest level of sophistication, and ten year olds). Table 4 reveals that no child under eight drew more than one side of the pram in other than a flat relationship; that 27 of the 42 children drew only one side of the pram; that only one child under ten years old drew overlapping pram wheels; and that no child under ten years old drew a pram from a convenient angle for viewing the baby. Table 5 shows that no child below nine drew the table top as an ellipse or trapezium, and that a predominance of absent or upright searching boys gradually gave way to crouching and half-hidden figures. As anticipated, only younger children were content to allow the spoon alone to represent this part of the Invitation. Table 6 indicates that in the third Invitation front views of the two principal figures
Table 4. Age group solutions to selected spatial problems in Invitation I, arranged in order of increasing sophistication.

<table>
<thead>
<tr>
<th>CONCEPT</th>
<th>LEVEL OF SOPHISTICATION</th>
<th>RELEVANT DETAILS</th>
<th>AGE GROUP</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4+ 5+ 6+ 7+ 8+ 9+ 10+</td>
<td></td>
</tr>
<tr>
<td>BABY AND PRAM</td>
<td>LOWER</td>
<td>No pram</td>
<td>1 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple enclosure (Baby in pram area)</td>
<td>4 2 2 2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brown separately</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transparency</td>
<td>1 1 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HIGHER</td>
<td>Baby omitted</td>
<td>1 2 3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly visible</td>
<td>1 3 6 3 4 3</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly visible and suitable angle</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>CRADLES AND WHEELS</td>
<td>LOWER</td>
<td>No wheels</td>
<td>3 1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cradle with dispersed wheels</td>
<td>4 1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 wheels in a row</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>HIGHER</td>
<td>2 wheels only</td>
<td>1 3 4 5 6 6 2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 overlapping wheels or equivalent</td>
<td>1</td>
<td>4 5</td>
</tr>
<tr>
<td>PRAM AS BOX</td>
<td>LOWER</td>
<td>1 side only</td>
<td>5 5 6 6 4 5 3</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More than 1 side but on 1 plane</td>
<td>1 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>HIGHER</td>
<td>More than 1 plane but related incorrectly</td>
<td>1 1 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-D like box</td>
<td>1</td>
<td>2 2</td>
</tr>
</tbody>
</table>
Table 5. Age group solutions to selected spatial problems in Invitation II, arranged in order of increasing sophistication.

<table>
<thead>
<tr>
<th>CONCEPT</th>
<th>LEVEL OF SOPHISTICATION</th>
<th>RELEVANT DETAILS</th>
<th>AGE GROUP</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4+ 5+ 6+ 7+ 8+ 9+ 10+</td>
<td></td>
</tr>
<tr>
<td>TABLE</td>
<td>LOWER</td>
<td>Confused or non-existent</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flatly ^ Ho legs 2 1 1 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Defined ^ Legs splayed 3 2 2 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area ^ Legs parallel 3 1 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 legs 1 5 4 1 1 13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profile ^ 3 legs 1 1 2 2 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 legs 1 1 2 2 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGHER</td>
<td>Eclipse ^ 2 legs 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>or ^ 3 legs 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trapezium ^ 4 legs 1 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEARCHING</td>
<td>LOWER</td>
<td>Confused or non-existent 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spoon but no boy 4 1</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upright 1 1 2 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOY</td>
<td>HIGHER</td>
<td>Horizontal or crouching 1 2 5 4 3 5 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly visible 3 1 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 6. Age group solutions to a selected spatial problem in Invitation III arranged in order of sophistication.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Level of Sophistication</th>
<th>Relevant Details</th>
<th>Age Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Figures:</td>
<td>Lower</td>
<td>1 or 2 facing front None in profile</td>
<td>4+ 5+ 6+ 7+ 8+ 9+ 10+</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One waving to</td>
<td>Higher</td>
<td>1 or 2 in profile 1 back view</td>
<td>4+ 5+ 6+ 7+ 8+ 9+ 10+</td>
<td>13</td>
</tr>
<tr>
<td>other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
steadily diminished to be replaced by profiles and back views.

In general, the application of the 'Steps-in Space' criterion to the sample of children's drawings demonstrates the steady development of spatial awareness as the children increased in age. This relationship between age and the drawing measure was subsequently borne out by a correlation of .80 shown in the computer analysis. However, it would be prudent to weigh against this the small number of children involved (that is, 42 children producing 126 drawings) and the variability of human nature. An examination of individual and group scores in Table 3 will expose such exceptional performances with, for example, two ten year olds scoring one point only for a drawing (e.g. Figure 29, above) and two six year old boys amassing 73% of the points for their group.

The Scoring Consistency of the Drawing Test

A measure of the scoring consistency of the Drawing Test was provided by the degree of agreement between the principal investigator's (Scorer 1) scoring and that of an independent scorer (Scorer 2). The latter was an experienced art teacher with degrees in art and art education. Scorer 2 was trained by first having him examine a tentative guide to scoring, similar to that to be found in this study. This was followed by a session judging drawings not taken from the sample, but which were produced in response to identical subject matter by children of a similar age range. During this session many of the subtle aspects of the scoring were dealt with orally, and apparent ambiguities in procedure explained to the satisfaction of
Scorer 2. The session included a separate trial scoring of ten drawings by Scorers 1 and 2, which was followed by a discussion of any resulting differences. The drawings in the sample were numbered 1 - 126, and numbers were drawn from a statistician's Table of Random Numbers (Arkin and Colton, 1963), until twenty drawings from each of the three Invitations (total 60) were selected. The drawings were then scored blind by Scorer 2, and in the absence of Scorer 1.

A comparison of Scorer 1 and Scorer 2 ratings appears in Table 10. This shows differences in the scores of 12 of the 60 drawings (20%). However, these are differences of one point only, except for one drawing with a two point difference. Overall, Scorer 2 awarded three points less than Scorer 1, with five points more over five drawings, and eight points less over seven drawings.

These results are shown in further detail in Table 9 where an average correlation of 0.956 is revealed between the two Scorers over 60 drawings. The grand mean for all ratings was 1.308, with a mean rating for Scorer 1 of 1.333 and a mean rating for Scorer 2 of 1.283. The twenty drawings of Invitation I produced a correlation of 0.967 between the Scorers, and an equal mean rating of 1.700. The Invitation II drawings produced the lowest correlation (0.947), again with an equal mean rating, this time of 1.650. The Invitation III drawings produced a correlation of 0.976 between the Scorers, and a grand mean of 0.576, with a mean rating for Scorer 1 of 0.650, and for Scorer 2 of 0.500. However, the Deviation from G. column shows a 0.075 and a -0.075 which is a sign that the Scorers are not as harmonious as the correlations imply.
Table 7. CORRELATION CO-EFFICIENTS with Drawings (4) as the criterion and Age (1), Co-ordinates (2) and the 3-Mountain Test (3) as Predictors.

1. Both Sexes

<table>
<thead>
<tr>
<th>Variables</th>
<th>1. Age</th>
<th>2. Co-ordinates</th>
<th>3. 3-Mountains</th>
<th>4. Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>1.00</td>
<td>0.84</td>
<td>0.83</td>
<td>0.80</td>
</tr>
<tr>
<td>2. Co-ordinates</td>
<td>0.84</td>
<td>1.00</td>
<td>0.93</td>
<td>0.95</td>
</tr>
<tr>
<td>3. 3-Mountains</td>
<td>0.83</td>
<td>0.93</td>
<td>1.00</td>
<td>0.89</td>
</tr>
<tr>
<td>4. Drawings</td>
<td>0.80</td>
<td>0.95</td>
<td>0.89</td>
<td>1.00</td>
</tr>
</tbody>
</table>

2. Males Only

<table>
<thead>
<tr>
<th>Variables</th>
<th>1. Age</th>
<th>2. Co-ordinates</th>
<th>3. 3-Mountains</th>
<th>4. Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>1.00</td>
<td>0.79</td>
<td>0.85</td>
<td>0.78</td>
</tr>
<tr>
<td>2. Co-ordinates</td>
<td>0.79</td>
<td>1.00</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>3. 3-Mountains</td>
<td>0.85</td>
<td>0.94</td>
<td>1.00</td>
<td>0.89</td>
</tr>
<tr>
<td>4. Drawings</td>
<td>0.78</td>
<td>0.94</td>
<td>0.89</td>
<td>1.00</td>
</tr>
</tbody>
</table>

3. Females Only

<table>
<thead>
<tr>
<th>Variables</th>
<th>1. Age</th>
<th>2. Co-ordinates</th>
<th>3. 3-Mountains</th>
<th>4. Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>1.00</td>
<td>0.88</td>
<td>0.82</td>
<td>0.81</td>
</tr>
<tr>
<td>2. Co-ordinates</td>
<td>0.88</td>
<td>1.00</td>
<td>0.91</td>
<td>0.96</td>
</tr>
<tr>
<td>3. 3-Mountains</td>
<td>0.82</td>
<td>0.91</td>
<td>1.00</td>
<td>0.89</td>
</tr>
<tr>
<td>4. Drawings</td>
<td>0.81</td>
<td>0.96</td>
<td>0.89</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Table 8. Correlation Co-efficients of 6+ to 10+ years only

<table>
<thead>
<tr>
<th></th>
<th>Drawings</th>
<th>Coordinates</th>
<th>3-M Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawings</td>
<td>1.00000</td>
<td>0.94232</td>
<td>0.87386</td>
</tr>
<tr>
<td>Coordinates</td>
<td>0.94232</td>
<td>1.00000</td>
<td>0.89963</td>
</tr>
<tr>
<td>3-M Test</td>
<td>0.87386</td>
<td>0.89963</td>
<td>1.00000</td>
</tr>
</tbody>
</table>
A second scoring consistency comparison was provided by an agreement trial between the principal investigator (Scorer 1) and a second independent scorer (Scorer 3). Scorer 3 was also an experienced art teacher, and underwent similar training procedures as Scorer 2. The purpose of this second agreement trial was to rule out the possibility that the numbering of the drawings would in some way affect the judgment of the independent scorer. In the first trial the drawings were numbered 1 - 126 progressively by age with the lower numbers being assigned to the older children and vice-versa. In the second trial the drawings were numbered randomly (compare the Drawing Number Columns in Tables 10 and 12). A comparison of the correlations shown in Tables 9 and 11 reveals very little difference, which would indicate that the numbering of the drawings was not operating to influence the scorers' judgment.

These results would appear to suggest a high degree of scoring consistency in the Drawing Test, and may be regarded as an indication of the test's reliability.

The Horizontal/Vertical Co-ordinates

The results revealed all the sub-stages and stages described by Piaget, and Table 3 shows a gradual improvement in scores as age increases. The computer analysis gave a correlation co-efficient between the 3-Mountain Test and Age (.83), and that between Drawings and Age (.80). All the youngest children's (the four year olds) responses resulted in no scores, which was identical to the situation existing in the Drawings, yet unlike that existing in the 3-Mountain Test. This
Table 9. Correlations between Scorer 1 and Scorer 2 on 60 Drawings Randomly Selected from the 126 produced for the Drawing Test.

<table>
<thead>
<tr>
<th></th>
<th>Corr. Between Scorers</th>
<th>Grand Mean</th>
<th>Mean Rating</th>
<th>Deviation From G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sc. 1</td>
<td>Sc. 2</td>
</tr>
<tr>
<td>60 Drawings</td>
<td>0.956</td>
<td>1.308</td>
<td>1.333</td>
<td>1.283</td>
</tr>
<tr>
<td>Invitation I</td>
<td>0.967</td>
<td>1.700</td>
<td>1.700</td>
<td>1.700</td>
</tr>
<tr>
<td>Invitation II</td>
<td>0.947</td>
<td>1.650</td>
<td>1.650</td>
<td>1.650</td>
</tr>
<tr>
<td>Invitation III</td>
<td>0.976</td>
<td>0.576</td>
<td>0.650</td>
<td>0.500</td>
</tr>
</tbody>
</table>
Table 10. A Comparison of Scorer 1 (Sc. 1) and Scorer 2 (Sc. 2) on 60 Drawings Selected Randomly from the Total Sample of 126 Drawings.

<table>
<thead>
<tr>
<th>Invitation I</th>
<th>Invitation II</th>
<th>Invitation III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Dr.No</td>
<td>Sc.1</td>
</tr>
<tr>
<td>Cathryn H.</td>
<td>102</td>
<td>0</td>
</tr>
<tr>
<td>Rachel H.</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>James B.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Simon Bel.</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Lucy A.</td>
<td>73</td>
<td>0</td>
</tr>
<tr>
<td>Phillip H.</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>Timothy E.</td>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>Denise R.</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Helen R.</td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td>Julia T.</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>Lisa A.</td>
<td>67</td>
<td>1</td>
</tr>
<tr>
<td>Paul A.</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td>Phillip W.</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>Alison S.</td>
<td>70</td>
<td>2</td>
</tr>
<tr>
<td>Dylan B.</td>
<td>79</td>
<td>1</td>
</tr>
<tr>
<td>Catherine A.</td>
<td>119</td>
<td>0</td>
</tr>
<tr>
<td>David W.</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Mandy L.</td>
<td>64</td>
<td>3</td>
</tr>
<tr>
<td>Lorraine S.</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Mark G.</td>
<td>90</td>
<td>0</td>
</tr>
</tbody>
</table>
may be due to the fact that luck could have been operating in one or two instances in the 3-Mountain Test, as will be explained later. As such, the set of scores for the Drawings has more in common with the scores of the Co-ordinates than with those of the 3-Mountain Test. There are also many more individual cases of children gaining parallel scores when the Co-ordinates and the Drawings are paired, than when the 3-Mountain Test and the Drawings are paired. This is reflected in the computer analysis which gave the far higher correlation of .95 between Co-ordinates and Drawing, compared with a correlation of .89 between the 3-Mountain Test and Drawing.

A comparison of the vertical scores (Column III) and the horizontal scores (Columns I and II) of the Co-ordinates section of Table 3 will reveal no support for Beard's (1964) claim that the concept of vertical precedes that of horizontal, though her subjects seem to have achieved it a little earlier than the subjects involved in the present study. Table 3 shows that a maximum score is not recorded until 10+ years. Three of these children score maximum points in the horizontal and vertical parts of the test, which if not achieved simultaneously gives no indication at all of the order of appearance. However, a fourth subject (Stephen A.) has gained full marks on the horizontal part whilst still falling short on the vertical part. Though one instance only, this would seem to contradict Beard's claim.

The 3-Mountain Test

It was clear that although the youngest children (the four and five year olds) enjoyed the social aspects of the exercise, they did.
Table 11. Correlations between Scorer 1 and Scorer 3 on 60 Drawings randomly selected and randomly numbered from the 126 Drawings produced in response to Invitations I, II and III.

<table>
<thead>
<tr>
<th></th>
<th>Corr. Between Scorers</th>
<th>Grand Mean</th>
<th>Mean Rating</th>
<th>Deviation from G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sc.1</td>
<td>Sc.3</td>
</tr>
<tr>
<td>Invitation I</td>
<td>0.967</td>
<td>1.225</td>
<td>1.400</td>
<td>1.050</td>
</tr>
<tr>
<td>Invitation II</td>
<td>0.971</td>
<td>1.875</td>
<td>2.000</td>
<td>1.750</td>
</tr>
<tr>
<td>Invitation III</td>
<td>0.980</td>
<td>1.475</td>
<td>1.600</td>
<td>1.350</td>
</tr>
</tbody>
</table>
Table 12. A comparison of Scorer 1 (Sc. 1) and Scorer 3 (Sc. 3) on 60 Drawings randomly selected and randomly numbered from the total sample of 126 Drawings.

<table>
<thead>
<tr>
<th>Invitation I</th>
<th>Invitation II</th>
<th>Invitation III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Dr. No.</td>
<td>Sc. 1</td>
</tr>
<tr>
<td>Ruth K.</td>
<td>78</td>
<td>0</td>
</tr>
<tr>
<td>Dylan B.</td>
<td>92</td>
<td>1</td>
</tr>
<tr>
<td>David T.</td>
<td>89</td>
<td>4</td>
</tr>
<tr>
<td>Julia T.</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Helen R.</td>
<td>97</td>
<td>1</td>
</tr>
<tr>
<td>Mirian K.</td>
<td>70</td>
<td>1</td>
</tr>
<tr>
<td>Phillip H.</td>
<td>41</td>
<td>2</td>
</tr>
<tr>
<td>Michael L.</td>
<td>113</td>
<td>6</td>
</tr>
<tr>
<td>Rachel D.</td>
<td>94</td>
<td>0</td>
</tr>
<tr>
<td>Timothy E.</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>Michael G.</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Cathryn H.</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>Rebecca B.</td>
<td>104</td>
<td>0</td>
</tr>
<tr>
<td>James B.</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Christine P.</td>
<td>93</td>
<td>1</td>
</tr>
<tr>
<td>Johanna D.</td>
<td>68</td>
<td>6</td>
</tr>
<tr>
<td>Jonathan B.</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>David W.</td>
<td>61</td>
<td>2</td>
</tr>
<tr>
<td>Lisa G.</td>
<td>58</td>
<td>1</td>
</tr>
<tr>
<td>Richard V.</td>
<td>38</td>
<td>0</td>
</tr>
</tbody>
</table>
not understand the questions asked and could not grasp what was required of them. Most of them politely went through the motions of a response to the questions, and one little girl actually took the bear up to one of the coloured drawings to show him the view, an act which characterized the level of her understanding, and that of her classmates. Egocentric views predominated amongst the six, seven and eight year olds during the first part of the test, when children repeatedly reproduced their own view. Although this tendency diminished in the nine and ten year olds it still appeared to have an influence on their performance in the first part of the test.

Table 3 shows the steady improvement in scores as age increases which clearly parallels Drawing performance. Despite this, the computer analysis (see Table 7) of scores reveals a correlation co-efficient of only .89 between the 3-Mountain Test and the Drawings, compared with that of .95 between the Co-ordinates Test and the Drawings, while the correlation co-efficient between the 3-Mountain Test and Age is shown as .83, which is closer to the correlation of .80 between Drawings and Age than the Co-ordinates Test (.84).

The overall improvement with increasing age is what one might expect, but perusal of Table 3 will reveal some fluctuations. Some older children scored like younger children and vice-versa, no child achieved a maximum score, and no child performed consistently (apart from complete failures) throughout the five parts of the test.

There were two features of the test, as it was carried out for this study, which might help to explain the pattern of scoring. The first was that the coloured drawing of Position V proved a very
Table 13. Cross Tabulation Grids showing the distribution of the 42 children according to high, middle and low score on each task of the Drawing Invitations, the 3-Mountain Test, and the Perpendicular/Horizontal Co-ordinates.

<table>
<thead>
<tr>
<th>DRAWINGS</th>
<th>3-MOUNTAIN TEST</th>
<th>CO-ORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>5+ 4,3,2 1,0</td>
<td>5+ 4,3,2 1,0</td>
<td>5+ 4,3,2 1,0</td>
</tr>
<tr>
<td>3+</td>
<td>9 3 0</td>
<td>2 7 0</td>
</tr>
<tr>
<td>1,2</td>
<td>3 10 4</td>
<td>1 8 7 1</td>
</tr>
<tr>
<td>0</td>
<td>0 0 13</td>
<td>0 1 6 12</td>
</tr>
<tr>
<td>3+</td>
<td>11 1 0</td>
<td>2 8 3 0</td>
</tr>
<tr>
<td>1,2</td>
<td>1 9 4</td>
<td>1 7 4 3</td>
</tr>
<tr>
<td>0</td>
<td>0 3 13</td>
<td>0 1 6 10</td>
</tr>
<tr>
<td>3+</td>
<td>7 0 0</td>
<td>2 6 0 0</td>
</tr>
<tr>
<td>1,2</td>
<td>3 7 0</td>
<td>1 6 5 0</td>
</tr>
<tr>
<td>0</td>
<td>2 6 17</td>
<td>0 4 8 13</td>
</tr>
<tr>
<td>2</td>
<td>9 4 0</td>
<td>Hi</td>
</tr>
<tr>
<td>1</td>
<td>5 4 2</td>
<td>M</td>
</tr>
<tr>
<td>0</td>
<td>2 5 11</td>
<td>Lo</td>
</tr>
</tbody>
</table>
successful choice during the second part of the test. Figure 20 will show that Position V is the back view of the large grey mountain, as it obscures the other two mountains. It is the most recognizable view, and would therefore be likely to boost the scores of the children who were just beginning to grasp the nature of the test (that is, they could be scoring on this one whilst still failing on the others). The second feature worth noting, is that the 3-Mountain Test, as conducted in this study, possessed a limited number of possible answers where the two other tests used, the Drawings and the Co-ordinates, possessed an unlimited number of possible answers. With five attempts from six children (30 from each year) and only eight possibilities the laws of chance would allow a certain number of correct guesses. Guessing was the order of the day for the younger ones, and must explain the 3-Mountain Tests greater success over the Drawings and the Co-ordinates with the younger children in the sample. It should be noted that Laurendeau and Pinard (1970) carried out the 3-Mountain Test in similar circumstances, based on the procedures of Piaget and Inhelder. They worked with an age range (4½ years to 12 years) close to the one used in the present study, and consistent with it they found that the older children performed better than the younger ones, but with even the twelve year olds making approximately 40% errors. The six ten year olds in the present study acquired a total score of 47 out of a maximum of 60 points, which is almost 22% errors; not quite as much as Laurendeau and Pinard's sample, but still far from perfect. Discussing their error data Laurendeau and Pinard suggest that "an attitude of recurrent egocentricism" pervades the thinking of even older children.
Statistical Results

Many of the important implications of the assembled data have been described in the preceding discussion, but some consideration of the results of the computer analysis alone remains. Individual total scores for each test, the Drawing Invitations, the 3-Mountain Test, and the Horizontal/Vertical Co-ordinates Test, together with details of Sex and Age were submitted to computer analysis, in which the Drawing Test functioned as criterion and the remainder as predictors. The correlation co-efficients obtained from this analysis appear in Table 7.

The Co-ordinates Test proved highly significant with a correlation co-efficient with Drawings of 0.95 and was far and above the most successful result of the analysis. As such it was somewhat above that of the 3-Mountain Test and Drawings (0.89). The correlation co-efficient between the two Piagetian Tests was equally high with a figure of 0.93 obtained. The Co-ordinates also correlated better with Age (.84) than did the 3-Mountain Test (0.83), though the differences were slender. The zeros recorded by almost all the younger children (4+ and 5+ years) no doubt goes some way to explain these high correlations. A second computer run of the scores, this time without the 4+ and 5+ children's scores would confirm this opinion. Table 8 shows the correlation co-efficients of the 6+ to 10+ years only. Here, the remarkably high correlation between the Co-ordinates Test and the Drawings Test of 0.95 is reduced to 0.94232, which is still very high. The correlation between the 3-Mountain Test and the Drawings Test shows a greater drop from 0.89 to 0.87386. However, the largest difference occurs between
the two Piagetian tests themselves, where the correlation falls from 0.93 to 0.89963. The explanation of the extraordinary high correlation may lie with the sample of children used. As described earlier in the Subjects and Location section of Chapter V, the school selected was in one of the most desirable neighborhoods of Leicester, England, with a predominance of professional and University children in attendance. The sample of children chosen by the teachers may have been amongst the brightest and conforming of these. Such a population is likely to produce a more consistent profile than a population from a school in a troubled and run-down neighborhood.

The steady improvement in the Drawing Test with increasing age was confirmed with a positive correlation between Drawings and Age of 0.80 which was slightly below that of Co-ordinates and the 3-Mountain Test.

The girls achieved the remarkably high correlation of 0.96 between the Co-ordinates Test and the Drawings, compared with a 0.94 correlation for the boys. The correlations between the 3-Mountain Test and Drawing revealed no differences with a figure of 0.89 for both sexes. However, other differences in performance were revealed between Drawings and Age where a higher correlation was again recorded for the girls, 0.81 compared with 0.78 for the boys.

An important point to emerge from the analysis is the information that the Co-ordinates showed a more positive correlation (0.95) with Drawings than did the 3-Mountain Test (0.89). This finding cannot be explained on the grounds that the Co-ordinates are more dependent of age, for the analysis revealed that the 3-Mountain Test and the
Co-ordinates have almost identical correlations with Age (0.84 and 0.83), nor can the 3-Mountain Test be regarded as a test of specific abilities as it is shown to correlate well with other tests. In the light of what has been said earlier concerning the unevenness of the 3-Mountain Test scores, and some of its administrative problems, the question of reliability comes to the fore. Cross-tabulations in Table IV, giving the distribution of the sample according to high, middle, and low scores in the Drawings, 3-Mountain Test, and the Co-ordinates, show an average of 14 children out of 42 appearing to the left of the diagonal in the 3-Mountain Test, compared with an average of only 9 out of 42 for the Co-ordinates and an average of 5 out of 42 for the Drawings. One can add to this suggestion of unreliability Laurendeau and Pinard's "recurrent egocentricism" and, of course, the small number of children in the sample.

The children's drawings demonstrated a close relationship between themselves and Piagetian Tests of the development of spatial concepts in the child, and as such can be seen as confirmation of the link between artistic development and Piaget's theory of cognitive growth.

Conclusion

The relationship between children's ability to represent space in drawing and the child's concept of space as measured by Piagetian tests was confirmed by this investigation. The computer analysis which established the confirmation of the drawing/Piaget hypothesis showed that it owed more to the Co-ordinates Test, concerned with the
acquisition of horizontal and vertical referential axes, than it did to the 3-Mountain Test, concerned with the co-ordination of perspectives. This was a surprise, for of the two, the 3-Mountain Test seemed immediately more relevant to the demands of representing space by drawing. However, explanations for its performance have been mooted during the discussion of the results, and its high correlation co-efficient with the Drawings confirms its relevance. The Drawing Test developed for this study appears to have discharged itself with credit, and apart from the accomplishments already mentioned, it seems to correspond well with age, at least within the years of the primary school.
CHAPTER VII

CONCLUSIONS AND IMPLICATIONS

The motivation for this study was a desire to re-introduce Piaget to the world of art education so that art educators might more frequently turn to his work for insights into problems of artistic development, learning and teaching. There was no intention to account for all artistic behavior in Piagetian terms (tempting though this might have been), or to replace existing theories with Piagetian ones. Uppermost was the awareness of a formidable body of literature penned by Piaget which had shed light upon so many features of human development that it was inconceivable that art education could not in some way profit from it. A study of art education literature revealed that very few of Piaget's ideas had affected art education, unlike some of the other subjects in the school curriculum. In addition it was recognized that a knowledge of Piaget's Theory above does little to explain its significance. However, the voluminous writings of Piaget re-interpret, re-work, re-apply and re-explain the theory in innumerable contexts, and it is here that the art educator may turn for an alternative view of the problems encountered in artistic learning and development.

This study sought to demonstrate the significance of Piaget's work for art education by choosing an area of common concern, and then by indicating some of the existing relationships. The area chosen for this
study was the development of the concept of space in the child, and the relationships were established by the two means. First, by interpreting existing accounts and explanations of the development of space in children's drawings in the light of Piaget's study of the growth of space concepts in the child. Here, plausible alternative explanations were found for recognized features of child art, which held broader significance as part of Piaget's general theory of intellectual functioning.

Second, by carrying out an investigation with a sample of primary school children which compared their ability to represent space in drawing with their performance on two of Piaget's tests of spatial concepts. The space content of the drawings was assessed by a test devised by the writer. This test reflected the degree to which a child could employ in given contexts the pictorial conventions of space representation within this culture. One of the Piaget tests (Horizontal and Vertical Co-ordinates) was chosen from the Euclidean field, and the other (Co-ordination of Perspectives) from the projective field. These represented the two fields of spatial relationships towards which conceptual development progresses.

High correlations were recorded between the scores on the Drawings and those on the Piagetian tests, which provide descriptive evidence that the two functions are strongly associated.

Piaget's studies of the development of space concepts in the child included an examination of many of the features that might have been used for this investigation, such as: linear and circular order; projective lines and perspective; the projection of shadows; sections
of solid figures; and the rotation and development of surfaces. These are all matters of concern to the art educator, and would appear equally fruitful areas of comparison and inquiry.

Space was chosen as the subject of this study. But, in the pursuit of the child's developing thought processes, Piaget investigated many other topics with comparable thoroughness. Amongst these are perception, physical causality, imitation, dreams, thinking, imagery, memory, language and reality. All of them are relevant and some are central concerns for the art educator, and must represent further topics for comparative investigation.

The results of the investigation can also be seen as a successful attempt to isolate some of the cognitive aspects of artistic development/behavior. In this case, horizontal and vertical referential axes, and the ability to realize the implications of a given viewpoint. Here again, the Piagetian corpus would offer a valuable resource for identifying much of the remainder. This would help to make artistic behavior clearer, even for those interested solely in 'non-cognitive' aspects. There is no doubt that a clearer recognition of the cognitive aspects of artistic behavior, learning and teaching, is needed. No matter how perceptually oriented teachers believe their goals to be they should recognize that they employ cognitive means to achieve their ends, - and likewise their pupils.

In the course of examining art education literature the writer became aware of a decided preference for 'perceptual' theories over 'cognitive' theories in a two choice situation (i.e. Draw what they see or Draw what they know). This preference may well have arisen from the
assumption that cognitive skills are synonymous with verbal and scientific skills, and therefore that art was 'non-cognitive'. Art educators might be reminded that in Piaget's theory cognition is the total process of adaptation of the organism to its environment, and as such would not be restricted to the verbal and scientific. The model of developing cognitive abilities evolving from Piaget's explorations of children's thinking includes two parallel structures of knowledge. Defining the two Piaget says ...

"... these structures may be figurative, for example, perceptions and mental images, or operative, for example, the structures of actions or operations ... (the image) serves on the par with language as symbolic instrument to signify the content of cognitive significations; for spatial concepts the image is particularly evident" (Piaget, 1973 pp. 356-357)

Some of the frailties of the perceptual, largely Arnheim's, view were pointed out in the review of literature. This study does not seek to perpetuate the perceptual/conceptual dichotomy, but it may serve a clearer understanding of the interdependent roles of perception and cognition in artistic behavior.
BIBLIOGRAPHY


Britsch, A. Theory of Pictorial Art, Munich: Bruckman, 1926.

Burt, C. Mental and Scholastic Tests, London: King and Sons, 1921.


Gesell, A.L. The Mental Growth of the Pre-school Child: a psychological outline of normal development from birth to the sixth year, including a system of developmental diagnosis, New York: Macmillan, 1925.

Golomb, C. "Children's Representation of the Human Figure: The Effects of Models, Media and Instructions" Genetic Psychol. Monogr. 87, (1973), pp. 197-251.


Kohlberg, L. "Stage and Sequence: the cognitive developmental approach to socialization", *Handbook of Socialization*, Edited by Goslin, D., Chicago 1968.


