THE CO-ORDINATION OF PERSPECTIVES -

A DEVELOPMENTAL STUDY.

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C O N T E N T S

S U M M A R Y

Research into the co-ordination of perspectives had its beginnings with the 'three mountains experiment' of Piaget and Inhelder (1956). The present study examined the original findings and showed two developmental factors to be implicit in the conclusions made. These were egocentrism/sociocentrism, i.e. the ability of a child to free himself from his own perception of the display, and centration/decentration, i.e. the ability of the child to free himself from the tendency to centrate on one object within the display.

The major replication (Laurendeau and Pinard, 1970) was shown to give strong support for Piaget and Inhelder (1956).

The research literature was organised into four headings grouped according to the dominant methodology. These were:-

(a) characteristics of the display

(b) the introductory sequence used

(c) the response procedure

and (d) correlational methods.

In this way it proved possible to reconcile the variety of apparently conflicting and contradictory findings of the literature.

The experimental investigations were made in the two primary areas found in Piaget and Inhelder (1956). Experiments 1 to 4 assessed the development of sociocentrism. Children of ages 4 to 6 years were shown to be able to predict accurately the view of an observer when a verbal response was required. Addition of a picture selection task, however, led to egocentric responding. In Experiments 5 and 6 co-ordination of perspectives was investigated. Three major procedural variables - verbal description, model building and picture selection - were compared for 5½, 8 and 10½

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year olds using the same display. The effect of the presence of the egocentric photograph was assessed by making it available for selection for only half of the picture selection trials.

A model for the co-ordination of perspectives was developed which linked children's performance to a perceptual/representational distinction. The model incorporated the concept of 'failure to inhibit one's own view' (Higl and Fishbein, 1974) within the representational solution path.

A C K N O W L E D G E M E N T S

The completion of this study would not have been possible without the co-operation of the head teachers and staff of The Montessori Nursery, Burpham, Boxgrove County Primary School, Guildford, Park Mead County First School, Cranleigh and Park Mead County Middle School, Cranleigh. The kindness and interest shown by all are acknowledged with thanks. Particular gratitude, however, is due to the children who so enthusiastically agreed to participate.

I wish to record my thanks to Dr. Harry McGurk, Department of Psychology, University of Surrey, who supervised this study. His understanding criticism and helpful advice were a spur throughout.

Finally, I owe the greatest debt to my wife and children who have suffered an absent husband and father with remarkable understanding and tolerance.

INTRODUCTION

1.1 Initial distinctions.

Jean Piaget (Piaget and Inhelder, 1956) produced the first comprehensive theory of the development of spatial understanding in young children. The study of the development of the concept of space is, for Piaget, much more than an investigation of the growth of a child's perception of his immediate environment. Piaget is concerned with the total development of spatial thought at both a representational and perceptual level and how this reflects his general theory of the ontogenesis of perception and intelligence. Fundamental to Piaget's view of cognitive development is the clear distinction that he makes between perception and intelligence and hence between aspects of perceptual spatial development and the growth of a child's conception of space (c.f. Piaget, 1950; 1969). In his theory he proposes differences between the operative and figurative aspects of understanding or knowledge. Operative aspects relate to 'internalised actions' that are performed on an object and it's representation to facilitate the object's reproduction and are dependent upon the intellectual processes. The figurative aspects are concerned with the immediate mental image and therefore link with the perceptual features of an object. The intellectual and perceptual processes are not, however, to be seen as isolated from each other but rather as being in a continuing state of action and reaction at all levels of development. At the same time, though, Piagetian theory views perception and intelligence as two separate

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mechanisms by which the child comes to understand reality. A distinction is, therefore, made between the development of perceptual space and the child's acquisition of the ability to represent space. The former, being part of a child's growing awareness of the world about him has it's major period of growth with the development of the object concept during the sensori-motor period of the child's earliest years (Piaget 1952, 1954). Representational space develops later, from the age of about two years, during the preoperational and concrete operational stages. Piaget constantly stresses that the seemingly effortless understanding and appreciation by adults of the metrical and dimensional aspects of euclidian space are not innate structures present at birth. They are the result of a long and extensive learning period which occupies the first ten or twelve years of life. Concepts like horizontal and vertical, distance and angle are not 'basic intuitions', but are the end product that has been developed throughout childhood on successively more refined structures which have their origin with the basic reflexes present at birth.

Piaget's studies of space (Piaget and Inhelder, 1956; Piaget, Inhelder and Szeminska, 1960) are an analysis of the child's development of representational space and are, therefore, concerned with the growth of intellectual structures as they relate to the child's internal construction of the external reality of space. Three themes derived from the cognitive theory of Piaget and previous Genevan experimental work are reflected by studies in the spatial area, particularly as the development of representational space follows a similar sequence to that of perceptual space (Piaget, 1954). Firstly, that the foundations of representational spatial development show a primacy for topological properties over

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euclidian and projective relationships. Secondly, that the course of the development of representational space parallels the stages of Piaget's cognitive theory, marked during the preoperational stage by a form of cognitive egocentrism that should be displaced at an age of seven or eight years by a gradual growth of understanding of concrete relations between self and the external world. Thirdly, the development of the concept of space is an on-going active process resulting from the actions made upon objects in the environment. The overall process is a lengthy, developmental interaction between the child and the external world leading from an immature, egocentric view of space to the automatic interpretation of the adult.

Piaget and Inhelder (1956) began their investigation of representational spatial development by discussing the differential growth of topological, projective and euclidian concepts in young children. Using the recognition of shapes by haptic perception, copying drawings, knots and continuity the developmental primacy of topological aspects was found. Whilst many have argued that the development progression is not as clear as Piaget and Inhelder (1956) concluded, (e.g. Lovell, 1959; Fisher, 1966; Laurendeau and Pinard, 1970) there is no doubt that young children find topological concepts at least as easy to grasp, and possibly easier, than aspects of the euclidian 'real world'. [redacted]. Following the discussion of topological space Piaget and Inhelder (1956) investigated projective spatial relations. The significant properties of projective space are ratio and proportion because attributes like straightness and number of sides are invariant under a projective transformation whereas size of angle, length or degree of curvature are not. Thus this geometry is concerned with

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relative rather than absolute values. Part of the investigation of projective space was concerned with the ability of children to co-ordinate the relational dimensions of a model of three mountains - the co-ordination of perspectives task.

1.2 The Three Mountains Experiment.

The three mountains experiment was the task used by Piaget and Inhelder (1956) to study the growth of co-ordination of perspectives in children. It was an investigation of the discovery by the child of the relevance that the projective relations of near-far and left-right of his own perspective had to the views of others, his growing realisation that others had a different view from his own and, finally, his ability to predict another's view by co-ordinating the relations relative to his own and the others perspective. Piaget and Inhelder (1956) stated their objective thus:-

> 'to study the construction of a global system linking together a number of perspectives and to examine the relationship which the child establishes between his own point of view and those of the observer.' (pg. 260)

One hundred children between 4 and 12 years participated in the experiment. They observed a display which consisted of three model mountains; the largest, coloured grey, had a peak painted white to represent snow, a medium sized mountain, coloured brown, with a little red cross on the top and a small, green model with a house at the summit (see fig. 1). A 'little rivulet', visible only from position B, was represented on the slope of the brown mountain and down the side of the green model was a 'zig-zag path' seen only from the rear position (c). No exact specification

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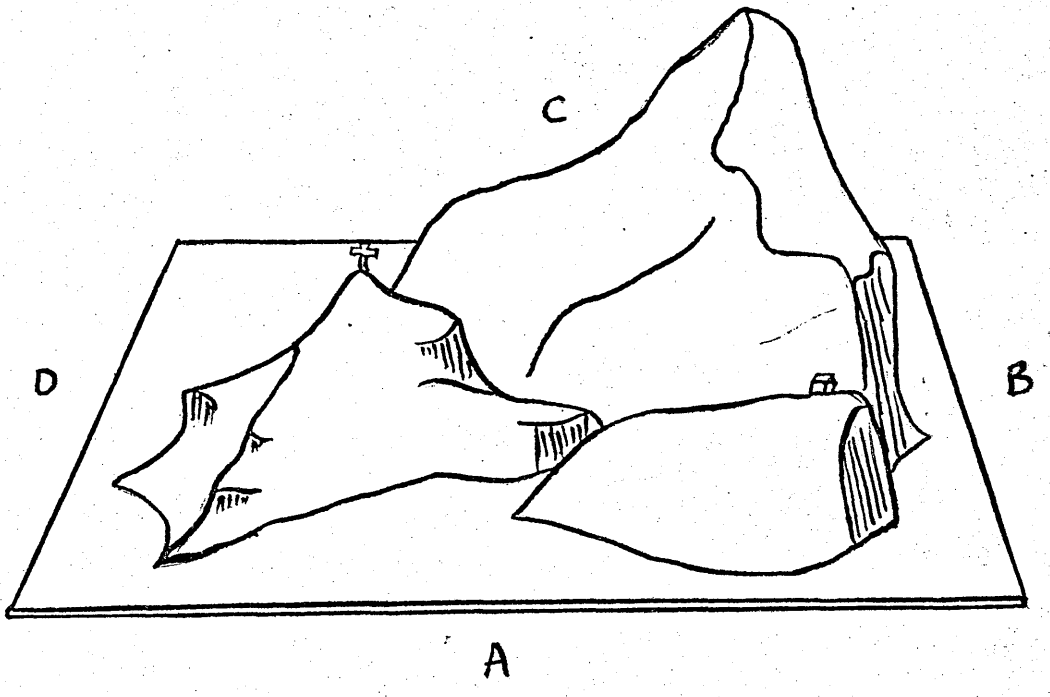
fig. 1

Figure shows sketch of the three mountains model used by Piaget and Inhelder (1956).



of the size of the mountains was given although a general idea may be obtained from the statement that the models were 'from twelve to thirty centimetres high' and were 'on a base one metre square'.

The experimental procedure consisted of three separate phases. Firstly, the children were given 'three pieces of cardboard shaped and coloured the same as each mountain' in order to construct a representation of the view which a little doll (2 or 3 cm. high) and the child could both see from position A. After the pieces had been arranged the doll was then moved to C and the child was asked to make the picture which the doll could see from the new position. A similar construction was made by the child when the doll occupied positions B and D. The second part of the experiment again began with the doll placed immediately in front of the child at A. This time the child had to choose from ten pictures the view that they both could see. The pictures (20 x 28 cm.) were painted to represent views of the mountain from various points round the model. Piaget and Inhelder (1956) do not state explicitly which orientations the ten pictures represent although during discussion of protocols the views from A, B, C and D were mentioned. A further picture is described as 'somewhat to the left of A but very similar in appearance' and another as 'grey left, brown right, green not visible'. Following the choice of the view from A the doll was moved to different points round the model mountains. For each position the child had to find which of the ten pictures was equivalent to the view that the doll could see. Always included in the pictures were the view that the child could see from A and 'impossible' views that corresponded

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to the mirror image of the doll's view. The final phase of the study was the converse of the second; given a single picture the child had to decide which position the doll would have to occupy to have that view of the display.

Piaget and Inhelder (1956) analysed their results and found three developmental stages with the second and third stages having two sub divisions. In the first stage (Stage I) children failed to comprehend the task set and did not make a recognisible response. This may be due to the relative complexity of the language used in the instructions, the size of the cognitive load of the task or, perhaps, the general immaturity of attentional or concentration factors.

Stage IIA was described by Piaget and Inhelder (1956) as the stage when 'a child is confined to reproducing his own point of view' or 'a random choice indicating that, so far as the child is concerned, all of the pictures are suitable for all points of view so long as they show all three mountains' (pg. 215). However, during detailed discussion of this stage Piaget and Inhelder (1956) referred only to examples of the former type, children reproduced their own view or selected the picture which corresponded to their view of the display regardless of the position of the doll.

The child at Stage IIB was reported to be progressing from sole reproduction of his own point of view and making some attempt to discover the perspective of another. In the picture choosing phase, for example, the child selected the picture which contained the most dominant feature relative to the doll's position. Since, however, the most striking aspect was usually the grey mountain, the

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picture most frequently chosen had this mountain in the foreground. Some children at this stage could verbalise that others had a different view as they denied that the same snapshot could be taken from anywhere round the board. Hence, although children at this stage had come to understand that others did not have the same view as themselves they did not have sufficient spatial skill to predict the other person's view of the model.

Stage IIIA was marked by the growth of the ability to predict what the other person saw. Children of eight or nine years of age, for example, frequently were able to succeed with one of the dimensions involved but failed with the other. Usually the successful reversal occurred with the near-far dimension and failure with left-right although the converse was occasionally recorded.

The final developmental Stage IIIB showed that children of nine or ten years could correctly identify the view of another. Some differences were found in terms of the ages of accession to this stage under the three experimental phases. Children were able to reproduce the correct picture using the cut-out shapes rather earlier than either the picture selection or the doll placing procedures. Although Piaget and Inhelder (1956) did not attempt to explain this decalage, it would seem to be readily understandable in terms of the differences in procedure. Manipulating the cut-outs may be slightly more interesting as a task and, therefore, differences could be due to a motivational or concentration factor. The child's view photograph was not on display when reproducing another's view with the shapes so that he was less likely to respond by selecting the immediate perceptual image. The picture making phase, too,

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does not involve the interpretation and organisation of the two dimensional photograph cues in three dimensions. Thus the information load may be rather higher for the tasks that make use of photographs.

In summary, the development of the co-ordination of perspectives using the three mountains model showed a progression of developmental stages consistent with the cognitive model of Piaget. Children aged 4 to 7 or 8 years occupied Stage IIA and chose, or reproduced, their own view of the display. This cognitive egocentrism was the type of response that Piagetian theory would predict for children within the preoperational stage. An inability to use his intelligence to reflect upon his actions and to assess critically how his own view and what he sees relates to another's perspective is typical of the thinking of a child within this stage. Parallel findings have been reported by Piaget for thought and language (Piaget, 1926), judgement and reasoning (Piaget, 1928), causality (Piaget, 1930), and moral judgement (Piaget, 1932). As a result of the extension of cognitive egocentrism across much of his work Piaget has accorded it a central place in his theory of development (Piaget, 1950). At the age of about 8 years children became aware that their own view and the view of another person differed. A gradual building of the elements of the other's perspective began with the correct reproduction of one of the two dimensions involved, usually near-far, and continued with an increased accuracy of response. It was not until the end of the concrete operations period, however, before the child finally achieved the full co-ordination of perspectives. The developmental sequence of stages was significant for the Piagetian theory because the progression from egocentrism

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Table 1.

Table shows a summary of the stages found by Piaget and Inhelder (1956) for the three mountains experiment with the age range and the main characteristics of each stage.

Stage	Age range	Main characteristics
I	5 years -	failure to comprehend instructions
IIA	5-7 yrs.	complete egocentrism
IIB	7 years	centering on dominant feature
IIIA	8-9 yrs.	sociocentric response but failure with one dimension
IIIB	9-10 yrs.+	full co-ordination of perspectives

through a transitional stage of sociocentrism with partially correct responding, to full co-ordination mirrored the preoperational-- concrete operational processes of the general theory (Piaget, 1950). See Table 1 for a summary of stages.

The findings from the above study are open to the general criticisms that may be made of Piaget's experimental methodology. For example, although there was more detailed description of his subject sample and the apparatus used than is evident in some of his earlier research, it still falls short of the detail which would be expected today. The primary area of criticism, however, is associated with the technique that Piaget used in this study, as well as for much of his other research, the 'methode clinique'. The objective data are amplified during the progress of the experiment by free questioning and probing by the experimenter. In order to follow the child's chain of thought the experimenter pursues a series of questions that are raised by the child's answer to the previous question and which differs from child to child. The validity of this method is subject to much debate (eg. Flavell, 1963). Lack of standardised questions may result in the child being led, albeit unconsciously, by the experimenter to respond in the manner predicted. More verbal children may receive more feedback than less verbal children and therefore present a different picture in terms of level of functioning. The lack of standardised procedure and data collection means that individuals or groups cannot be compared using statistical techniques. Nor may the experiment be readily replicated to investigate the reliability of results. On the positive side it should be stated that Piaget was well aware of the dangers and limitations of his method (Piaget, 1929).

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However, he justified the method on the grounds that only by allowing the child to respond freely was it possible to obtain a wide variety of responses, thus providing greater insight into underlying cognitive processes.

1.3 The Experiment of Laurendeau and Pinard

To answer the criticisms of the procedure and lack of experimental rigour of the original study a subsequent replication was conducted by Laurendeau and Pinard in Canada (Laurendeau and Pinard, 1970). It is the study which has most clearly attempted to mirror the aims of the original experiment and it's theoretical background; as such it has a parallel position with the original.

448 children took part in the study with approximately 50 children at each yearly interval between 4 and 12 years. Care was taken to equate for sex, education and socio-economic status at each age level. Each child observed the display which consisted of three regular, symmetrical cones, a large red one 20cm. in diameter at the base and 11.5cm. high, a blue cone of 14cm. diameter and height 7.5cm., and a small yellow cone of 9cm. diameter and 5cm. high. They were arranged on a baseboard consisting of four pieces of card 26cm. square taped together so that the cross lines so formed could be used as points of reference if required. (A sketch of the display is shown in fig. 2).

The procedure began with the familiarisation of the child to the display during which the experimenter walked a small doll, 3cm. high, round the board saying that the doll was taking pictures with his camera. The doll was then placed in front of the child who sat observing the display at A, (see fig. 2). Two photographs

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fig. 2

Figure shows a sketch of the apparatus used by Laurendeau and Pinard (1970).

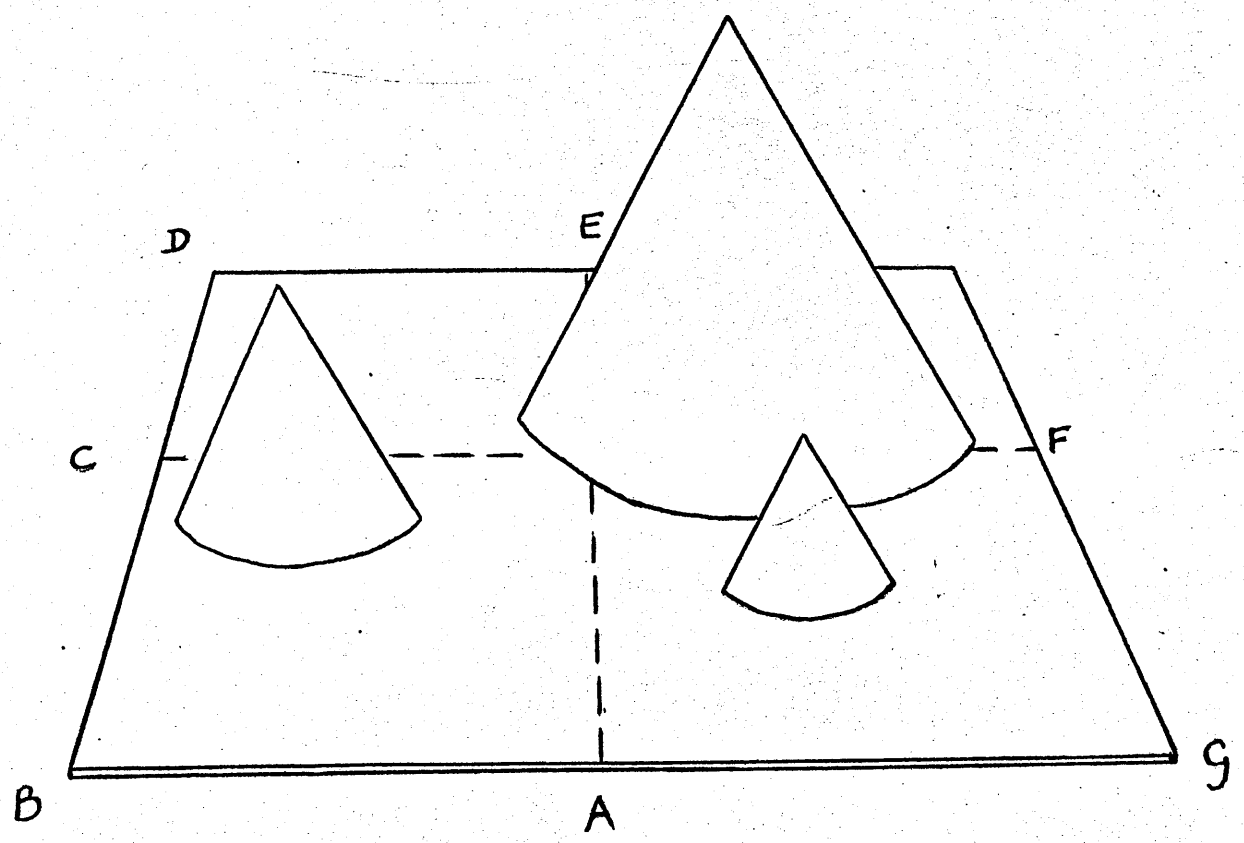
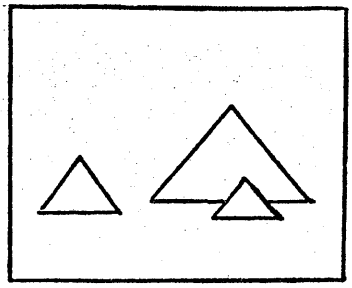
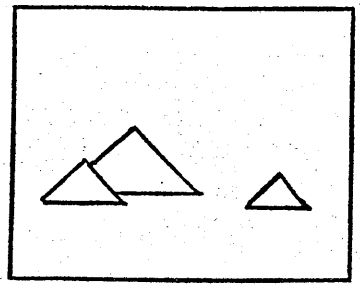


fig. 3

Figure shows pictures used by Laurendeau and Pinard (1970)



A



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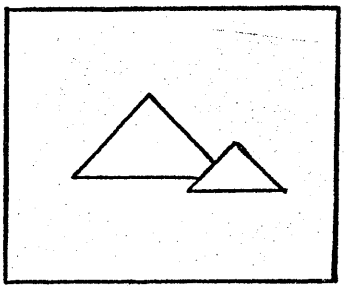

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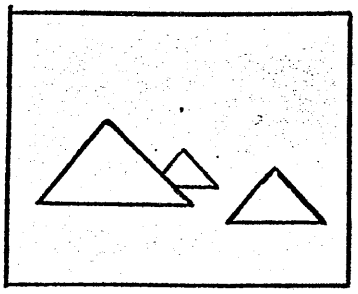

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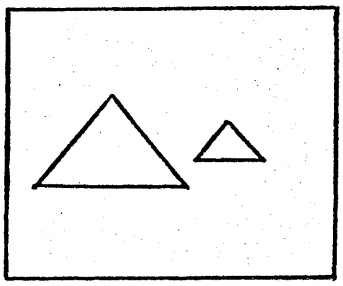

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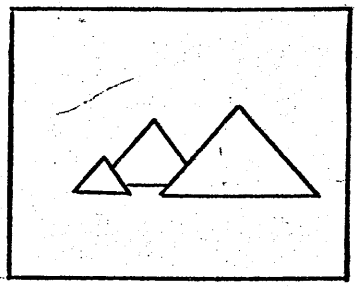

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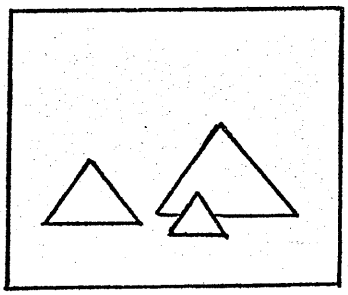

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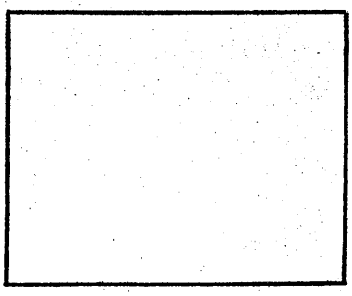

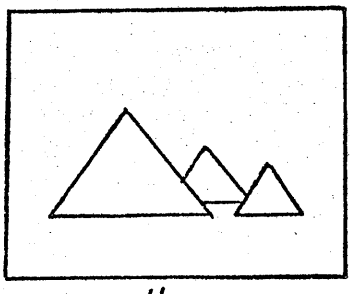

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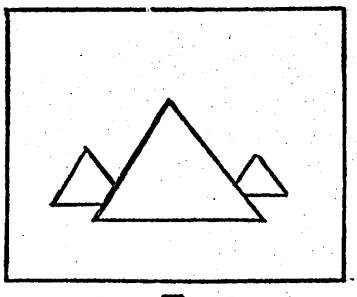

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(14 x 18cm.), the views from A and D, were placed in front of the child and the doll, and the child was asked which of the pictures the little doll saw. Regardless of the child's response, the experimenter verbalised the various relationships in the display and explained how they matched photograph A but not photograph D. Phrases like 'in the back' or 'to the left' were used whilst showing the child that the little man 'sees the same thing that you do'. Following this, the doll was placed at F and the child was required to choose the photograph that corresponded to the doll's view from a selection of five photographs taken from the positions G, A, D and F together with the mirror image photograph of the view from F. (The letters A to G refer to figs. 2 and 3). Next the doll was placed at C and the child had to choose from the photograph from E, C, F, A and B. For the final trial of the photograph recognition stage the child moved from the position that he had occupied for the first two experimental trials (i.e. A) to a new point, E (where the experimenter sat throughout). The doll was placed at C and the photograph choice consisted of four photographs of real views from B, E, D and A together with an impossible view (I) which did, however, approximate to the mirror image of the view from the corner between E and F. The second phase of the experiment was the reverse of the photograph recognition phase and consisted of the presentation to the child (who had returned to A) in succession of the photographs from C, F, B, E and the impossible view. The child had to place the doll 'where he was when he took the picture'. Throughout both experimental phases the child was encouraged to verbalise the reasoning behind his having chosen a particular

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Table 2

Percentages of each type of response, correct (C), transitional (T), egocentric (E) or other (O), of the photograph selection stage of the Laurendeau and Pinard (1970) co-ordination of perspectives task.

Position F

	Response			
Age	C	T	E	O
12	70	2	28	
11	52	2	44	2
10	48	4	48	
9	38	10	50	2
8	24	8	56	12
7	20	16	56	8
6	6	6	52	36
5	8	6	34	52
4	2	6	26	66

Position C

	Response			
Age	C	T	E	O
12	50	22	26	2
11	48	18	32	2
10	22	26	50	2
9	30	26	42	2
8	8	6	68	18
7	10	20	62	8
6	4	12	38	46
5	8	11	23	58
4	6	8	20	66

Position B

	Response			
Age	C	T	E	O
12	64	12	24	
11	52	14	32	2
10	38	18	36	8
9	36	18	34	12
8	20	16	46	18
7	20	14	40	26
6	10	20	28	42
5	11	15	6	68
4	8	10	8	74

photograph or position.

Laurendeau and Pinard (1970) illustrated their results in two ways. Firstly, the initial choice of the children (i.e. prior to questioning) was recorded in terms of the type of response made. Laurendeau and Pinard (1970) identified a three stage process parallel to the original Piaget findings. The children either chose the photograph which corresponded to their own view, an egocentric response (E), or selected the photograph which corresponded to the position of the doll, the correct or decentered response (C), or they made a transitional response (T). A transitional response was defined as a response made by the child that showed he was aware that the doll had a different perspective but found difficulty in accurately establishing what the view was. For example, a child may have correctly interpreted near-far relations but failed with left-right. Some children either refused to make a choice, pointed to several pictures or chose the picture which had no relationship with the appropriate view, e.g. the impossible perspective in the third trial. These responses were classified as "Others" (O). The percentage of each type of response made at each level is tabulated for each of the three positions of the doll in Table 2.

The group results showed that for the first phase of the experiment, i.e. the photograph recognition task, positioning the doll at F and B led to significantly higher performance than if the doll was placed at C. (see fig. 2). The distribution of egocentric responses, however, showed similar results for all three positions. Thus it was the continuance of transitional responses for position C that caused the relatively lower number

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of correct responses. A high number of subjects throughout the age range judged the two pictures from C and E to be equivalent since both showed the primary aspect of the view from C, the disappearance of the yellow mountain (see fig. 3). This similarity was expressed even though the near-far relationship relative to position C is clearly observed in picture C but not for picture E. It is evidence of a continuing dominance in some children by the primary perceptual dimension of the new perspective. Paradoxically Laurendeau and Pinard (1970) found that many children denied that picture C was correct because there was an overlap (pg. 331). Picture E was preferred because 'the little man is supposed to see the whole red mountain where he is standing'. Children generally found problems in the second phase of the experiment, i.e. the doll placing task, easier than the photograph recognition phase. The exception to this relates to the use of the impossible photograph that represented a non existent view of the cones which was found to be harder than any other. There seems little doubt that this is the result of an expectancy that all of the problems presented were capable of solution. The impossible photograph was used at the end of a sequence of four real views of the display and no doubt caused confusion as no position of the doll relative to the cones was appropriate. The difference between the photograph selection task and the doll placement phase was explained by Laurendeau and Pinard (1970) in two ways. Firstly, no attempt was made to counterbalance for order of presentation of the two phases, hence a learning or familiarisation factor would lead to a higher level of correct performance in the last presented. Secondly, some items in the

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Table 3

Table shows the distribution of subjects for stage level and age for the co-ordination of perspectives task of Laurendeau and Pinard (1970).

		Stage						
Age	N	Unclassified	0	1A	1B	2A	2B	3
12	50		1	1	3	19	12	14
11	50		1	-	10	16	12	11
10	50		-	1	15	15	13	6
9	50	1	2	1	12	20	7	7
8	50	2	3	5	17	18	4	1
7	50	2	8	6	18	12	3	1
6	50	1	26	7	10	5	1	-
5	48	5	34	4	4	2	1	-
4	50	2	45	2	-	1	-	-

latter task may be solved by centering on one aspect of the perspective and eliminating possible alternatives. During this part of the experiment, for example, the placing of the doll given picture F may be solved by observing that the blue mountain should be behind the red and yellow mountains. There is no necessity to co-ordinate this near-far dimension with left-right. When, however, the child has to choose the picture from F in the first stage of the experiment there are two pictures which have the relationship given above, the correct picture from F and it's mirror image (H) (see fig. 3). Thus whilst children who used this non-coordinated strategy would be successful only 50% of the time for the first phase of the study, they would present perfect performance for the second part.

An investigation was also made of individual protocols and, by examining errors and performance style, each child was allocated to a developmental stage in a similar manner to the original study (Table 3). Stage 0 referred to children who were unable to understand the instructions given, 28% of the group were placed at this level. The following stage (1A) was characterised by the child's invariable choice of the picture which corresponded to their own perspective, i.e. the egocentric stage. Stage 1B was specifically related to the design of the Laurendeau and Pinard (1970) experiment and their use of the movement of the child to a new position for the third trial of the photograph selection task. Some subjects exhibited a 'pseudo decentration' in that they chose the photograph of their first view of the display. Since this photograph (i.e. A) was adjacent to the correct view (B) then at first sight this seemed

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an attempted decentration by the child. Subsequent questioning enabled Laurendeau and Pinard (1970) to exclude children, who had remembered the first egocentric view, from placement at a higher developmental stage. The transition stages, 2A and 2B, illustrated the child who had achieved true sociocentrism yet who still had difficulty in simultaneously co-ordinating the dimensions of near-far and left-right. Placement at this level was secured if a child presented some attempt to choose a picture other than that corresponding to his own view. (This was a real choice and not a random selection as might be expected from a child at Stage 0). The protocols were marked by continuing egocentric responding, however, accompanied by some transitional or even correct responses. Children who made at least two correctly decentered choices were placed at Stage 2B and those who made fewer than two were allocated to the earlier stage 2A. Finally, the group of children who successfully co-ordinated perspectives relative to the three cones for all three trials were placed at stage 3. Only 9% of the total sample of 448 children achieved this stage. This finding, together with the placement of 28% of the children at Stage 0, illustrates the difficulty of the task for Canadian children. A summary of the stages found by Laurendeau and Pinard (1970) is given in Table 4.

The replication study of Laurendeau and Pinard (1970) adds a fullness of detail about subjects, procedure and design that was lacking in the original research of Piaget and Inhelder (1956). The use of statistical analyses gives objective evidence for the comparisons made validating conclusions reached by the

cont/....

Table 4

Summary of the stages found by Laurendeau and Pinard (1970) for the co-ordination of perspectives experiment with the ages of accession and main characteristics of each stage.

Stage	Age of Accession	Main characteristics
0	4 yrs.	Complete incomprehension
1A	6 yrs.	Cognitive egocentrism
1B	7 yrs.	Pseudo decentration
2A	8½ yrs.	Transitional stage - sociocentrism but failure to break fully from egocentric functioning.
2B	10 yrs.	
3	11 yrs.	Full co-ordination of perspectives.

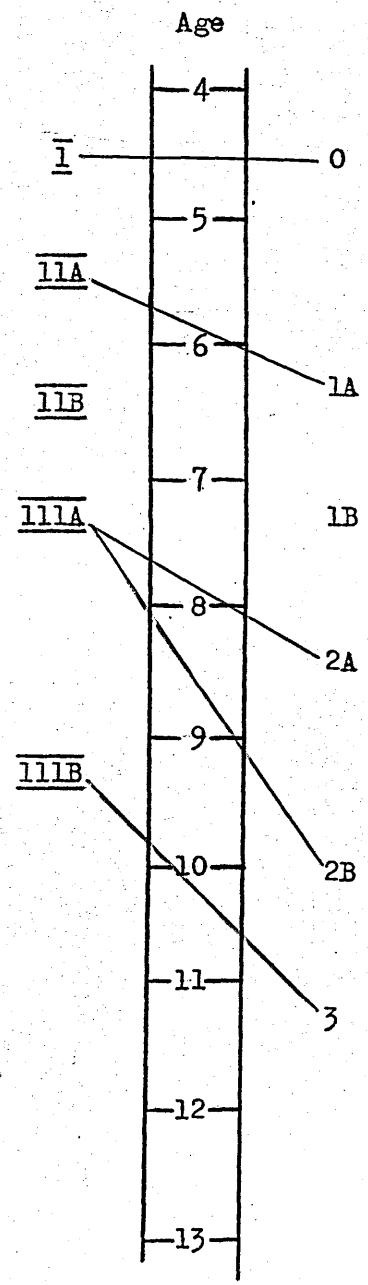
rigour required by contemporary experimental practice. Generally the Laurendeau and Pinard (1970) study represents a systematic confirmation of many of the Piaget and Inhelder (1956) findings. A group of children were isolated who made only egocentric responses. A transition stage was discovered which represented a growth from the egocentric responding of young children. Finally some children reached the stage of full co-ordination of perspectives. However, unlike the original, the children of Laurendeau and Pinard (1970) made approximately equal numbers of egocentric, partially decentrated and fully co-ordinated responses during the transition stage. This was unlike the results of Piaget and Inhelder (1956) when children did not appear to make any egocentric responses during the partially decentered stage (IIIA) (see pg. 8). A further criticism relates to the difficulty that Canadian children found with the task; only 9% of the 450 children aged between 4 and 12 years achieved full co-ordination of perspectives whilst nearly a third of them (28%) 'failed to understand the instructions'. The effect of this is shown most clearly when the ages of accession to equivalent stages are compared for the original and the replication. The comparison (fig. 4) shows an age difference between the two studies that increases as the children develop through the stages. It is most marked for the final stage where the failure of so many of the children to reach this stage may indicate that the co-ordination of perspectives is dependent upon formal operational processes. Other findings of the Laurendeau and Pinard (1970) study have also important implications for the original particularly as Piaget and Inhelder (1956) regard their own findings as reflecting the general theory.

cont/....

fig. 4

Figure shows a comparison of the Piaget and Inhelder (1956) and Laurendeau and Pinard (1970) stages of development for the co-ordination of perspectives.

Piaget and Inhelder (1956) Laurendeau and Pinard (1970)



The red line links equivalent stages.

Laurendeau and Pinard (1970) found that children across the complete age range between 4 and 12 years continue to choose the photograph that corresponds to their own view when asked to find the view of another, then Piaget's conclusion, that the choice of the egocentric photograph is due to the preoperational child's fixation on the perceptual aspects of the model, must be under some question. However, it must be acknowledged that, despite the criticisms made, for Piagetian theory it is the sequence of stages that is important and not the age of accession to the stages. Hence, in these terms Laurendeau and Pinard (1970) may be seen as giving support to the original study.

1.4 Analysis of necessary skills

The two experiments discussed above illustrate in detail the responses made by children when they undertook co-ordination of perspectives procedures and had to discover the view of another person. In order to understand more fully the rationale of the task it is necessary to turn to the specific sub-skills involved that are essential for accurate performance. By analysing the within task problems that children have to meet to be able to understand, to tackle and to solve the three mountains experiment a glimpse may be gained of the underlying mechanisms that are responsible for a child's success or failure.

One sub-skill that is essential for a child to be able to co-ordinate perspectives relates to his ability to interpret the language used when the object of the task is being explained. It is a necessary pre-requisite of the experimental procedure that the child understands and comprehends the instructions given, i.e. 'I

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want you to find the picture the little man sees from here'. The child must be aware that, when the doll is placed between himself and the display, then, as he and the doll are in a similar position relative to the display, the doll has the same view. This is the perceptual aspect of the task and consists of relating the three dimensional image of the display to the two dimensional photograph. When the doll is moved to a new position the child has to understand that now when the experimenter refers to the photograph of what the doll can see, the experimenter no longer means the first (egocentric) photograph chosen by the child but the photograph from the doll's new position. The child has to be able to disassociate himself from the social reinforcing factors surrounding the egocentric photograph and make a position related response.

Throughout the procedure the child is assumed to be able to interpret the depth and relational cues of a photograph and be able to attach the appropriate verbal labels, i.e.

> 'so he sees the same thing as you do: he sees the red mountain in the back, and the blue one to the left here, and then the yellow one to the right here. So you see, he sees this picture. On this picture, the red one is in the back, then the blue one is to the left, and the yellow one is to the right, in front of the red one. On the other (incorrect) picture, the red one is in front of the yellow one and the blue one is on the wrong side. To see it like this, he would have to go somewhere else, do you understand?'.

cont/....

(The familiarisation sequence in which the child has to select the view he sees from two photographs, Laurendeau and Pinard, 1970, pg. 455).

When the experimenter refers to 'the back of the picture' he assumes that the child interprets this as the far part of the 3-D image of the picture and not the reverse side of the card. Similarly, when the red cone being 'in front of' the yellow cone is mentioned, the child has to understand this to mean the partial obscural of the one by the other in the photograph.

When the child is aware of the meaning of the language associated with the instructions and the familiarisation sequence the child has to grasp the relevence of the language for the task. He has to understand, firstly, that others can have a different view so that, secondly, he may attempt to build an image of how the display appears to the observer. These two mechanisms are subsumed by the egocentrism to decentration model of Piaget (pg. 9). The development from egocentrism to sociocentrism and the progression from centration to decentration are two interacting constructs being difficult individually to define. For the co-ordination of perspectives task egocentrism will be taken to mean the tendency to assume that all observers, regardless of how they are positioned relative to the display, have the same visual image of the display. Hence when required to choose the picture which corresponds to another's view, a child will choose the photograph that is the same as his own perspective. Gradual building of experience in interpersonal situations, when the egocentric assumption is shown to be false, leads eventually to the child becoming aware that each person has a unique and personal view of

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the world - the sociocentric response. The development of the sociocentric response does not necessarily imply that the child is aware of the mental image of the observer, or what he can see, the child knows only that the other's view is different from the one that he can see. Progression from egocentrism to socio-centrism is therefore a necessary but not a sufficient condition for a child to be able to discover the view of another and how the relations of a display look from elsewhere. It is, in part at least, a social skill. The dimension of centration-decentration refers to the child's development from immature centrations on one aspect of the figure. Perceptually the child learns to decentrate from single fixations on one aspect of the model during the sensori-motor period. Full decentration as part of representational space can, however, develop only subsequent to, or at most parallel with, sociocentric thought. To discover <u>how</u> the display looks to the observer (which is the task of the decentration process for the co-ordination of perspectives) relates more closely to the child's spatial ability rather than the interpersonal awareness of socio-centric thought. Although the two mechanisms of egocentrism - sociocentrism and centration - decentration may be compared respectively to social and spatial development this should not be seen as an assumption that they are necessarily orthogonal, the evidence so far presented does not allow for such a conclusion to be reached.

At a more specific level the child, following the instructions and familiarisation procedure, has to build a perceptual representation of his own view of the display. This may be accomplished iconically by using the cues available and

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storing the image in a purely pictorial form. Alternatively the child may use a verbal strategy tieing various available spatial cues to words and phrases like 'in front of' or 'to the right of'. The particular strategy used would depend upon the skills and abilities of an individual child and, indeed, could be a combination of verbal and pictorial methods. The result of the process is the child forming a mental image of the display. If the child has progressed beyond the sociocentric level then to co-ordinate the perspectives of the display he has to manipulate the image of the display as it appears to him and transpose the dimensions involved. By so doing he constructs an image of how the cues would relate to somebody sitting elsewhere viewing the display. The new view of the display may be obtained either (a) by the child mentally rotating himself relative to the display or (b) by rotating the display relative to himself. He may also solve the problem by verbal rules, i.e. 'if the blue cone is nearest to the doll then in the photograph should appear in the foreground'. Finally, the child has to compare successive attempts with each picture in turn, rejecting those that do not match and accepting only the picture which corresponds to the cues as they appear to the observer.

To summarise, the co-ordination of perspectives tasks of Piaget and Inhelder (1956) and Laurendeau and Pinard (1970) require the following sequence before the child may correctly choose the photograph which corresponds to the view of the observer:

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(i) to understand the instructions given

(ii) to appreciate that the other's view is different

(iii) to build an image of the display

(iv) to build the image of the view from the new position

and (v) to interpret the view from the new position and compare successively with two dimensional photographs.

A co-ordination of perspectives model that follows from this analysis is shown in fig. 5.

1.5 Summary

As has been discussed previously the model proposed by Piaget and Inhelder (1956) to account for their findings for the three mountains experiment is based upon an egocentrism to decentration process. Implicit, however, within the model are the interacting factors of egocentrism-sociocentrism and centration-decentration. The model is closely linked in developmental terms to the general cognitive theory of Piaget. The stages found by Piaget and Inhelder (1956) parallel a general developmental progression from the egocentric thought of the young preschool child to the child within the preadolescent stage who is able to make judgements that are based upon the concrete reality of the world external to the child. The more detailed model of the co-ordination of perspectives (pg. 28) could incorporate the developmental stage theory of Piaget and Inhelder (1956) but is linked to a descriptive process rather than tied to a general theory. With this summary and discussion of the original Genevan study, and of the replication by Laurendeau and Pinard (1970) as background, the following sections will review the literature which has been generated

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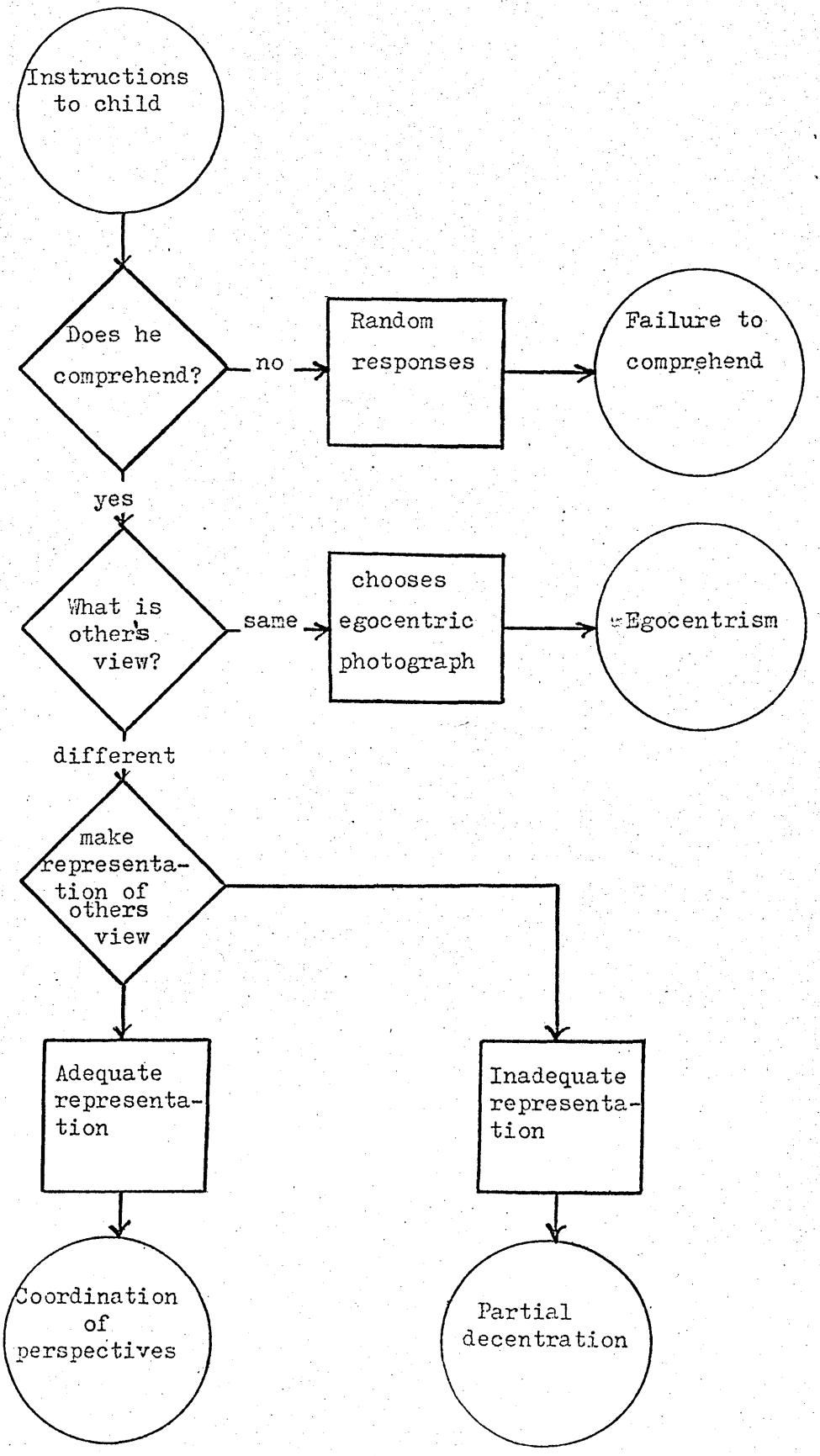
Figure 5

Piaget and Inhelder's (1956) Model



for the topic of the development of spatial understanding in young children, in particular as it relates to the co-ordination of perspectives.

REVIEW OF THE RESEARCH LITERATURE

2.1 Introduction.

At first sight the research literature on co-ordination of perspectives appears to present a variety of conflicting and contradictory findings. Some studies show the young preschool child to be capable not only of understanding that another person has a different view but, also, of being able to discover what it is the other person sees (e.g. Fishbein, Lewis and Keiffer, 1972). Other work, however, as we have shown above presents evidence of egocentric responding well into the middle years of childhood (Laurendeau and Pinard, 1970). As a means of imposing structure upon the present review, and as a contribution towards identifying the factors underlying apparently contradictory results, the review has been organised around four headings and studies thereby grouped according to dominant methodology. The headings are:-

(a) characteristics of the display

(b) the introductory sequence used

(c) the response procedure

and (d) correlational methods

These headings while reflecting major distinctions

cont/....

which may be seen in the research literature, are neither exhaustive nor mutually exclusive. Hence some studies make use of more than one of these categories or manipulate more than one variable within a section. Therefore, one paper may occur in more than one of the above headings or may be mentioned more than once within a heading.

2.2.1 Characteristics of the Display

The initial sub-classification in this section refers to the variations of the number of objects forming the display. Single object displays have been used (e.g. Lewis and Fishbein, 1969). Others employ a three model landscape similar to Piaget and Inhelder (1956), e.g. Dodwell (1963). An even greater number of components has also been utilised, as in the multiple toy 'farmyard scene' of Brodzinsky, Jackson and Overton (1972). Few attempts, however, have been made to manipulate explicitly the number of objects and usually the display variable was not primarily of interest.

2.2.2 Single object displays

Studies using a single object have normally as a goal the simplification of the complex display of Piaget and Inhelder (1956) and a consequent reduction of the cognitive load that the processing of spatial relations between several objects requires. Hypotheses have resulted that propose children within the preoperational should be able to appreciate that others have a different view. Essentially this restricts the co-ordination of perspectives task to the egocentrism-sociocentrism component. If the child has only one object to observe then he is not required to understand how the

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internal relations of the display vary with the position of the observer. Thus studies using a single model investigate the child's growing awareness that others have a different view - the development of the sociocentric response. Lewis and Fishbein (1969) and Fishbein et al (1972) made use of a single toy in two types of experimental procedure. They concluded that children as young as 3½ or 4 years could correctly predict the view of an observer. 'Almost 100% correct responses' of children of this age was reported (Fishbein et al, 1972) for a 'tray turning task'. The tray turning apparatus consisted of a circular base that rotated about the centre point. A toy was placed on the tray which was rotated by the child until the view of the toy as seen by the observer coincided with a view that the observer had previously described, e.g. 'show me the doll's face'. When the interpretation of photographs was added to this procedure, i.e. the base had to be turned so that the observer could see the view of the toy given in a particular photograph, the success rate dropped but still remained at 60% for children of this age. Even younger children have participated. Strayer, Bigelow and Ames (1973) used children aged from 19 to 31 months whilst children in two groups mean ages 2:6 years and 3:4 years participated in an experiment of Masangkay, McCluskey, McIntyre, Sims-Knight, Vaughn and Flavell (1974). Both studies made use of the simplest possible model - a single object with only two sides. The child and the experimenter sat on opposite sides of a table with a screen held vertically between them. There were pictures on each side of the screen which the child had previously named to the experimenter. Experimental trials

cont/....

Table 5

Table gives the number of children in each age group distributed according to their performance on a picture task given by Strayer et al (1972).

	Age (months)				
Performance	19	22	25	28	31
No response	6	3			
Egocentric	2	3	3	1	
Transition			2	2	
Turn		2	2	3	2
Correct			1	2	6

consisted of the experimenter asking,'What do you see?' followed by 'What do I see?' To add 'variety and flexibility' to the procedure trials with a transparent screen were interspersed between experimental trials. Since the same picture was seen by both the child and the experimenter, Masangkay et al (1974) viewed this as a test of a response set by the child to give a different answer to a different question in the experimental trials.

side of the table to see what was on the other side of the screen. A transitional group was added for children who made responses in all three categories but who made more 'egocentric' or 'turn' responses than correct choices. The distribution of children by age and response is shown in Table 5. A clear developmental pattern can be seen. Masangkay et al (1974) did not express their results in the same detail as Strayer et al (1972) but report success by 61% of their younger group (2 to 3 years) and almost perfect performance by their older children (aged 3 to 3½ years). The study was extended by Masangkay et al (1974) to five half yearly age groups of children from three to five years. Four new tasks were used, two verbal and two non verbal. Two of the tasks (one verbal and one non verbal) involved the child recalling a view that he had seen previously, i.e. as in the picture and screen sequence described above. The two remaining problems were devised to discover how well a child was able to predict a view that he had not previously seen. The non-verbal of the prediction tasks consisted of a witch's head placed centrally on a table between the child and the experimenter who sat opposite each other.

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Immediately in front of the child were three similar heads, one facing the child, one facing in the direction of the experimenter and the third facing sideways. (They were screened from the direct line of sight of the experimenter for procedural reasons in order not to confuse the child). The child was required to choose from the three, the head which looked to him as the centrally placed head looked to the experimenter. Meesangkay et al (1974) found a significant age effect ($p < .001$), a significant task effect ($p < .001$) and a significant age x task interaction when correct responses per subject were analysed for the four tasks. Between group comparisons showed the non-verbal prediction task (described above) to be harder than all of the others and the verbal counterpart to be more difficult than either of the recall procedures. These differences, however, were no longer significant at five years of age. Hence although children as young as three years of age are aware that an observer sees something different, they find it hard to predict how a new perspective of a single model appears to the observer. By five years of age, however, children are able successfully to predict a new view. The use of photographs as part of the procedure adds to the complexity of the task and leads to a lower rate of correct responding.

Contrary conclusions, however, follow from work by Flavell et al (1968) and Brodzinsky et al (1972). The former employed a model copying procedure which required the child to make an exact replica of how the display looked to the experimenter using a second, identical, set of materials. The child's model was

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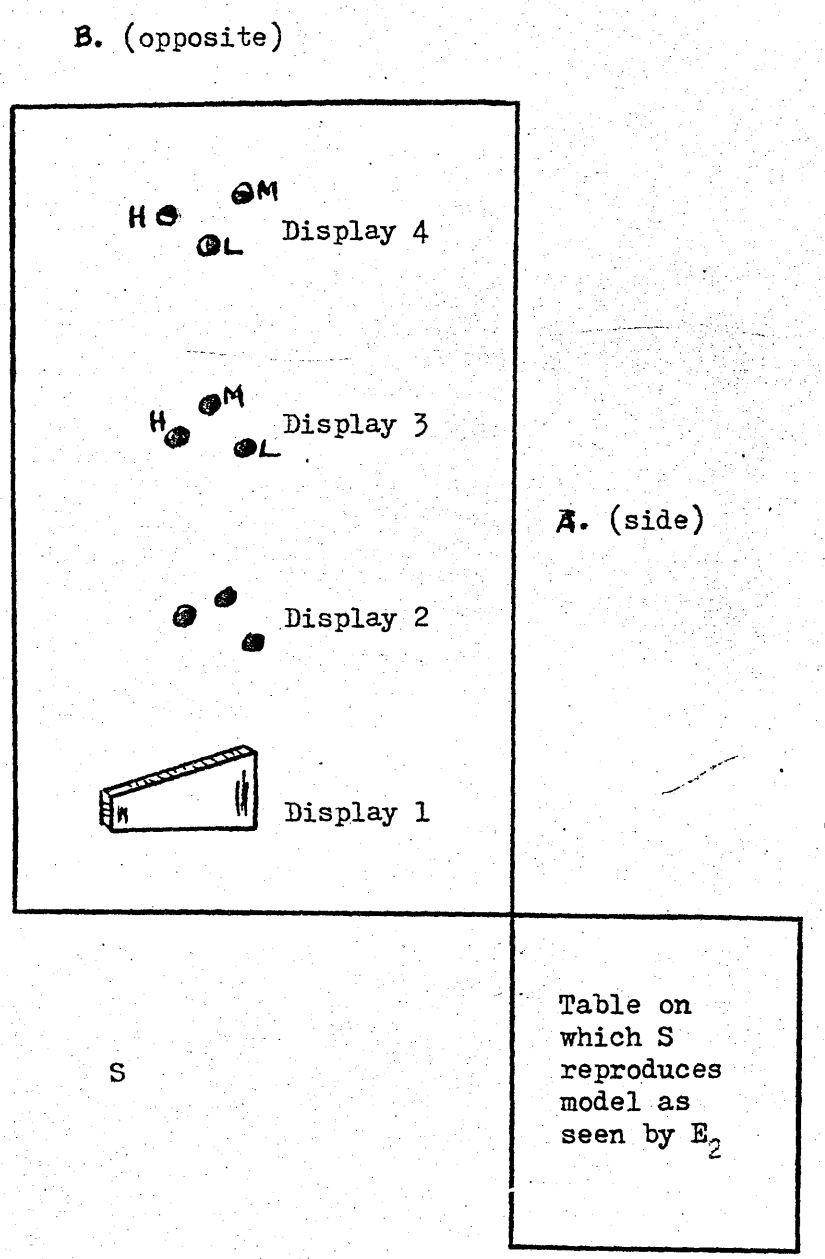
Figure shows the four displays used by Flavell et al (1968) in an investigation of the role taking skills of children.



constructed on a second table that was oriented at right angles to the child's line of sight towards the stimulus display (see fig. 6, pg. 38). A trapezoidal prism (2.5cm. long) was the first display to be used in a sequence of four. The diagram (fig. 6) shows it's orientation vis-a-vis the child who views the prism in cross-section. Only 50% of a group of 20 eight year old children were able to predict accurately how the prism would appear to an observer sitting at the side of the table at 90° to the child (A). Even fewer of these children (30%) successfully reproduced the view of an observer sitting on the opposite side of the display (B). The type of error made varied with the position of the observer. When he sat opposite the child at B the errors were almost exclusively egocentric whereas no egocentric errors were made for the side position (A). This differential error response is likely to be related to the general asymmetry of the display object. These results are critical for Piaget's three stage theory of development. If the egocentric responses made by children when the experimenter sat opposite the child reflect the cognitive egocentrism of the preoperational child why was a similar type of error not made when the experimenter sat at 90° to the child? It is true, however, that children of seven or eight years of age tend to confuse left and right for others. (Piaget, 1926; Elkind, 1961; Laurendeau and Pinard, 1970). Difficulty is found in distinguishing the appropriate left-right response from the mirror image of the correct response. A prediction might therefore be made that children of this age should be successful fifty percent of trials and make egocentric responses (i.e. mirror image response) for the remainder. The number of

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subjects making an egocentric response for the display was somewhat less than this (38%). Nevertheless, this would appear to be a possible means of explaining the differential response. (see also the symmetry - asymmetry discussion below, pg. 43). Brodzinsky et al (1972) used a single model display of either a pair of glasses or a torch in a photograph selection procedure similar to Piaget and Inhelder (1956). Few of their six year old subjects were successful (32% correct responding). No details, however, are given of the type of error made.

The studies, then, which use a single object display frequently show a high level of correct performance and a low rate of egocentric responding for children within the pre-operational stage. The primary reason for the high degree of accuracy appears to be that for a single object no reorganisation of the internal relationships is necessary. Hence the task does not require the child to co-ordinate perspectives. Both Flavell et al (1968) and Brodzinsky et al (1972) present findings at variance with the majority of studies but the difference may be due, in part, to aspects of the object forming the display. The symmetry - asymmetry issue raised above will be discussed in more detail below (pg. 43). Egocentrism is not a dominant feature for single model displays. Studies in the area have, therefore, important implications with reference to the generality of the model proposed by Piaget and Inhelder (1956) to account for the results of the 'three mountains experiment' (see pg. 9).

2.2.2 Multiple object displays

The general conclusions of studies that employ multiple displays is to confirm the original findings of Piaget and Inhelder (1956).

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This is true for the work of Houssiadas (1965), Larsen and Abravanel (1972), Neilgast (1971), Garner and Plant (1972) and Cole, Costanzo and Farnhill (1973). All show a similar order of difficulty using variations of the three mountains experiment. With variations of procedure or model, differences occur with the age of accession, e.g. Minnigerode and Carey (1974), Roy (1974) and Rorke (1975), but the general developmental trend of increase in correct responding with increasing age is observed in all. Houssiadas and Brown (1967) observed a similar trend for retarded children with changes of response related to mental age rather than chronological age. Children with hearing impairment, too, perform in much the same way as children without the handicap (Youniss and Robertson, 1970). When egocentric errors are analysed a corresponding decrease with age is shown. If, however, they are considered relative to total errors then the proportion of egocentric errors increases with age. (Houssiadas, 1965; Fishbein et al, 1972; Larsen and Abravanel, 1972). Laurendeau and Pinard's (1970) more detailed results also confirm this trend. (see Table 2). Thus although a child's tendency to make an error declines with age it is more likely for that error, if made, to be egocentric as he grows older. Some studies, too, find a similar general level of difficulty to Piaget and Inhelder (1956) but dispute the validity of the developmental stages reported. Dodwell (1965), for example, finds overall results that are comparable with Laurendeau and Pinard (1970) but reaches a totally different conclusion:

> 'it was not possible to characterise the great majority of the children studied as being in one of the

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particular stages of spatial concept development described by Piaget'.

(Bedwell, 1963, pg. 161)

Some displays using several objects do not conform to the order of difficulty of the Piaget and Inhelder (1956) study, i.e. Shantz and Watson (1970, 1971), Fishbein et al (1972), Pufall, Degaw and Aschkenasy (1974), Roy (1974) and Borke (1975). This is invariably due to the procedural differences which will be discussed in more detail below (pg.49).

Four studies explicitly compare children's performance with different numbers of objects in the display. Flavell et al (1968) compared four sub-tasks each of which related to a display. Display 1 was the trapezoidal prism discussed above (pg. 39). Three identical blue wooden rods standing on end were the constituents of Display 2. The next display (3) used similar materials to the previous display but of different heights; 6" (H), 4" (M) and 2" (L). Display 4 used similar rods to display 3 but each was painted half red and half white along a length. The child was given identical apparatus to that forming each stage and required to reproduce the display as it appeared to the experimenter on a small table by his side. (see fig. 6, pg.38). The displays were always presented in the order 1 to 4 with two responses (side and opposite) being made for each. Results showed, using 20 subjects (10 boys and 10 girls) from grades 2 through 8 plus grade 11, an increasing order of difficulty over displays. Whilst it is possible that, since the sequence of display presentation remained constant, there was a

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learning effect, this heightens the results since the order of presentation in the inverse of the order of difficulty. Fishbein et al (1972) with two groups of children mean ages 5:7 years and 7:7 years found a significant difference ($p < .01$) between a one toy and a three toy display. The latter display being more difficult for a task that involved rotating the display to a view described by the experimenter (see pg. 34) and a traditional photograph selection task. (A significant task x number of toys interaction was discovered with the photograph selection task being more difficult under the three toy display condition). Brodzinsky et al (1972) also found a higher level of correct responding for a single model display compared with a multiple toy 'farmyard scene'. Children aged six, eight and ten years took part in the study. The differences found, however, appear to be limited to single versus multiple displays. In the only study which compares different numbers of objects forming multiple displays, as opposed to multiple v. single, (Nigl and Fishbein, 1974), no difference was found ($p < .05$) between three, five and seven object displays. This was true for children aged from four to twelve years.

2.2.4 Symmetry - asymmetry of objects

The second display characteristic which relates to a child's performance for the co-ordination of perspectives is the symmetry of the models forming the display. Almost without exception all studies within the field have used asymmetric objects for the display, e.g. the toys of Fishbein et al (1972) or the model buildings of Keilgast (1972). Only two studies have compared symmetrical and

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asymmetrical models and one of these made no attempt to assess differences using statistical techniques. Rather Garner and Plant (1972) refer to one of the displays used, which contained symmetrical objects like an inverted funnel or a cone, as the 'difficult problem' and the display which consisted of asymmetric toys like a model car as the 'easy problem'. An a priori distinction between symmetrical and asymmetrical objects was assumed. The paper reported higher egocentric responding for children aged six to eight years for the display using symmetrical objects. A complimentary finding is given by Borke (1975) for children aged three and four years. She used a display rotation procedure and found a lower level of correct responding for the display with symmetrical objects. The high degree of difficulty, too, of Laurendeau and Pinard (1970) compared with Piaget and Inhelder (1956) may, in part be due to the greater symmetry of the three cone model of the former.

There are two elements within the object symmetry discussion. Firstly, the asymmetry of an object usually means that there is a specific aspect of the model which may be identified and it's position plotted by the child relative to the observer. Hence the child may use the face of the toy soldier (Fishbein et al, 1972) or the headlights of the model bus (Garner and Plant, 1972) as 'distinctive features' (Gibson, 1969). The child has then to look for the photograph which shows this feature. If, in addition, only one photograph includes the detail then the child is likely to choose the correct picture. No co-ordination of perspectives is required. Symmetrical objects, however, demand that the child discovers the change in the internal relationships of the display

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before the observer's view may be found. A similar reduction of the co-ordination of perspectives task to what is essentially a sociocentric response occurs as a function of the photograph choice. Unless 'impossible' mirror image view photographs are specifically manufactured left/right errors are impossible to detect. In the majority of studies, including Houssiadas (1965), Houssiadas and Brown (1967), Shantz and Watson (1971), Brodzinsky et al (1972), Garner and Plant (1972), Larsen and Abravanel (1972), Fishbein et al (1972) and Keilgast (1972), this was not done. Kiser (1974) used two 'trick' pictures by interchanging mountains but seven positions of the observer. As some positions of the observer, therefore, had 'mirror image' pictures from which to choose whilst other positions did not, this may be an explanation of the differential position effect that she finds for correct responses. The second element with reference to symmetry concerns the axis of symmetry of a symmetrical display. If such an axis exists (e.g. Flavell et al, 1968, display 1) then the performance of the child depends upon whether the axis lies at 90^{o} to or parallel with the edge of the table at which the child sits. For the trapezoidal prism of Flavell et al (1968) the axis of symmetry is parallel to the table edge (see fig. 6 pg.38). The problem of finding the view of the observer who sits opposite the child reduces to discovering left and right in another. When the observer sits at the edge of the table at 90^{o} left/right errors are not possible. The axis of symmetry lies through the observer's position. In this case the problem becomes that of finding near and far relative to another. The earlier emergence developmentally of the near/far dimension relative to left/right would therefore explain the differences in performance found by Flavell et al (1968)

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for the opposite and side positions. (Piaget and Inhelder, 1956).

2.2.5 Summary

The variation of display characteristics for adaptations of the three mountains experiment explains in part why there is a discrepancy between some of the research literature and the results of Piaget and Inhelder (1956) and Laurendeau and Pinard (1970). Evidence presented from a single model studies shows the reason for the high level of correct responding to be due to the fact that no internal restructuring of the elements of the display is required. The task reduces to the development of the sociocentric response for the single model as no co-ordination of perspectives is necessary. The literature also shows that the use of asymmetric models for units of the display may lead to a disproportionately high level of correct responding because the child may solve the problem by relating a particular aspect of one of the models vis-a-vis the observer. If mirror image photographs are not used (and most of the studies do not) the child has only to find the photograph which shows this aspect to make the correct choice. Thus the problem may again be solved without necessarily co-ordinating perspectives. When the display is symmetrical then positional variations occur in correct responding that concern how the observer is placed relative to the axis of symmetry. Differences, too, in the type of error response may be observed. These conclusions illustrate the care that needs to be taken when making a replication of a study. It appears that the type of display used may have a profound effect upon the performance of children and produce results artefactually changed by the display characteristics.

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2.3.1 The introductory sequence

An area that has been little investigated concerns how the child is introduced to the task. It is the function of the familiarisation sequence to explain to the child what is expected of him in the subsequent procedure. In the Piaget and Inhelder (1956) study and Laurendeau and Pinard's (1970) replication this consisted of the doll being placed initially immediately in front of the child. He was asked to select the photograph that was the same as the view of both the doll and himself. After the child made his selection the doll was placed at another point so that the child and the doll had different views. The child had, then, to understand that his own view was incorrect and select the photograph that corresponded only to the position of the doll. Most other studies have used a similar technique. Aebli (1967) hypothesised that it was this sequence that caused the egocentric response. The choice of the photograph which represented his own view was a learned substitute reaction for an otherwise unsolvable task. The egocentric response was 'invented' by the child as a 'pseudo solution' because during the familiarisation trials it was his own view photograph that was acceptable to the experimenter. When the child was confronted by a large number of photographs and found the instructions confusing he chose the egocentric photograph because this was the photograph that had previously been socially reinforced. Aebli (1967) and Garner and Plant (1972) tested this hypothesis by varying the familiarisation sequence. One group used the egocentric photograph in the sequence in a similar fasion to Piaget and Inhelder (1956). The second, matched sample, however, had the task explained without

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the use of this photograph. The experimenter showed how a nonegocentric view would appear on a photograph, i.e. 'if I am here I can see....'. Thus for the latter group the egocentric photograph was never socially reinforced. Both studies report a significantly greater number of egocentric responses for the group of children for whom the egocentric photograph was used in the introductory sequence. However, the children also made a high proportion of egocentric response. Hence, although when the egocentric photograph is used in the initial sequence an increase in the probability of an egocentric response results, this sequence does not ipso facto cause the child to choose the photograph.

A second variation to the introductory sequence concerns whether the child is given prior experience of how the display looks from different sides. Coie et al (1974), for example, showed the child the view from each position before commencing the experiment proper. This was true also for Minnigerode and Carey (1974). Keilgast (1972) was concerned to give equal reinforcement to all positions and photographs. Hence Keilgast (1972) adopted a procedure in which all positions and photographs were used in the introductory sequence. The children were also shown each of the four views used in Houssiadas' (1966) study. In a study Kiser (1974) set out to investigate explicitly the effect of such prior exploration of the display. The experiment is discussed more fully under procedural variations (see pg. 62) but generally she showed that fewer egocentric responses were made when the child had been given prior experience of other views of the display.

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2.4.1 The response procedure

The majority of studies in the literature employ a photograph selection procedure similar to that of Piaget and Inhelder (1956) and Laurendeau and Pinard (1970). The child is required to choose from an array of photographs the one which corresponds to the view of the observer. Other studies have used different procedures. The child may

(a) have to reconstruct the view as it appears to the observer by using an identical apparatus,

(b) choose from a set of ready made models,

(c) have to describe verbally the view of the observer,

(d) be involved in an expectancy violation,

or (e) move either the board on which the model is displayed or himself to another position.

2.4.2. Photograph selection

The number of photographs shown to the child for the photograph selection procedure has varied from four (Houssiadas, 1965) to twelve (Coie et al, 1973). No consistent finding is apparent from this group in terms of the effect upon performance of differences in the number of photographs. Coie et al (1973), however, comment that the reason that they reduced the number of photographs between parts one and two of their experiment from twelve to four was because

'the selection of the correct picture from an array of twelve alternatives is in itself a confusing chore for children' (pg. 173).

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Only one study (Fishbein et al, 1972) has investigated how the number of photographs effects a child's performance. A simultaneous investigation was made of a stimulus display variable (one or three toys) and the number of photographs in the response array (four or eight). For each display the number of correct responses was fewer under the eight photograph condition (appropriate allowances were made for the probability of guessing). Centrally placed, in terms of performance, between the easiest, one toy/four photograph condition, and the most difficult, three toy/eight photograph condition, were both the one toy/eight photographs and the three toy/four photographs. It would seem likely that fewer photographs should lead to less distractibility and, therefore, more correct performance although there is at present no experimental evidence other than Fishbein et al (1972).

2.4.3 Reconstruction

The procedure in which the child has to reproduce the view from the observer's position using a set of identical materials has been mentioned earlier (pg. 37). Flavell et al (1968) made use of four displays (see fig. 6, pg. 38), and required the child to reproduce the display on a table at 90° to his right. Using a second set of materials the child made his display so that it looked to him like the observer's display looked to the observer. Two observer positions were occupied, opposite and at the side at right angles to the child. A scoring system was devised according to the accuracy of reproduction at each stage of the four displays. No evidence for stage related performance was

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discovered and Flavell et al (1968) concluded that it was

> 'as though development here was primarily a question of gradual and progressive refinement of some unitary approach or skill'.
>
> (pg.46)

This task seems to be at least as difficult as Laurendeau and Pinard (1970). There are some indications that it may be somewhat harder. For example, at Grade 11 (age 16 - 17 years) about 75% success was achieved with display 2, 65% for display 3 but only 40% for display 4. The increased flexibility of response which this procedure introduces must be a contributary factor in increasing the likelihood of error - instead of choosing from a limited number of photographs the child has an almost infinite choice of the positions in which he may place objects in the new display. Clearly, as we found with the Laurendeau and Pinard (1970) results (pg.21) children within the formal operations stage still find co-ordination of perspectives taxing. A rather easier procedure was devised by Dufall et al (1974). Two circular bases were employed with three objects (a toy barrel and two identical model trees) arranged to form an isosceles triangle. The experimenter placed a toy animal by each of his trees. He then rotated the child's board and required the child to place two similar animals on his model so that they were 'in the same place and looking the same way as the experimenter's animals'. (The two boards were side by side with the child and the experimenter facing at a similar position vis-a-vis their respective boards). Children made few correct responses at

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four and six years of age with about half of the errors classified by Rufall et al (1974) as egocentric. Performance of correct responses increased with age, ten year olds making more accurate responses than either of the two younger groups. Hoy (1974) made an experimental comparison between photograph choosing and model reproduction with groups of six, eight and ten year olds. The display was much simpler than either Flavell et al (1968) or Rufall et al (1974). Two blocks made up this display. 'A 5" red cube' was placed on the table and immediately behind it, so that contact was made, Hoy (1974) put either a 'blue, rectangular block 10" high' or a 'yellow, triangular block' of the same height. Accuracy of reproducing another's view increased generally across the three age groups. Picture selection was at a chance level for six and eight year olds. Ten year olds could build and select with equal accuracy. Egocentric responses were made more frequently for picture selection (31.6%) than for model reproduction (7.9%). The equivalence of the accuracy level found by Hoy (1974) for selection and reproduction of the ten year olds at first sight appears to run counter to the earlier conclusions made when comparing the results of Flavell et al (1968) and Laurendeau and Pinard (1970). However, as was discussed in detail in an earlier section of this review (section 2.2.4), variation of the internal relationships of the parts of the display according to observer position is a pre-requisite of a study of co-ordination of perspectives. Since the models forming both of Hoy's (1974) displays were in contact then this criteria is not fulfilled and hence the flexibility of the reproduction response is curtailed.

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This group of studies presents evidence that a model reproduction task is rather different to the picture selection sequence. A gradual development was observed without the stage development reported by Piaget and Inhelder (1956). A much lower level of egocentric functioning was found by Hoy (1974) and implied by Flavell et al (1968). (All subjects were, in fact, beyond the preoperational stage for the latter). Thus the major strength of the egocentric response occurs when photographs are being used. The presence of the egocentric view photograph may induce this response rather than be a manifestation of an underlying cognitive structure as Piaget believes.

2.4.4 Ready made models

Three studies require the child to choose the view of the observer from a set of models representing various perspectives. Massangkay et al (1974) in an experiment described earlier (pg. 37) placed a model of a witch's head centrally on a table between the child and the experimenter. The child had to choose from three similar heads in different orientations relative to the child the one that represented the view of the stimulus head as seen by the experimenter. Five year olds found this task well within their capacity (i.e. 90% successful responding). Direct comparisons are not possible because Massangkay et al (1974) did not use a photograph selection task at this age. Nigl and Fishbein (1974) compared directly two groups of children aged six and ten years by their performance for a picture selection procedure and a task using three dimensional models. A display of three bricks was presented with, for each position of the observer, three possible response perspectives, the correct view, a left-right reflection and a

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near-far reflection. Half of each age group chose from the photographs and half from the real models. Children performed more accurately when using the models ($p < .01$). However, the three way interaction age x response material x observer position was significant. The observer position condition referred to differences between the observer sitting next to the child, i.e. requiring the child to discriminate his own and the experimenter's view, and the observer sitting elsewhere, i.e. co-ordination of perspectives. Post hoc comparisons showed that six year olds found their own view easier to discriminate when using models compared with photographs. The models did not help children of this age to co-ordinate perspectives, performance was equally poor for photographs and models. For the older children high performance was achieved for photographs and models for the discrimination of own view condition. However, the use of models significantly improved the performance of this group for the co-ordination of perspectives. A similar finding with older children was reported by Huttenlocher and Presson (1973). In the earlier part of the experiment children were required to respond to a co-ordination of perspectives task that used as a display a linear array of three coloured bricks. Drawings of the array in various positions were the stimulus material. For the second phase of the study the drawings were replaced by real models of the bricks in the different orientations. It is only possible, using Huttenlocher and Presson's (1973) results, to make comparisons between the two response materials under a condition for which the stimulus display was hidden from view whilst the child made his choice. Errors in selecting his own view of the display consisted of about 25% of the responses to photographs but only 8% for models.

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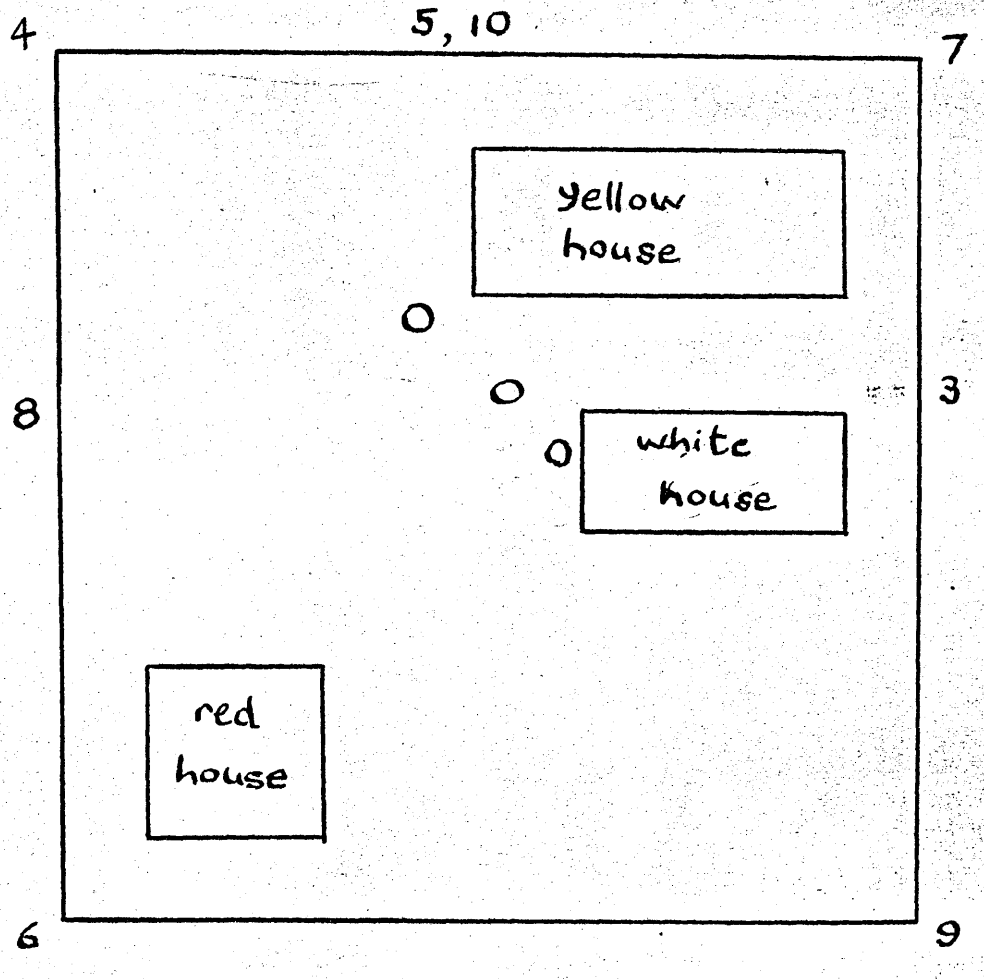
fig. 7

Figure shows a sketch of the display used in the co-ordination of perspectives task of Coie et al (1973).



Equivalent scores for the co-ordination of perspectives were 71% errors for photographs but 35% for models. Since Huttenlocher and Presson (1972) did not intend this comparison to be part of their study matched groups were not used for the picture selection and model stages; a combined group of third and fifth graders undertook the former and fourth grade children the latter. It would seem unlikely that the differences reported are due to differences in age between the samples.

The use, therefore, of three dimensional models appears to improve a child's performance for co-ordination of perspectives when compared to an equivalent task under a picture selection procedure. This is true for the single model display with younger subjects and the multiple model display with older children. The improvement in performance no doubt relates to Gibson's (1969) report that children more easily extracted the spatially distinctive features of a display when a real model was used.

2.3.4 Verbal description

A further cluster of studies make use of neither models nor photographs but seek the child to describe verbally what the experimenter sees. As was earlier reported (pg. 35) Strayer et al (1972) and Massangkay et al (1974) both employ a verbal response technique for their screen/picture task. Children as young as three years of age could successfully describe what was on the experimenter's side of the screen. Coie et al (1973), too, found that children of six years of age found a verbal response task well within their capacity (70% correct responding). Coins were placed at points on a landscape of three model houses. (see fig. 7). When a doll was placed at positions 3,5 and 8

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children were asked how many coins the doll could see. In an experiment Keilgast (1971) argued that an ability to describe the perspective of another should correlate highly with correct performance for a picture selection task. A non perspective description, however, should imply a high frequency of choice of the child's own view photograph. He trained a group of six to eight year olds to describe their own perspective as they moved round eight positions for a display. Half of the children verbalised each view in terms of the relationship which existed between the objects, e.g. 'The church is in front of the tower' (a relations group). The rest learned to describe the iconic features of their own perspective, eg. 'I can see all of the church but only part of the tower' (the iconic group). All eight positions (and photographs) were used as part of a training procedure in order to avoid the sole reinforcement of the egocentric view photograph (Aebli, 1967 and above pg. 47). Prior to undertaking the experimental picture selection task each child was required to describe in words the view of the observer. The performance of the children is given in Table 6. 'Only in a very few cases did they describe their own perspective' (Keilgast, 1971, pg. 185), yet 20% of subsequent responses for the picture selection task were egocentric.

The evidence from these studies seems paradoxical. Young preoperational children were aware that the observer has a different view of the display and could make an attempt to describe that view yet, in a subsequent picture selection phase, they chose the egocentric photograph as being the view of the observer. Since this conclusion is based on essentially a single study it is necessary, firstly, to

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Table 6

Table shows percentage of types of solution for the verbal description and picture selection task made by the relations (R) and iconic (I) group for a co-ordination of perspectives task of Keilgast (1971).

Verbal task

	R group	I group
Correct	61.3	55.9
Perspectiveness	14	22.9
Wrong perspective	19.2	18.4
Unscorable	5.5	2.8

Non Verbal task

	R group	I group
Correct	48.3	51.7
Own perspective	22.9	18.4
Other perspective	28.8	29.9

replicate in order to ensure that the results are not specific to the procedure used by Keilgast (1971). If similar results are found then verbal description and picture selection would appear to be tapping different mechanisms. Thus the egocentric response may be specific to the latter sequence. Hence as with model reproduction above (pg.50) the three mountains experiment may not reflect an underlying structure of cognitive development but a skill specific to the picture selection process.

2.3.5 Expectancy violation

Shantz and Watson (1970, 1971) have a unique place in the co-ordination of perspectives literature. They developed a method of measuring a child's response to a co-ordination of perspectives procedure by using the principle of 'expectancy violation'. They hypothesised that when a display was hidden from a child's view the child should have an expectation of how the display would look from a different point of view. If, when the child was shown the display from another point, he was presented with the same view that he had seen before the display was hidden from view, then the child should show surprise in terms of facial features, verbal comments, etc. Shantz and Watson (1970, 1971) hid a model landscape within a box. For the initial study the child could observe the display by pressing a switch which illuminated the interior for half a second. A 3 x 3 array of doors was cut in the lid of the box for the second experiment. The child had to establish to criterion the position of each of the objects of the landscape relative to the

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appropriate lid. The child was then moved to the opposite end of the box and the respective procedure was repeated. Two primary experimental conditions were implemented. Either

(a) the box and it's contained landscape remained stationary and the child saw a 180° reversal of the display - the real condition

or (b) by an ingenious system of pullies, the inside of the box was rotated through 180° so that when the child looked from the opposite end he saw the same view of the display that he had originally observed - the trick condition.

Significantly more children aged three and four years in the earlier study showed changes in facial expression that were thought to indicate surprice when the 'trick condition' was administered. A modification of the three mountains procedure was used additionally in the later study and comparisons were made between performance at both tasks. Children who successfully recognised the 'trick perspective' were more likely to have some success for the photograph selection task. The children, aged three to six years, were easily able to predict the new location of objects in the landscape for the 'expectancy violation' procedure but found great difficulty with the similar display when photograph selection of the observer's view was required. There appear to be four factors which could account for the difference in performance. Firstly, the display of Shantz and Watson (1970, 1971) was hidden from view. As the child could not see the perceptual features of the display from his own point of view they did not interfere with his construction of the observer's view of the display. Secondly,

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the child moved from his position to the point from where the response was required for the expectancy violation procedure. In the traditional task the movement takes place symbolically. Thirdly, photographs, and their interpretation, were not part of the 'expectancy' phase but are essential to any procedure similar to Piaget and Inhelder (1956). Finally, several views were used for the photograph selection task but only one, the 180° opposite position for the expectancy task. Further evidence must be sought before we may conclude whether one of these four factors is the sole cause of the ease with which young children solve the co-ordination of perspectives problem as set by expectancy violation procedures of Shantz and Watson (1970, 1971). It may well be due to a combination of all four.

2.3.6 The role of movement

The final cluster of procedural studies have movement as a common factor. The movement may be

(a) prior and active, i.e. round the display before the experiment proper begins

(b) passive, i.e. when the display moves but the child remains stationary throughout the experiment

or (c) active, i.e. the child moves during the experiment to the point from which the response is required.

When the last type of movement is undertaken the display has to be hidden from view to avoid the trivial solution of the child being able to see the view that he has to find. Although it

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is somewhat of a contradiction in that no movement is involved this is probably the most appropriate place to include the study of shielding the display whilst the child makes his response.

Prior, active movement of the child round the display has been explored by Eiser (1974). (See also pg. 48). Before the experimental trials were given half of a group of six to eight year olds were shown the display from different positions. They were asked if the mountains 'looked different from different positions'. Eiser (1974) argued that the group with prior experience had only to 'recognise' a view that they had seen previously. The group of subjects not given that experience had to 'infer' a new view. More egocentric responses were made by the latter group. Some support for these findings is provided by Coie et al (1974) and Minnigerode and Carey (1974). Both made use of a familiarisation sequence to the experiment that involved prior exploration of the display. Coie et al (1974) report only 80 egocentric out of 476 total errors for children aged nine years; a ratio of 1:5. This compares to a ratio of 3:1 for Laurendeau and Pinard's (1970) children of a similar age. Combining egocentric and non egocentric errors for Minnigerode and Carey's (1974) nine to eleven year olds gives a ratio of egocentric to total errors of 1:3. Hence, when the child faces a 'recognition' rather than an 'inference' task the awareness that other views are possible, or perhaps the recall of previous views, appears to lead to a decrease in the proportion of egocentric responses.

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A further group of studies also involves movement, but movement of the display during the experiment whilst the child remains stationary. Lewis and Fishbein (1969) and Fishbein et al (1972) mounted the display on a circular base board which rotated about the centre. The child had either to turn the display so that a specific aspect faced the experimenter, i.e. 'show me the front of the mouse and the side of the soldier holding his candy cane so I cannot see the doll at all' (Fishbein et al, 1972, pg. 25) or so that the experimenter could see the view given by a photograph. For the former almost 100% correct responding was reported for children aged four, six and nine years but a rather lower level for the latter. When the latter procedure was compared to the traditional picture selection task similar to Piaget and Inhelder (1956) differences were found between display size and type of response. There was no difference in performance for a single toy display, but when three toys were used performance for display turning was superior to picture selection ($p < .01$, response type x number of toys interaction $p < .05$ Fishbein et al, 1972). A similar display rotation sequence was developed by Rufall et al (1974) and Borke (1975) but unlike Fishbein et al (1972) both made use of two bases. On each of Rufall et al's (1974) circular bases were placed three objects in the form of an isosceles triangle. A toy animal was placed by the experimenter close to one of the objects. The child's board was then rotated. He then had to place his toy animal on his board so that it was 'in the same place and looking the same way' as the original. Few correct responses were made by either four or six year olds with some 50% of the errors being egocentric. Ten year

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olds made more correct and fewer egocentric responses. Borke (1975) found significant display differences when investigating this type of procedure. She found generally, however, that correct responding was high for groups of three and four year olds.

The tray turning procedures present somewhat contradictory evidence. Three, Lewis and Fishbein (1969), Fishbein et al (1972) and Borke (1975) show a high degree of correct responding even with preschool children. Pufall et al (1974), however, report children of a similar age perform much as Piaget and Inhelder (1956) found. These differences may be due to specific characteristics of the display in addition to the procedural variations. We have discussed earlier (pg. 43) that the asymmetry of the model used in displays may help the child to establish the view seen by the observer without necessarily having to co-ordinate perspectives. A child may use this for both the Fishbein et al (1972) and Borke (1975) studies. However, Pufall et al (1974) required the toy animal to be placed independently and made a subsequent judgement of placement and direction. In addition the tray was rotated prior to placement in the Pufall et al (1974) study. Thus unlike Fishbein et al (1972) and Borke (1974) he would be unable to track individual parts of the display vis-a-vis the experimenter as the display rotated. (Huttenlocher and Presson, 1972; Shepherd and Metzler, 1972). The skill assessed by Pufall et al (1972) appears more akin methodologically to the localisation of topographical positions of Piaget and Inhelder (1956) and Laurendeau and Pinard (1970) than to the co-ordination of perspectives.

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Active movement of the child during the experiment has been studied. Usually the movement has involved the child moving to the point from where the observer views the display. Since the child would be able to see the observer's view after moving, the display is usually hidden whilst the child moves and makes a response. Shantz and Watson, (1970, 1971), found that children of three to six years were able to predict the view that they would see when they observed the display from the opposite side. They showed surprise when the same view was presented, 'violating an expectancy'. (see also pg. 59). Huttenlocher and Presson (1973) used children of ages nine and eleven years who had to anticipate how a linear array of three coloured blocks should look to an observer. A matched group of children made a similar attempt after having moved to the position occupied by the observer. The display was hidden from view whilst the child moved and made a response. Making the response from the observer's position led to a highly significant ($p < .001$) increase in responding when compared to the stationary group. The proportion of egocentric to other errors was in the ratio 3:1 for the traditional procedure but fell to a chance level when the child moved. Pufall et al (1974) echoed these results with a totally different procedure. As previously (pg. 81) two identical models were used. In this instance, however, following the placement of the toy animals by the experimenter on the stimulus display, the board was hidden from view by placing the second base board on a platform immediately above the first. The child then moved to the position of the observer and placed his animal on the second landscape so that 'the animals' matched the location and orientation of the experimenter's animals.

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A significant age trend was found with four year olds performing less well then either six or ten year olds who presented a similar pattern of scores. A low level of egocentric responses (4%) was noticable and similar to the Huttenlocher and Presson (1972) findings.

The studies in which the child actively moves to the point from which the response has to be made, result in a consistent pattern of findings. Children within the preoperational stage perform accurately and make only chance egocentric errors. However, the precise meaning of an egocentric response for these studies seems under some question. It is clear that when the display is fully visible the egocentric photograph is the child's view of the display. When the child moves to a new position, as in the third trial of Laurendeau and Pinard (1970), the photograph from the child's original position ceases to be the egocentric view. The egocentric photograph becomes the representation of the perspective from the child's view position. If, however, the display is hidden from the child's sight as he moves and makes a response then the child is unable to see the view from the new position. To refer, therefore, as the studies do, to the photographs from the original position as the egocentric view appears inappropriate. (Laurendeau and Pinard, 1970, describe children who made this response, i.e. chose the photograph which corresponded to their original view of the display, as presenting 'pseudo decentration'). Equally, since the child has never seen the view from the new position, to describe the view that he would see as 'egocentric' also seems inappropriate. The use, therefore,

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of egocentric response frequency does not seem justified for these studies. The correct responses categorisation is not open to the same degree of criticism as egocentric responding. The view of the observer refers solely to the observer who remains stationary for each experimental trial; it is the perspective which the observer saw before the display was hidden from view. It is true, however, that, if the display were <u>not</u> hidden, the observer's view would be the same as the egocentric view after the child had moved. Hence the correct response is equivalent to the (hidden) egocentric response. With this degree of confusion as to the constitution of a correct or egocentric response the conclusions reached in this group of experiments must be regarded with some caution.

Two studies compare the effect of shielding a display without movement of either the child or the display. The child remains at a fixed point relative to the display but whilst he chooses the picture representing the view of the observer the model is hidden from sight. Brodzinsky et al (1972) compared the number of correct responses made by three groups of children aged six, eight and ten years to a co-ordination of perspectives task. Two sizes of display were presented, single and multiple object (see also above pg. 40) under either a hidden or visible condition. Shielding the display from view whilst the response was being made resulted in a significant increase in correct responding for the two older ages of children but for only the multi toy display ('a toy farmyard scene'). A similar gain was found for neither the single object display nor the youngest subjects. A study by Huttenlocher and Presson (1972) investigated the same area. Difficulties in display

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classification, however, make it unclear whether the results confirm or contradict Brodzinsky et al's (1972) conclusions. Huttenlocher and Presson (1972) found, for eight and ten year olds, that hiding the display from view led to significantly poorer performance than for the visible condition. The linear set of three coloured bricks used by Huttenlocher and Presson's (1972) study are not readily placed as either a single or a multiple model (sections 2.2.2 and 2.2.3). An analysis of the errors made by children for this study show egocentric to miscellaneous errors were in a ratio of 10:1 for the visible condition but 4:1 when the display was hidden. This difference is in the expected direction considering the additional memory load for the hidden condition.

Movement of the child or the display as part of a co-ordination of perspectives procedure generally facilitates correct responding but leads to a decline in the number of egocentric responses. The reason for the increase in performance is not a function of movement per se but rather arises from the effect that movement has on other aspects of particular procedures. Prior movement and exploration of the display reduces the task from the discovery (or 'inference') of a new view to the recognition (or 'recall') of a perspective seen previously. As might be expected the recall task with a lower cognitive load leads to a significant increase in the correctness of a response. The child is aware of the other views of the display which leads to a reduction in egocentric responding. When the child rotates the display a high frequency of correct performance again occurs. Gradual

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rotation of the display by the child may well enable specific aspects of the display to be oriented vis-a-vis the observer. The one rotational task which presented findings of a similar order to the traditional co-ordination of perspectives procedure employed rotation by the experimenter before the child made a response. When the child moves to the observer's position to make a response (with the display hidden from view) the child achieves a high level of correct responding. Egocentric responses reduce to a chance level. The meaning of 'correct' and 'egocentric' for these experiments is open to doubt so that the results must be treated with some caution.

Procedural differences in studies investigating the co-ordination of perspectives show corresponding differences in performance. Evidence has been presented which implies that although the displays are similar different skills are being tapped. When the task involved photograph selection the choice of the egocentric photograph occurs more frequently than would be expected by chance. There is some evidence to support Piaget and Inhelder (1956) that the process is stage dependent (Laurendeau and Pinard, 1970). The model copying technique, however, may be 'a gradual and progressive refinement of some unitary approach or skill'. (Flavell et al, 1968, pg.46). An indication was also found that, even when children are aware that others see things differently and may go some way to verbalising a description of this view, the egocentric view is still chosen in a subsequent photograph selection procedure.

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There is one study that although part of a general procedural variation does not readily fit into any of the above groupings. Both Piaget and Inhelder (1956) and Laurendeau and Pinard (1970) represented the position of the observer by means of a doll. Several other investigators, however, Fishbein et al (1972), Eiser (1974), Nigl and Fishbein (1974) and Hoy (1974) have used a person rather than a doll. The observer moving to take up a position and asking the child, eg. 'what do I see from here?'. The wide variation of other procedural aspects obscure differences between performance when a doll rather than an adult is used. Cox (1975), however, specifically investigated doll/person differences and showed that children of about seven years of age made significantly more correct responses ($p < .01$) and significantly fewer egocentric responses when the observer was a person rather than a doll. He noted that the group using the doll 'often ignored the position of the doll and seemed not to notice that it had moved to a different position'. There seem to be two possible reasons for the difference. It may be due to the child finding it hard to comprehend that the experimenter expects that a sightless, inanimate toy doll can 'see' the display. Children do not, however, usually find great difficulty in ascribing human characteristics to toys (e.g. Piaget, 1929, 1930) so this is unlikely to be a major factor. More probable is that the person provides a significant reminder of the position from which the response is required. If the experimenter's instructions to the child are 'to find the photograph that is the same as how the model looks to me from here where I am sitting', there is little ambiguity. When Laurendeau and Pinard (1970) use the instructions 'show me the

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picture that the man sees when he is there', the precise meaning remains in doubt. If, too, as frequently occurs, the experimenter sits next to the child throughout then the child has to understand that 'the man' in the instructions refers to the doll and not the experimenter. Huttenlocher and Presson (1972) investigated, with a shielded display, the effect of using a marker to indicate from where the observer viewed the display. Performance under this condition was compared to the absence of a marker. The number of correct responses increased when the marker was used ($.05 < p < .1$).

2.4 Correlational studies

Correlational studies form the last grouping of studies. Comparisons have been made between the co-ordination of perspectives and other Piagetian demonstrations. Dodwell (1963) and Larsen and Abravanel (1972) showed the three mountains experiment to be part of a general spatial trend linking areas like conservation of length or number and awareness of horizontal and vertical. Rubin (1973) correlated social, language and role playing skills with the co-ordination of perspectives. Using an adaptation of the Flavell et al (1968) procedure he showed co-ordination of perspectives to be part of 'a general, decentration factor' in an overall maturational trend.

3.1 Summary of Experimental Evidence

The first cluster of studies resulted from attempts to vary the complexity of the display presented to the child. Rarely was the variation of complexity an explicit part of a study, rather it resulted from attempts to simplify the display for procedural reasons. Frequently an a priori assumption appears to have been made that reducing the display complexity would result ipso facto in the simplification of the task. The evidence presented, however, seems to show that the a priori assumption has some justification. With simplification, though, comes a change in the nature of the task before the child. It is the change in the task that follows simplifying the display that brings the single model display procedures within the range of pre-school children. It was shown in section 2.2.2 (pg. 33) that even very young children were able to discover the view of an observer when a single model display was employed. However, the conclusion may not be reached that young children are able to co-ordination perspectives because, when a single model is used, children no longer have to co-ordinate perspectives to find the view of the observer. Co-ordination of perspectives requires the simultaneous manipulation of the dimensions of left-right and near-far and with single model studies no internal restructuring of the display is required. The development of the sociocentric response has a direct bearing on a child's ability to co-ordinate perspectives and plays an important part in the development of an explanation of the 'three mountains experiment'. A reconciliation has still to be attempted between the sociocentric findings of the single model studies and the results of Piaget and Inhelder (1956)

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which showed children of a similar age to choose the egocentric photograph. Why, if children of five or six years can make successful attempts showing sociocentric thinking for a simplified model, do children of a similar age perform egocentrically when presented with a co-ordination of perspectives task? There is some evidence that for single models an egocentric - sociocentric developmental sequence occurs (Strayer et al, 1972; Fishbein et al, 1972). The implications of this to the Piaget cognitive model are discussed further below.

A reduction of the co-ordination of perspectives task to the development of the sociocentric response was also found as part of the multiple model section (section 2.2.3, pg. 40). When asymmetric displays were used a high level of correct responding may have been due to the child noting the relationship between a specific feature of one of the objects vis-a-vis the observer. If, as in many of the studies, mirror image photographs were not used then the child may select the correct photograph by centering on this one aspect and hence appear to have co-ordinated the perspectives. However, the centering of children in, for example, the Fishbein et al (1972) study (pg. 34) is of a different quality to that reported by Piaget and Inhelder (1956) in Stage IIB (see pg. 7 above). Children of 6 or 7 years for Fishbein et al (1972) centred on the most <u>significant</u> feature of the display and hence made correct responses. Piaget and Inhelder's (1956) children of a similar age centred on the most prominent feature of the three mountains display, i.e. usually the grey mountain, and therefore made inappropriate responses. It is likely that the mechanism is the same yet Fishbein et al (1972)

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trained their children to put it to significant use whereas Piaget and Inhelder (1956) did not.

The area that has received only scant attention from researchers is the sequence by which the child is introduced to the experimental procedure. It would seem reasonable to assume that this is the most fundamental part of a study. Unless the child comprehends that it is the view of the observer that he is expected to find then even children within a later developmental stage may present as egocentric. No studies have been attempted to evaluate the child's comprehension of the instructions given.

Most studies use the egocentric photograph and the child's position as an introduction to the experiment. Aebli (1966) linked the child's subsequent production of egocentric responses in experimental trials to the social reinforcement of the choice of the egocentric photograph during the familiarisation sequence. Experimental work (Aebli, 1966; Garner and Plant, 1972; see pg.47) showed the use of the photograph as part of the initial procedure led to the child choosing the egocentric photograph more frequently. However, even when another photograph was used initially the child still made egocentric responses when asked to find the observer's view. The use of the egocentric photograph as part of the familiarisation sequence does not cause the egocentric response for the observer's position. A prior exploration of the display (Kiser, 1974; Cole et al, 1974; Kinnigerode and Carey, 1974, see pg.52) reduces the subsequent co-ordination of perspectives task to the recall of a previously seen view. Hence egocentric responses decline as a proportion of total errors.

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The majority of studies in the research literature concentrate on differences in procedure. A wide variety of methods may be found by which the co-ordination of perspectives has been investigated. The most frequently used procedure is the photograph selection phase of Piaget and Inhelder (1956). There is some evidence that the number of alternatives in the response array effects performance (Fishbein et al, 1972). Children, reported Coie et al (1973) (see pg. 56) found selecting from a large number 'a confusing chore'. Generally, however, variations between performance in different studies were related to differences in the display variable. Most studies using a procedure and display similar to Piaget and Inhelder (1956) found similar results. It may be that a possible (non-Piagetian) explanation for the egocentric response tendency of young children may lie with the presentation of an array of photographs. If the number of photographs exceeds the number that a child can readily process then the child may compromise by choosing the photograph showing the view that is most familiar or most immediate, i.e. the egocentric.

Few egocentric responses were reported by Flavell et al (1968) and Hoy (1974) (pg. 50) when a model reproduction procedure was undertaken by children. This was not unexpected for Flavell et al (1968), as all of his experimental group of children were beyond the preoperational stage. Hoy (1974), however, used a group of six year olds. Hoy's (1974) results contrast with the large numbers of children of this age making egocentric responses for the picture selection procedure of Piaget and Inhelder (1956) and Laurendeau and Pinard (1970). Neither of the two model reproduction experiments lend any support for a stage development

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hypothesis. A gradual, continuous progression for correct responding was reported. The low level of egocentric functioning for model reproduction may indicate that the egocentric response is primarily related to the process of selecting a photograph. Thus it may be that the photographic image of the child's view is instrumental in producing the egocentric response rather than the child's egocentric view per se.

Other procedures have made use of several sets of identical materials rather than give the child an almost limitless choice of possible positions that the procedure of Flavell et al (1968) allows. Higl and Fishbein (1974) and Huttenlocher and Presson (1972) (pg. 53) made duplicate sets of models that were arranged in front of the child and corresponded to the photographs from the various observers positions. Hence comparisons could be made between performance when selecting from a set of photographs or from a similar set of models. No difference was found for co-ordination of perspectives with six year olds, both performed poorly, but when older children participated selection from models was superior to the photograph response.

Two experiments required the child to describe verbally the view of the observer. Only on the rarest of occasions did a child describe his own view. The egocentric response was given only very infrequently even with young preoperational children. The research evidence is not, however, strong and rests primarily with a single experiment (Keilgast, 1972) although part of Coie et al (1973) provides some support. Keilgast (1972) (pg.57) followed the verbal description phase with a picture selection procedure. Although few of the original descriptions were egocentric the results for picture selection contained a similar

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percentage of egocentric responses to that found by Laurendeau and Pinard (1970). Hence, paradoxically, although verbally aware that the egocentric response was not appropriate a child may still choose the egocentric view photograph in a subsequent picture selection procedure. This is added evidence that the egocentric response is specific to photograph selection.

A major procedural variable was movement. The use of movement as part of the procedure generally facilitated correct responding and led to a decline in the number of egocentric responses. The performances differences produced were not due to movement per se but rather to the effect that movement had upon the procedure under investigation. Prior, active movement, for example, changed the anticipatory or inference task of the co-ordination of perspectives with the child stationary to a recall task. As the child had observed the different views of the display he had only to recall the view that he had seen when in a similar position to the observer. Hence a reduction in egocentric responding occurs. When movement was passive during the experiment, differences were observed to the results obtained when the child actively moved. Since the studies in this area were display rotations the differences found may be explained in terms of display asymmetry. Active rotation of the tray by the child demands that he continually relates the display to the observer. Thus a specific aspect of one of the models is compared to the observer's position. If, however, the experimenter moves the tray there is not a similar compulsion on the child to give the task his complete attention. Active movement of the child during the experiment is usually to the point

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from which the observer views the display. A high level of correct responding is reported with only chance egocentric responses. However, to avoid the crucial response, the display has to be hidden from view. The precise meaning, therefore, of a correct or an egocentric response remains open to some doubt and the conclusions treated with caution.

4.1 Implications for further research

The studies reviewed appear to follow two general strategies. Either

(a) they were (explicitly or implicitly) tracing the development of the sociocentric response

or (b) they were investigating aspects of 'true' co-ordination of perspectives.

The original model proposed a two factor theory for the co-ordination of perspectives that has much in common with the above themes. Based on Piaget and Inhelder (1956) the model postulated two interacting developmental processes; egocentrism-sociocentrism and centration-decentration. The former referring to the child's breaking away from the immature belief that others have the same views, feelings and perceptions as himself. Gradual building of experience particularly through inter-personal contact leads the child to an awareness that each person is an individual with unique views and ideas. The implication is not that the child is aware of how another person feels but rather an understanding that they each have different feelings. Centration-decentration is the process by which the child frees himself from the tendency to centre on one aspect of a situation

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and comes to be able to inter-relate different aspects one with the other.

The development of the sociocentric response may, therefore, be seen as a legitimate area of further research since it forms an integral part of the development of co-ordination of perspectives. In particular, we need to assess how the development of the sociocentric response fits into the cognitive developmental theory of Piaget. If some children can perform in a sociocentric manner for a single model display, why should children of a similar age respond egocentrically for a model which requires two dimensions to be co-ordinated?

There is a need to evaluate the development of egocentrism-sociocentrism more clearly. The literature has shown that young children are aware that others have a different view when observing a single, asymmetric model. A logical initial experiment to extend these findings is to discover whether a child is aware that the observers sitting round a display have different views depending upon their position. The simplest display will involve the child in a discrimination as to which of a set of observers has the same view as himself and which have a different perspective. Increasing the complexity of the display will yield a situation where each observer has a different perspective, not only to the child but also to all other observers. Display complexity in the literature normally involved the horizontal dimensions of left-right and near-far and illustrated the difficulty children find with the former (e.g. Piaget, 1926; Flavell et al, 1968; Olson and Baker, 1969; Cole et al, 1973; Minnigerode and Carey, 1974; Nigl and Fishbein, 1974). An

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investigation in a different field by Lunsden and Poteat (1968) showed that the vertical dimension was the dimension primarily used by five and six year olds to define 'big'. By increasing display complexity in the vertical dimension keeping the horizontal dimension constant and vice versa the relative salience of the horizontal and vertical dimensions may be assessed.

Differences in procedure are also relevant for the development from egocentrism. The experiment of Keilgast (1971) was discussed above. He found differences in responding that were dependent upon the type of procedure: children verbally made non-egocentric guesses when describing an observer's view but, paradoxically, in a subsequent picture selection task, they chose the photograph which represented their own view. A replication has to be made of the descriptive procedure used by Keilgast (1971), particularly in terms of the single model display. By comparing the performance of children for a verbal descriptive task with their performance for a procedure involving the use of photographs or drawings we may investigate differences in response style between the two stages. For example, how the frequency of each type of response, egocentric transitional or sociocentric, changes. Hence the effect of the use of the two dimensional representation of a three dimensional model may be discovered and an assessment made of the problems that young children find when interpreting photographs.

Few attempts have been made to discover how the child understands the instructions given; what the language of the instructions mean to the child and the relevance of the

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familiarisation sequence. The young child's reaction to the instructions of Piaget and Inhelder (1956) is to choose the photograph which represents the view of the display as it appears to the child, i.e. the egocentric response. However, the egocentric response is also a matching by the child of the photograph with this view of the display. Using a modified procedure we may distinguish between the hypothesis that the choice of the own view photograph is a matching response and the Piaget and Inhelder (1956) conclusion.

In addition to studying the growth of the egocentrism-sociocentrism component further research is necessary to discover more about the development of the child's ability to manipulate simultaneously the two dimensions of the co-ordination of perspectives. The literature review compared and contrasted the procedures which have been used. Generally, however, the comparisons had to be made between studies with different displays and population samples. Rare attempts have been made within a study to compare procedures, models versus picture selection (Nigl and Fishbein, 1974) and model reproduction versus picture selection (Hoy, 1974), and they offer some evidence to suggest that different skills are involved depending upon the procedure used. Conclusive evidence, however, may only be obtained if the three major procedures of the literature review, i.e. verbal description, model reproduction and picture selection, are investigated using a similar display with matched groups of children. Detailed comparisons may then be made in terms of correct responses and

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the distribution of error responses for the three procedures. A developmental analysis may also be made using children of different ages. If each procedure is given to each child, with appropriate order controls, transfer effects may be investigated. Evidence may be found to test the Keilgast (1971) hypothesis that a correctly described perspective preceeds an egocentric response for picture selection. If several trials are administered for each procedure we may also investigate whether the egocentric response is an initial response resulting from confusion with the apparatus or instructions and whether egocentric responses decline over trials.

Flavell et al (1968) and Riser (1974) report differential effects due to the observer's position relative to the child. (see Section 2.2.4 pg. 85). An analysis of the child's performance in terms of the distribution of correct and error responses over observer position for different procedures may add clarification to the comparison between procedures.

Little work has been published subsequent to the original experiments of Piaget and Inhelder (1956) that specifically seeks the causes of an egocentric response. There is a good deal of research which challenges Piaget's explanation but little attempt to develop an alternative theoretical framework. Two immediate influences that may effect the type of response that a child makes are

(a) that the egocentric view is the <u>only</u> view that the child sees, he sees this view throughout and this may interfere with the building of the observer's view,

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and (b) that, for the picture selection phase, the representation of the egocentric view is always readily available to the child and may make the finding of the correct view more difficult.

The evidence for the former is contradictory (see pg. 61, section 2.36) and no work has so far been published as to the latter. An investigation of the child's performance with and without the egocentric response as part of the picture selection array would add evidence about the influence of the egocentric view photograph.

An hypothesis that may be advanced for the tendency of a child to choose the egocentric photograph relates to the number of photographs used. A child may be so confused by the number of photographs in the array (Coie et al, 1972) that he disregards the instructions given. He opts instead for the familiar photograph that matches his own point of view. (This tendency may be stronger particularly if the egocentric photograph had been used during the familiarisation sequence and had been socially reinforced. Aebli, 1966; Garner and Plent, 1972). Reducing the child's choice to the observer's view and the egocentric view would enable the child to be free of all distraction with the exception of the egocentric view.

The familiarisation sequence by which the task is introduced to the child has received sparse attention in the literature. It is, however, probably the most important stage in the experiment for, unless the child understands what is expected of him, then any results produced relate to the lack of understanding rather than the hypothesis under investigation. The effect of movement on performance was

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discussed above (see section 2.36, pg.61). Eiser (1974) showed prior exploration of the display was essentially a reduction of the anticipatory skill of the co-ordination of perspectives to a recall task and her results are explicable in these terms. Prior training using a display different to the experimental display would eliminate the anticipation-recognition confounding effect. In addition, the role played during the familiarisation sequence of verbal and pictorial cues may be assessed. Verbal or language pre-training may involve describing to the child how the display looks from the observer's position using the principal dimensions of near/far and left/right. Showing the child how the display looks from the different observer positions would constitute the visual pre-training. Combining language and movement factors would result in a series of different familiarisation sequences which could be compared.

The various issues discussed in this section are individually addressed in the experimental reports which follow.

The primary aim of the present experiments, in conjunction with the review of the research literature, is to assess the validity of the cognitive developmental model of Piaget to account for the conclusions reached by Piaget and Inhelder (1956) for the co-ordination of perspectives. The study has two primary areas:

(a) an investigation of the development of the sociocentric response, Experiments 1 to 4,

and (b) an exploration of the simultaneous co-ordination of the dimensions of near/far and left/right, Experiments 5 and 6.

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Experiment 1

Introduction:

As has been demonstrated in the literature review the methods used by experimenters to investigate the co-ordination of perspectives have frequently involved a complex display, instructions that expect a good deal of understanding, particularly of the younger child, and a procedure which assumes children are readily able to interpret the two dimensional photographic image. An initial starting point, therefore, in this series of experiments appears to be the simplification of as many aspects of the experiment as possible. Logically this implies the reduction of the display and procedural characteristics to the choice for the child of whether or not the observer has the same view as that of the child. The display has, therefore, to present two possible views, as the child sees and as the child cannot see. In order to eliminate the pictorial representation element the traditional picture selection procedure may be replaced by a verbal response. Hence in the simplest possible experiment the child is asked which of a set of observers, looking at an asymmetric two sided display, see the same object as the child and which do not.

Aim:

To investigate, using a simplified display,

(a) the ability of young children to appreciate that others have a different view of the display and that the view depends upon the position of the observer relative to the display, and (b) the relationship between egocentric responses and age.

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Method:

Subjects. Participating in the study were 36 children. An older group of 9 boys and 9 girls were from the reception class of an urban maintained school. Their ages ranged from 5-5 years to 5-11 years with a mean of 5-8 years. The younger group consisted of 6 boys and 12 girls from a private Montessori nursery. Their ages ranged from 3-9 years to 4-5 years with a mean of 4-0 years. Both schools were situated in a middle class residential area.

Apparatus: The apparatus consisted of a wooden doll 12cm. high and a cardboard screen 36cm. x 24cm. mounted vertically so that the doll could be hidden from view.

Procedure. Each child was brought to a small room and was seated at the longer side of a table 2m. x 1m. next to E.

When the child was relaxed and settled, E put the doll on the table in front of the child placing it centrally, equidistant from the longer sides of the table. He said to the child that they were going to play 'a game of pretend'. The child had to imagine that there were children sitting at each side of the table and looking at the doll. Having obtained each child's agreement that each of the imaginary children could see the doll, E then introduced the cardboard screen. This was placed in one of the four possible orientations parallel to the sides of the table (see fig. 8). E asked whether the imaginary children could now see the doll making non directive comments like "what about him?" pointing to a specific side of the table if a response from that position had not been forthcoming. When responses for all sides of the table had been elicited the screen and the doll were changed to a second predetermined orientation with the screen

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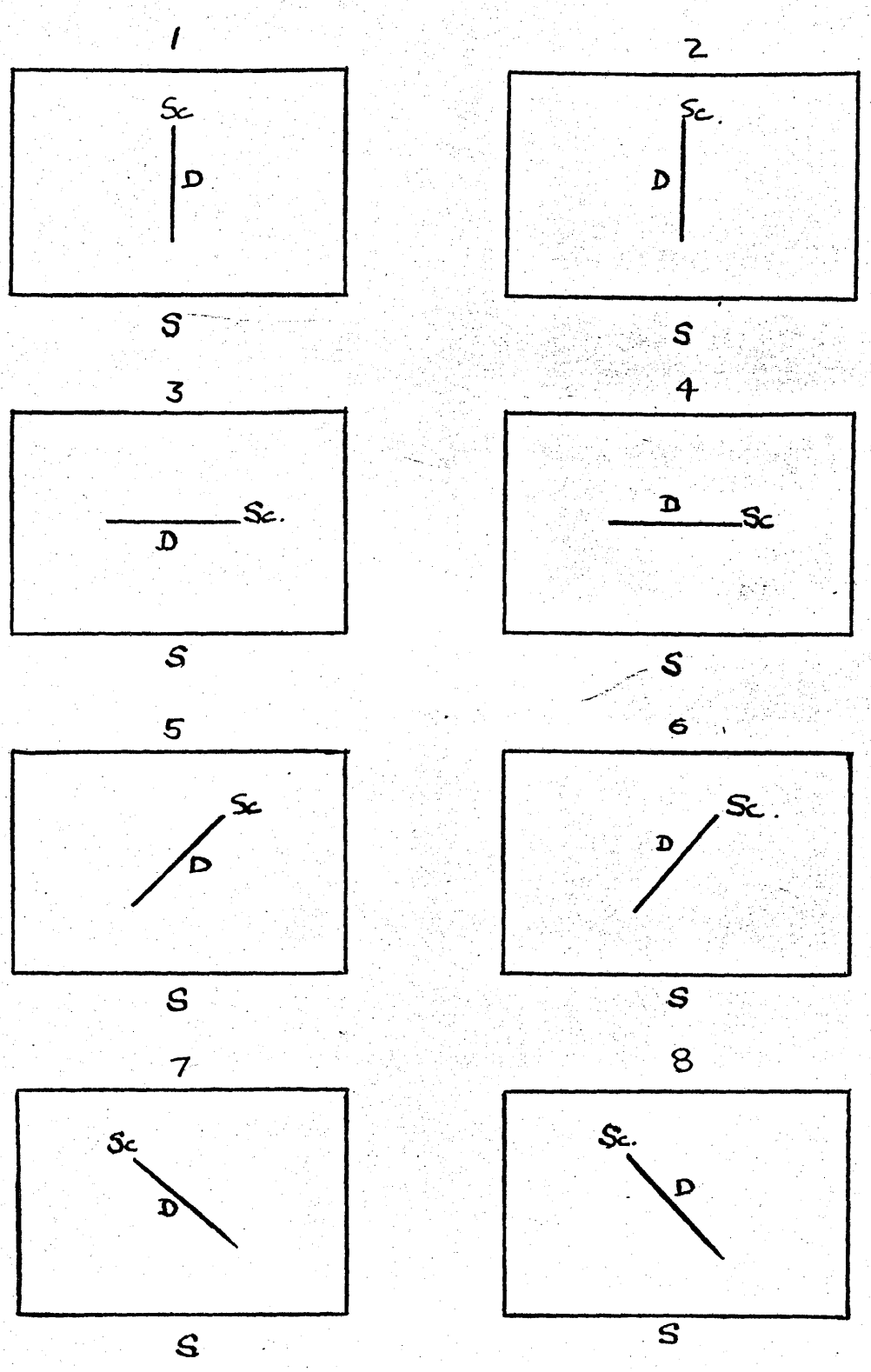
Figure shows the eight orientations of the doll (D) and the screen (Sc.) relative to the child (S).



parallel to the table's sides. The experimenter continued using a similar procedure for the remaining orientations of the screen in the parallel positions and followed using the four oblique positions of the screen (see fig. 8). The angle of the screen for the oblique position is 45°.

The order of presentation was always the four parallel orientations in a predetermined random sequence followed by the four oblique orientations also in a random sequence. For each child, therefore, eight positions of the screen relative to the doll were employed.

Results:

Of the responses made by the child to each stimulus display only some are critical. For example, in orientation 1 in fig. 8 only the child's response to the view of the display from the left side is relevant because this is the position where the egocentric response and the sociocentric response differ. When the two remaining positions are considered it may be seen that the egocentric response and the sociocentric response are similar. Hence for the latter positions it is not reliably possible to distinguish between an egocentric and a sociocentric response. Similarly when orientations 2 and 3 are considered it may be seen that only one of the responses is significant. A consideration of orientation 4, however, shows that there are three such view points whilst each of the oblique orientations of the screen (5-8) result in just two. Hence the total number of critical responses for each subject is 14.

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Table 7

Table shows the total number of egocentric and non-egocentric responses made by younger and older children for the critical positions.

	Older Children	Younger Children	Total
Egocentric	6	27	33
Non-egocentric	246	225	471
Percentage of Non-egocentric responses	97.6%	89.3%	93.5%

The group results (see Table 7) show few egocentric responses made by either the younger or the older children, 93.5% of the total responses made were sociocentric. However, significantly more sociocentric responses were made by the older group (Mann Whitney u = 97, $p < .05$; Seigel, 1956).

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Table 8

Table shows the number of children in each age group who made no egocentric responses or who made one or more egocentric responses.

	Older	Younger
One or more egocentric responses	4	11
No egocentric responses	14	7

$X^2 = 4.1$, $p < .05$

When individual responding was compared (see Table 8) more younger children made (at least one) egocentric responses than did older children.

Discussion:

For this highly simplified display it has been shown that children whom on the basis of age would be assumed to be within the preoperational stage made few egocentric errors. They were readily able to distinguish the view of the display as seen by imaginary observers.

These results extend the research reported in the literature for single model studies by showing that children were capable of understanding that the observer could have a different view of the display. The choice before the child is perhaps the

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simplest possible, however, between which observers have the same view as the child and which see it differently. We need now to increase the complexity of the display and investigate the responses made when each observer has a unique view of the display.

The decrease in egocentric responding found as the age of the children increased may indicate that younger children were more likely to make an egocentric response. However, since only two responses were available this result may reflect a greater response variability in the younger child. This variability being due to factors like the greater probability of the younger child failing to understand the instructions and hence respond randomly.

This experiment was designed to simplify, so far as was possible, the task facing the child. The results showed that children, whom on the grounds of age would be expected to be within the preoperationsstage, did not make egocentric responses when a verbal response was required. Hence egocentric responding may be specific to picture selection techniques. However, we may not conclude that the children were aware of what the observer saw but only whether or not they saw the doll, i.e. the non-egocentric response. We may increase the complexity of this experiment in two ways,

either (a) use a more complex display,

or (b) introduce picture selection.

The next experiment attempts the former whilst keeping a verbal response.

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Experiment 2.

Introduction:

In the previous experiment a highly simplified display was employed for which young children made very few egocentric responses. However, because the display was so simple it was not possible to conclude that the child was aware of what the observer saw. It is necessary to increase the complexity of the display so that each observer has a different perspective which is dependent upon his position vis-a-vs the display. Hence we may test whether the child is aware that each observer has a different view. An increase in display complexity may be accomplished either in the horizontal plane with the dimensions of left/right and near/far or in the vertical plane. In a related field Lumsden and Poteat (1968) found that 'big' was defined by five and six year olds in terms of height alone. Maratsos (1973, 1974) showed the tendency to be less apparent in younger children of three or four years. He evolved a concept called 'top point' which exercised increasing influence with age on children's definitions of 'big', 'tall' and 'high'. By making a comparison in terms of performance differences resulting from changes in the horizontal and vertical dimensions of the display, we may assess whether the greater salience linguistically of the vertical dimension is paralleled in the development of the sociocentric response.

Aims:

To investigate using a more complex display than Experiment 1

(a) the ability of young children to appreciate that others have a different view of a display and that the view depends upon the position of the observer relative to the display,

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(b) the relationship between egocentric responses and age,

and (c) the differential salience of horizontal and vertical dimensions.

Method:

Subjects. Two groups of subjects were used in this study. The younger mean age 4:0 years contained 5 boys and 13 girls who attended a Montessori nursery school. Age range 3:9 to 4:5. The older group mean age 5:6 years consisted of 9 boys and 9 girls from an urban maintained primary school. Age range 5:4 to 5:8. Both schools were situated in middle class residential areas. Different children were used to those who participated in Experiment 1.

Apparatus.

To assess the relative salience of the horizontal and vertical dimension three displays were used. For the first two displays models were made from bricks of different colours and different sizes, yellow bricks of 5cm. side, green and blue bricks of 2.5cm. side and a red brick 1.5cm. side. The display (a) in fig. 9 shows the model in which the green and blue bricks are the same height but of a different length. Figure 10 shows the second display (b) in which the green and blue bricks are the same length but of different heights. The third display (c) (fig. 11) consisted of four cardboard cones, a large orange cone height 20cm. base 10cm., a yellow cone height 10cm. base 5cm., a blue cone height 5cm. base 2.5cm. and the smallest red cone height 2cm. base 1cm.

Three small dolls (height 5cm.) represented the points of view from different sides of the table. The dolls were used so that the child would have a concrete height for the eye level of

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Figure 9.

Figure shows the arrangement of the wooden bricks for the height, same-length, different conditions, Display (a).

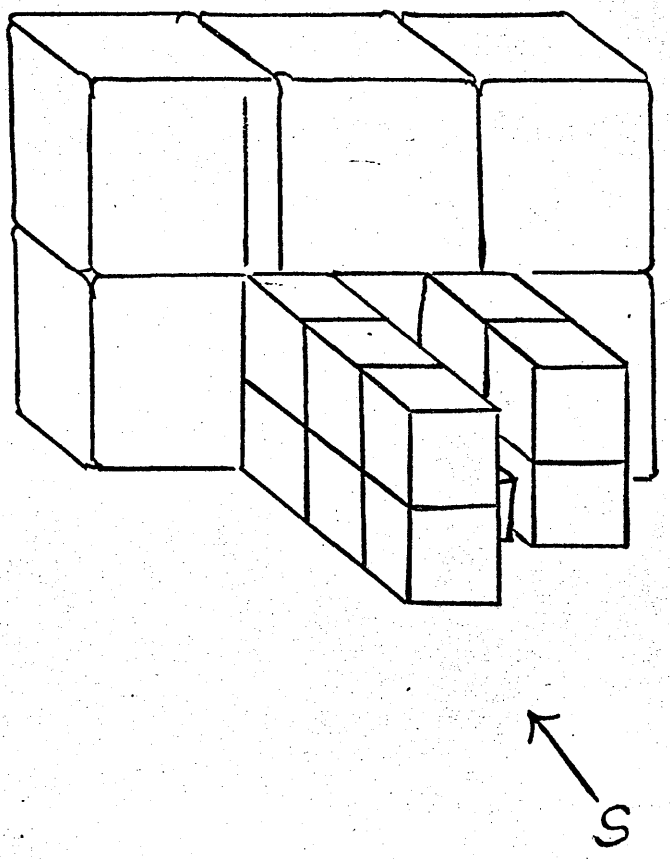


Figure 10

Figure shows the arrangement of the wooden bricks for the height, different-length, same conditions, Display (b).

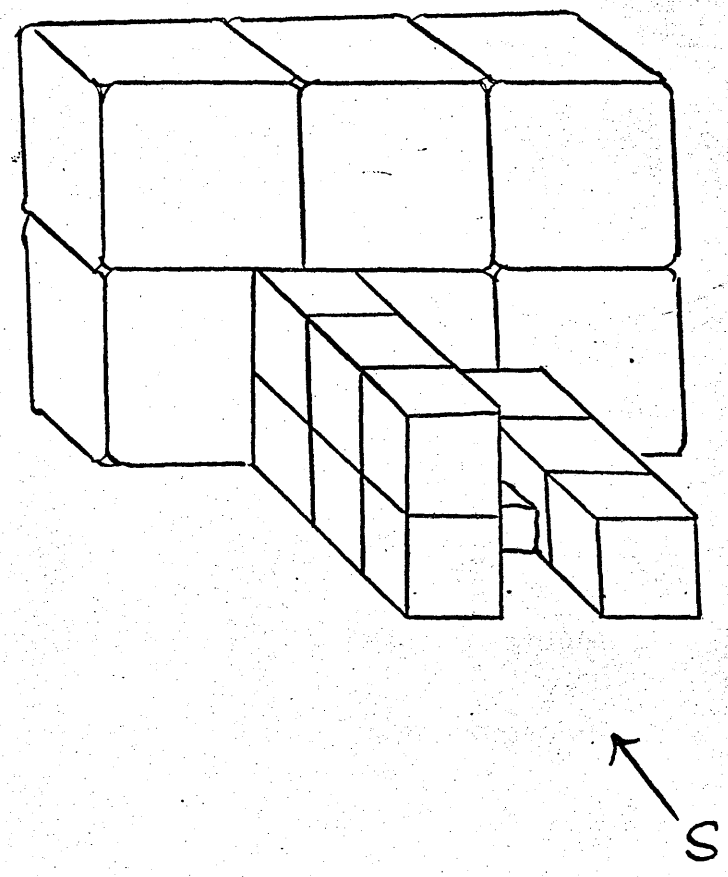
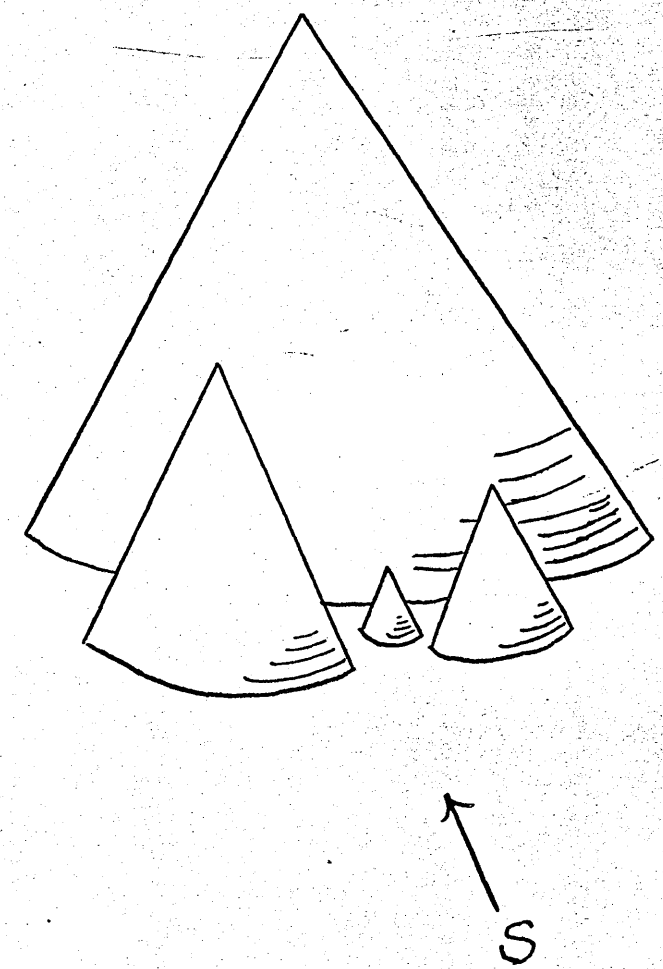


Figure 11

Figure shows arrangement of cones used in the Cone display conditions Display (c).



view from each position. If the child is left to imagine the observer's eye level (as in Experiment 1) then the eye level of the observer will vary over subjects without appropriate experimental control.

Procedure:

The children were seen individually in a small, quiet room. Each sat by the side of the experimenter at the longer edge of a table (2m. x 1m.) in the centre of which were the coloured bricks in a random pile. A brick of each colour was shown to the child to make sure he could discriminate colours. The three dolls were placed at the mid-points of the three other sides of the table - 'looking at the bricks too'. The experimenter then built the display in fig. 9 and asked the child to tell him which colours each of the dolls could see. If no response was made the experimenter pointed to each doll randomly and asked for the response of the doll from the child - 'which colour does that doll see?'.

For the other two displays the procedure was similar but with the displays in figs. 10 and 11 replacing the initial brick model.

Each of the displays was assessed on a separate occasion with three weeks between each visit, i.e. six weeks separated the initial and final sessions. The two brick displays always preceded the cone display. Hence on the first visit the display in fig. 9 was presented, three weeks later the display in fig. 10 and, finally, in a further three weeks the cone display in fig. 11. Whilst no attempt was made to balance for order of presentation it was felt that the three weeks between visits was sufficient time (to limit transfer effects) for children of this age. Nevertheless

cont/....

caution must be observed when interpreting the results of this experiment.

Results.

In order to assess the responses made by each child it was necessary to devise categories into which each response fell. The following categories were employed:

(a) egocentric response - when the child named all four colours for each position of the dolls, i.e. recited what he himself could see.

(b) transitional response - when the child gave a non-egocentric but inaccurate response, i.e. named just one colour when two were visible.

(c) sociocentric response - when the child correctly named the colours for each doll's position.

Table 9 shows the frequency with which children were allocated to each category according to the above criteria for the two age groups, the three displays and the three positions of the dolls. The doll positions are denoted by the points of the compass corresponding to the table sides with the child sitting at south.

By observation of Table 9 the similarity between the number and distribution of responses for the two age groups is readily apparent. For all analyses, therefore, the two groups have been combined into a single sample of 36 subjects.

cont/....

Table 9

Table shows the frequency of each response type for the three displays used, older and younger subjects and the three positions of the dolls round the table.

		Younger			Older		
		Ego-centric	Trans-itional	Socio-centric	Ego-centric	Trans-itional	Socio-centric
Display (a) (height same)	N	1	0	17	2	0	16
	W	1	1	16	2	0	16
	E	1	8	9	2	6	10
Display (b) (height different)	N	1	0	17	0	0	18
	W	1	1	16	0	0	18
	E	2	0	16	2	1	15
Display (c) (height different)	N	0	0	18	1	0	17
	W	0	0	18	1	0	17
	E	0	2	16	1	1	16

The results confirm the findings of Experiment 1 and show that young children were well able to discover the view of the observer for a relatively complex display. Of the 324 responses made, 286 (88.3%) were correct descriptions whilst only 5.5% could be classified as egocentric. No developmental trend was apparent for either response.

cont/....

In terms of the differences between a child's recognition of the horizontal and vertical dimensions the critical position for the doll was east (E) since in that position the doll could "see" all three colours. In this position it is meaningful to separate partially correct and completely correct responses because the omission of a colour enables a positive discrimination to be made. Whilst in theory an omission could also occur for the west or north positions, in practice it was never observed. Hence comparisons between the child's performance for the three displays have been made using only the E position data.

Significantly more children made partially correct or transitional responses for the display (a) than for display (b). (McNemar Test $p = .001$; Seigel, 1956). Hence fewer correct descriptions were made when there was no difference between the heights of the blue and green bricks but a difference in length than when the height of the blue and green bricks were different and the lengths the same. No such change occurred between the responses to display (b) and display (c). A similar change, however, to that between display (a) and display (b) was also recorded for display (a) and display (c). (McNemar Test $p = .001$; Seigal, 1956).

Discussion.

The present experiment extends the conclusions about correct responding that were reached in Experiment 1. With the relatively more complex display employed in the present experiment, children were well able to appreciate that others had a different view of the display and could make accurate descriptions of the view seen by each observer. No support, however, was found for the tendency shown in Experiment 1 for egocentric responding to

cont/....

decrease with age - similar frequencies were recorded for younger and older children. The failure to find an age difference in egocentric responding may relate to the measures used in the present experiment, i.e. only three trials per subject compared to eight per subject in Experiment 1.

Evidence was found showing the vertical dimension to be more salient for young children than the horizontal. This adds support for Laratsou' (1973, 1974) notion of 'top point' with height being the salient dimension when one object obscures another. Thus, when the heights of the two rows of green and blue bricks were the same, the 'top points' were identical and the first row of bricks 'obscured' the second despite the difference in length. When, however, the heights were different, the further bricks had a higher top point than the nearer and hence were visible to the observer. This explanation is given added credence by the lack of a performance difference between display (b) and the cone display.

In Experiments 1 and 2 we have shown that children are aware that observers have different perspectives of a single asymmetric display. Few egocentric responses were made. To bring the experiment nearer to the Piaget and Inhelder (1956) original study a picture selection procedure has to be added and compared to the verbal description task. This is attempted in the next experiment.

cont/....

Experiment 3.

Introduction:

Previous experiments in this series have used only a verbal descriptive technique. Children have had a good deal of success in predicting the view of an observer and have made very few egocentric responses. In the present experiment the procedure is brought closer to that employed by Piaget and Inhelder (1956) by the addition of the interpretation of a two dimensional representation. Recent research has shown that children, whom Piaget would describe as being within the pre-operational stage, have difficulty in making accurate interpretations of some aspects of photographs. (Jahoda and McGurk, 1974; McGurk and Jahoda, 1974). The effect of the addition of a photograph selection procedure would enable an evaluation to be made of the differential effect of the child's view of the display and the two dimensional representation of the child's view of the display, i.e. the egocentric photograph.

Keilgast (1971) demonstrated a paradoxical finding when he compared a verbal description procedure with a photograph selection task. Many of his subjects chose the egocentric photograph subsequent to making non egocentric attempts to describe verbally another's point of view. A replication using a less complex procedure would add to the original Keilgast (1971) study and would enable a more detailed analysis of errors to be presented.

If a verbal descriptive procedure is interposed between two similar photograph selection phases we may examine the Keilgast (1971) finding in more detail. We may also investigate the susceptibility of the responses made by children in the first phase to transfer effects. The ability of a child to make use of the language cues of the verbal descriptive phase to reach

cont/....

different conclusions about the photographs in the final phase may be assessed. An analysis of differences between the initial and final photograph selection phases will enable a comparison to be made of the effect of the language cues of the verbal description task.

Aims.

To investigate

(a) differences in response between a verbal descriptive procedure and a photograph selection task,

and (b) the effect of interposing a verbal descriptive procedure between two photograph selection tasks.

Method.

Subjects. The children who participated in the study consisted of 10 boys and 10 girls from a state primary school in a middle class residential area. Their ages ranged from 5:3 years to 5:9 years with a mean of 5:6 years.

Apparatus. The materials used consisted of 6 yellow bricks of 5cm. side, 6 green bricks and 3 blue bricks of 2.5cm. side and a single red brick of 1.5cm. side. The bricks were arranged so that from the subject's view all four colours were visible. From the right hand side of the table three could be seen - yellow, green and blue. Only yellow and green were visible from the left hand side whilst the opposite view was limited to yellow. A sketch of the display is shown in fig. 12. The subject sat at S.

Four coloured pictures (13cm. x 8cm.) were drawn on cards and represented the views from each side of the display.

cont/....

Procedure. Each child was brought by E from his classroom to a small, quiet room containing a table (2m. x 1m.). The experimenter followed a similar procedure to that used in Experiment 2. The child was shown a brick of each colour to make sure that he could discriminate the colours of the bricks. Three dolls (5cm. high) were placed at the mid points of the three other sides of the table (the child occupying the fourth) - 'looking at the bricks'. The experimenter built the display shown in fig. 12. E said that the dolls had been drawing pictures of the bricks from where they were sitting and the four pictures were introduced. The child was then asked which of the four pictures each doll had drawn from 'where they were sitting'. A response was elicited for each doll.

The pictures were withdrawn from the child's view and he had to name the colours that each doll could see.

Following the verbal descriptive phase the pictures were reintroduced by E and the child was again required to find the picture that corresponded to the view of each of the three dolls.

Results.

In order to assess the responses made by the children it was necessary to devise categories into which each response fell. The following categories were used:

(a) egocentric response - when the child chose the picture which corresponded to his view of the display,

(b) transitional response - when the child chose a picture which was neither the correct nor the egocentric response,

(c) sociocentric response - when the child chose the picture which corresponded to the doll's view.

cont/....

(These categories are the same as were used in Experiment 2).

For the intermediate naming of colours phase similar categories were used but refer to the colours named by the child. (see pg.100).

The positions of the three dolls are given by the compass points W, N and E with the subject sitting at S. The results for the three experimental phases are shown in Table 10.

Table 10

Table shows the frequency of each response type for the initial photograph selection phase, the verbal description phase and the final photograph selection phase for the three positions of the doll round the table.

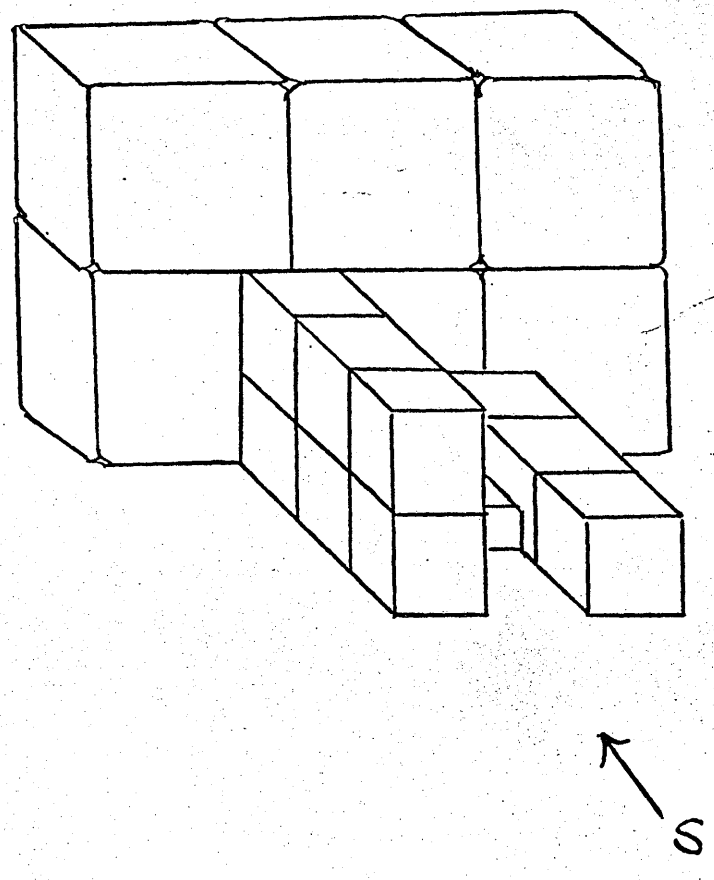
Response Type

		Ego-centrism	Trans-itional	Socio-centric
Initial Photograph Selection	N	2	4	14
	W	1	8	11
	E	7	6	7
Verbal Description	N	0	0	20
	W	1	0	19
	E	1	2	17
Final Photograph Selection	N	0	1	19
	W	0	3	17
	E	6	2	12

cont/....

Figure 12.

Figure shows the arrangement of wooden bricks used for the experimental display.



The results of the intermediate stage are consistant with the results found for display (b) of Experiment 2. (i.e. a similar display and procedure were used). Only 2 of the 60 responses made were egocentric (3%) whilst 56 (94%) were the correct descriptions of the perspective of the doll. All positions of the doll show significantly more correct responses than would be expected by chance (χ^2 all $p < .05$).

When the two picture selection phases are compared, egocentric responding is 17% for the initial stage and 10% for the final. Of the 120 responses for both stages 80 were correct selections of the appropriate picture, 53% for the initial and 80% for the final stage. For each of the positions N and W of both stages the distribution of responses significantly deviates from a chance expectancy (χ^2 all at least 6 $p < .05$). This reflects a low rate of egocentric responding. Examination of the E position shows chance responding for the initial phase but a significant deviation from chance for the final stage ($\chi^2 = 7.4$ $p < .05$). The significant distribution is caused by the low frequency of transitional responses and a corresponding increase in selection of the correct picture.

In comparing the different phases of the experiment the critical position of the doll is position E since in that position the doll could see three colours. Only in this position is it possible to separate in a meaningful way the transitional responses from the correct responses. Thus when comparing phases the analyses have concentrated on the E position.

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For the E position, 13 children made egocentric or transitional responses for the first picture selection stage but only 3 of these made a similar response for the verbal description phase. Hence 10 children changed from egocentric or transitional to correct responding between the two stages (McNemar $X^2 = 8.1$, $p < .01$, 1df; Seigel, 1956). There were 5 children who made a sociocentric response to the verbal description stage yet continued by making egocentric or transitional responses for the final picture selection stage. Hence more children made correct responses for verbal descriptions even though this preceded the final picture selection stage.

Support is shown for Neilgast (1971) with five children following a non-egocentric response for the intermediate verbal description with an egocentric response for the final picture selection phase.

When the two picture selection phases are compared it can be seen that egocentric responding remains constant; the gain in correct responding was almost totally at the expense of transitional responses. Verbal description, therefore, appears to have given children who made a transitional response for the initial picture selection a means by which to discover the correct response. Children who made egocentric responses remain resistant to change and appear unable to make use of the strategy suggested by the intermediate stage. However, half of this group made correct responses during verbal description and only one described his own perspective.

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Discussion.

The results of the present experiment confirm the results of earlier experiments of this series, that children are well able to describe correctly the view of an observer when a single asymmetric model forms the display.

The difference in performance between the picture selection phases and verbal description adds support to the conclusions found for a multiple model display by Keilgast (1971). There were some children who showed that they were aware of the view of an observer during the intermediate verbal descriptive phase but who continued by making egocentric responses in a subsequent picture selection task. Other children, however, were able to make use of the verbal stage perhaps in the development of a strategy, and transform partially correct responses for the initial picture selection to correct responses for the final stage. This finding parallels Brodzinsky et al (1972) who suggested that children in a transitional co-ordination of perspectives stage (i.e. sociocentric) possessed a latent structure that was inhibited by the child's view of the display. Shielding the display from view whilst the child made a response enabled the child to make use of the latent mechanisms and led to a significant increase in correct responding for a co-ordination of perspectives task. In the present experiment, however, the children are much younger than the group for whom Brodzinsky et al (1972) made the suggestion.

There appear to be two types of children in this sample not unlike the pre-operational and concrete operational groups described by Piaget and Inhelder (1956). However, rather than

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having a difficulty in freeing themselves from their own view of the display this experiment seems to show that a 'pre-operational like' group exists who find difficulty in freeing themselves from matching the egocentric photograph with the view that they see. It is, therefore, the egocentric photograph rather than the egocentric view per se that is significant. This would also be consistent with the conclusions of Nigl and Fishbein (1974) who introduced for co-ordination of perspectives the concept of 'inhibition of the child's own view'. The presence of the egocentric photograph may lead to an interference between differing representations and thus a matching response to the representation of the display as it is seen by the child rather than a representation of the observer's view.

The present experiment has demonstrated the extent to which procedural variations can have a significant effect upon children's responses. This issue is raised again in the following experiment where the influence of the instructions given to children is investigated.

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Experiment 4

Introduction:

Probably the most crucial part of any experiment is the means by which the experimenter communicates to the subject the task that he will be required to undertake. This is particularly so with children with whom it is vital to employ language and concepts that are within the child's understanding. As we have seen many of the studies within the research literature have attempted to simplify the task by reducing the cognitive load. Nevertheless, for most studies that approximate to Piaget and Inhelder (1956) young children tend to choose the egocentric photograph. It is, however, possible to place an alternative explanation for this choice because the egocentric photograph is also the photograph that 'matches' the view seen by the child. An alternative hypothesis, then, that might be suggested refers to the child failing to understand the language of the instructions so that he makes an 'inappropriate match' between his own view of the display and the egocentric photograph. To test the hypothesis with that of Piaget and Inhelder (1956) we require an experiment in which we compare the effect of 'matching' instructions with the effect of 'sociocentric' instructions.

It is clear that if the two instructions are to be compared we cannot use the traditional photograph selection of Piaget and Inhelder (1956). An adaptation of a model reproduction sequence appears more appropriate because the language of the instructions may be kept to a minimum and there is no interference of the child's ability to interpret photographs.

The differential response of children to the dimensions of

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left/right and near/far in others has been frequently investigated in the literature (Piaget, 1926; Flavell et al, 1968; Olson and Baker, 1972; Cole et al, 1973; Minnigerode and Carey, 1974; Higl and Fishbein, 1974). In this experiment we may assess how the child's superiority with the dimension of near/far in others relates to the instructions given.

Aims.

To investigate using a simple single model display

(a) the effect of using different sets of instructions and (b) the difference between the dimensions of left/right and near/far.

Method.

Subjects. There were 120 children who participated in the present experiment. They attended the reception classes of two maintained first schools situated in middle class residential areas. Each of the three experimental groups contained approximately equal numbers of boys and girls. The age range of the children was 5:5 years to 6:0 years with a mean age for each group of 5:9 years.

Apparatus. The apparatus consisted of two pieces of rigid card 15cm. x 15cm. Each card was divided by a centre line into two equal rectangles. One half of the card was coloured green and the other half yellow.

Procedure. Each child was brought from his classroom to a small, quiet room containing a table measuring approximately 2m. x 1m. He was given one of the two following sets of instructions that required him either to match a card with the experimenter's card or to respond in a sociocentric manner.

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In more detail the respective instructions were:-

(a) Simultaneous matching

E gave one of the two identical cards to the child and kept one for himself. He placed his card on the table, immediately in front of him, and asked the child to put the second card on the table 'so that it looks exactly the same as mine'. Following the response by the child, the orientation of the experimenter's card was changed and a second response was obtained from the child. Subsequent similar trials followed.

(b) Sociocentric response

The experimenter explained to the child that they were going to play a game called 'Follow my leader' - a game in which the child would have to do everything just as he did, 'as if you were me'. The experimenter made a few gestures with his hands like clapping, etc. and encouraged the child to repeat the experimenter's actions.

Both, then, picked up their respective cards. The experimenter placed his on the table saying 'Put your's on the table as if you were me'. Following the child's response the experimenter picked up his card and placed it in a second orientation encouraging the child to follow suit.

For all trials with both sets of instructions, the experimenter was always careful to avoid simply rotating the card on the table to a new position. Between trials he picked up his card and rotated it in horizontal and vertical planes to ensure that the child would receive few cues as to the degree of rotation between one trial and the next.

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A comparison was made between the positions of the child relative t ——————— ter using the following three positions:-

(a) side by side: the child and the experimenter sitting side by side at the same edge of the table.

(b) opposite: the child and the experimenter sat at the mid points of the longer opposite sides of the table.

(c) at 90°: the child sat at the shorter side of the table at 90° to the experimenter.

Each position of the child relative to the experimenter was used with matched groups of 20 subjects for the two sets of instructions. For each of the six combined conditions 32 trials were administered using random selections of eight of the 24 possible permutations of the four orientations of the experimenter's card.

Two stimulus variables were also under investigation corresponding to the two dimensions of the card, i.e.

(a) the near-far dimension

and (b) the left-right dimension.

The dimensions refer to the orientation of the experimenter's card relative to the experimenter.

To summarise the design, the two between subject conditions were instruction type and position of the subject relative to the experimenter. In each of the six cells were 20 subjects matched for age. Within each cell differences between the two dimensions of the stimulus card could be compared. A maximum score of 16 could, therefore, be obtained for each of the stimulus card dimensions.

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Results:

For each of the three subject positions there were four possible responses that a child could make for each of the four orientations of the stimulus card. Two response types are significant for this study. Firstly, the egocentric response, when the child's card and the experimenter's card are in the same orientation relative to the child. This also corresponds to a 'match' of the two cards. The second response type is the sociocentric response for which the subject's card is in the same orientation to the subject as the experimenter's card is relative to the experimenter.

Table 11 shows the mean number of responses for each response type for each of the three subject positions, two sets of instructions and two stimulus dimensions.

The effect of the different instructions for position A shows, as would be expected, no difference between the frequency of each response over instructions.

When the child and experimenter sat opposite there were numerically more egocentric (matching) responses for the matching instructions and more sociocentric responses for the sociocentric instructions for both left/right and near/far dimension. All comparisons between each response compared across instructions, however, failed even to reach significance.

The results for positions A and B seem to parallel closely the findings of Huttenlocher (1966, 1967) for each set of instructions. She noted the young child's tendency when two cards were arranged side by side to make bilaterally symmetrical responses to the left/right dimension, i.e. [ ]

cont/....

Table 11

The tables below show the mean number of responses for each response type, for each of the three positions and the two stimulus orientations.

Egocentric responses (E), Sociocentric responses (S). (Mirror image responses denoted by E' and S').

Position A (side by side)

	Dimension			
	Near-Far		Left-right	
	E resp.	E' resp.	E resp.	E' resp.
Matching instructions	15.2	0.8	11.1	4.9
Sociocentric instructions	14.3	1.7	10.3	5.7

Position B (opposite)

	Dimension			
	Near-far		Left-right	
	E resp.	S resp.	E resp.	S resp.
Matching instructions	5.6	10.4	15.1	0.9
Sociocentric instructions	3.4	12.6	13.8	2.2

Position C (90°)

	Dimension							
	Near-far				Left-right			
	E resp.	E' resp.	S resp.	S' resp.	E resp.	E' resp.	S resp.	S' resp.
Matching instructions	2.2	0.5	11.9	1.4	3.3	0.3	2.9	9.5
Sociocentric instructions	0.4	0.4	15.1	0.11	0.1	0.1	8.5	7.3

but not for the near/far dimension, i.e. ⊓⊓. However, when the cards were arranged one above the other bilaterally symmetrical responses were made to the near/far dimension, i.e. ⊓ but not for the left/right, i.e. ⊂⊃ . The proportion of correct to mirror image responses in positions A and B in the present experiment is almost identical to that found by Huttenlocher (1966, 1967).

Comparing the two sets of instructions for position C, there were significantly more correctly reproduced sociocentric responses for the sociocentric instructions for the near-far orientation of the stimulus card ($U = 114$, $p < .01$ one tailed test) and for the left/right orientation ($U = 71$ $p < .001$, one tailed test). There were many zero scores for children making egocentric responses. Hence when comparing egocentric responses for the two sets of instructions a comparison was made between children who made at least one egocentric (or matching) response with the number of children who did not make a matching response. The results showed a significant difference for the near-far dimension ($p = 0.009$, Fisher Exact Probability Test; Seigel, 1956) and for left-right ($p = 0.013$, Fisher Exact Probability Test, Seigel, 1956). It is noticable, however, from Table 11 Position C, that the distribution of responses for each of the types of instructions is not markedly different. It is apparent, therefore, that children find some difficulty in distinguishing between instructions for position C just as they found for positions A and B.

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Discussion.

Had only the sociocentric instructions been administered in the present experiment the conclusion might well have been reached that, with the exception of the right/left dimension, when the experimenter and the child sit on opposite sides of the table, children of 5½ years were well able to make sociocentric responses. However, as has been shown, the distribution of scores for each response for the sociocentric instructions is similar to the distribution obtained when children were required to match. The stronger the visual perceptual features the closer the distributions come. Indeed when the stimulus card, the response card and the child are 'in line' (Bryant, 1974), (child and experimenter sitting opposite), the results obtained are identical to Huttenlocher (1966, 1967). Hence it appears that the child's representation of the situation was sufficient to inhibit the requirements of the sociocentric instructions.

This experiment extends the present series in that the child has to understand more than the colour naming of Experiment 2 and part of Experiment 3; he has to discover how the card appears to the observer in terms of the dimensions of left/right and near/far. Just as with the picture selection parts of Experiment 3 children have difficulty in finding the other's view. However, totally different types of errors are made. The common element between the errors made in the two experiments refers to the tendency of the child to 'match' his response with the stimulus. The match in picture selection of Experiment 3 was the egocentric picture with the child's own view. In the

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present experiment the match is between the two cards - the stronger the visual cues the closer the match.

We have shown the difficulty that young children find when required to find the view of another and in distinguishing between sets of instructions. We shall continue by using a photograph selection task.which has a display based on the near/far and left/right dimensional cues of the present experiment. A comparison of the error responses may enable differences between model reproduction and picture selection to be evaluated.

Experiment 5

Introduction:

The previous experiments in this series have investigated the development of sociocentrism. In the present experiment the study will be extended to incorporate some aspects of co-ordination of perspectives.

In the literature the symmetry-asymmetry issue has been discussed (see pg. 43Section 2.2.4). It was concluded that when an asymmetric display was employed in a picture selection task without appropriate mirror image photographs, then the child may solve the co-ordination of perspectives task by noting the position of specific aspects of the display vis-a-vis the observer. Specific training, however, may be necessary before children may use this technique. Thus Fishbein et al's (1972) children could choose the most significant feature of a display whereas children of the same age in the study of Piaget and Inhelder (1956) responded to the most prominant feature and failed to co-ordinate. In the present experiment an attempt will be made to assess the effect of different base cues on performance without prior training. A comparison may be made of the errors so that the results of the model reproduction of Experiment 4 may be compared to picture selection.

An hypothesis that may be advanced for the tendency of a young child to choose the egocentric photograph relates to the number of photographs forming the array. A child may become so confused by the number (and relative similarity) of the photographs (Coie et al, 1972) that he disregards the instructions given to find the observer's view. He opts instead for the familiar photograph that matches his own perspective.

cont/....

The possibility that the egocentric response is an 'inappropriate match' due to the display, the egocentric photograph and the child being 'in line' was proposed in Experiment 4. If this is the sole cause of an egocentric response then the removal of the own view photograph from the selection array should free the child to make ansociocentric response. A comparison between the child's performance with and without the egocentric photograph should enable an evaluation to be made of the effect of the presence of the representation of the child's view.

Aims.

To investigate the effect on young childrens performance for a co-ordination of perspectives task

(a) of adding dimensional base cues

(b) of reducing the photograph choice to only two photographs,

and (c) of the presence or absence of the egocentric view photograph.

Method.

Subjects. The subjects participating in this experiment were two groups of 10 pupils at a rural infants school. The younger group had an age range 5:7 - 6:8 years (mean age 6:2 years) and the older a range of 6:10 years - 7:3 years (mean age 7:0 years). All were boys.

Apparatus: The apparatus consisted of four differently coloured base boards (30cm. x 30cm.) (see fig. 13).

A. A single colour with all quadrants pink

B. Half the board coloured brown and the other half red. This board was always presented

cont/....

with the brown half on S's right hand side.

C. Half the board coloured yellow and the other half green. This board was always presented with the yellow half towards S.

D. Each of the quadrants were different colours - red, yellow, blue and green. The red quadrant was always placed nearest S and on his right hand side.

A fifth board, F, was used during the familiarisation stage. Two diagonal quadrants were green and two blue.

Four toys were used for experimental trials, a red wooden brick 4.5cm. square, a plastic pink saucer 4.0cm. diameter, a white toy dustbin with a red lid 4cm. high and a white telegraph pole 10cm. high. The toys were placed in the central point of separate quadrants, according to whether one, two or four toys were being used.

Four different objects were used for the familiarisation sequence, a white toy chair 5cm. high, a green model car 7cm. long, a small, green brick 3cm. square and a 2p. piece.

Three coloured photographs (12 x 7cm.) were taken from approximately eye level for a seated child of three views of the display; the child's view, the view from the side at 90° to the child and the view from the side opposite. Thus for each of the 12 possible combinations of base board and number of toys there were 3 photographs.

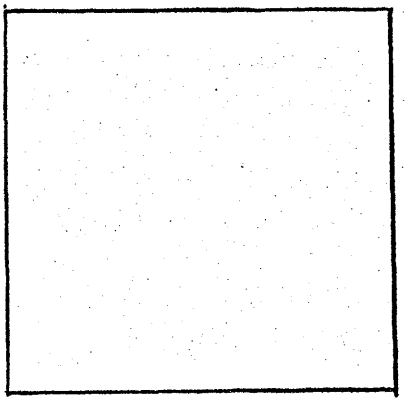
Procedure.

Each child was brought from his classroom into a small, quiet room which contained a small table and three chairs. The

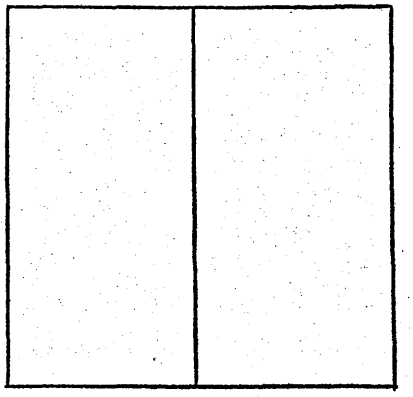
cont/....

Figure 13

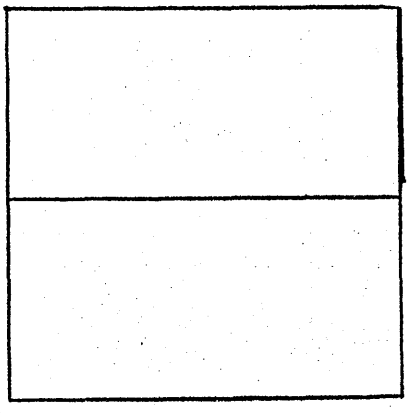
Figure shows the four base boards used in the experimental procedure A, B, C and D and the familiarisation base board, F.



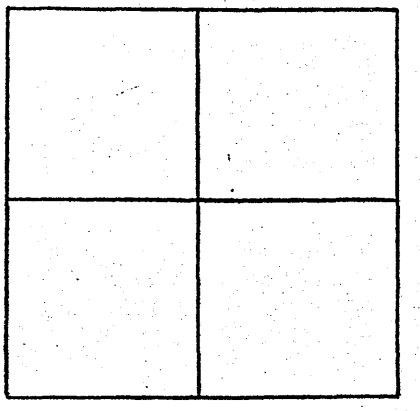
A



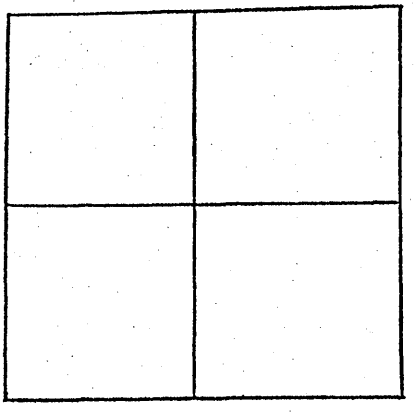
B



C



D



F

subject sat on one chair at the longer side of the table. The other two chairs, one at the side 90° to the child, the other at the side opposite to him, were used by the experimenter when taking up the two observer positions.

The familiarisation sequence consisted of three trials using base board F. E sat either at the 90° side or opposite (randomly varied over subjects) and placed the toy chair centrally on one quadrant of the display. He placed two photographs in front of the child, between the child and the display, and said that they had been taken either from where the child was sitting or where E was sitting. He, then, asked the child to choose 'the picture which I took from here'. Regardless of the child's response E gave praise and encouragement but no feedback of the correctness or otherwise of the child's response. Two subsequent trials were administered using two and four toys respectively. Throughout the familiarisation and experimental trials E alternated between the chair opposite and the chair at 90° after every two trials counter balancing position effect in an ABBA sequence.

For the experimental trials each child was presented with each of the four base boards in a random sequence with an increasing number of toys from one, two and then four. The different numbers of toys were used as a block of trials for each board. Thus, this represented 12 trials per subject, one trial per subject per board x toy combination.

Two experimental sessions were administered separated by about a week. In the first session the egocentric view was paired with the photograph that corresponded to E's view and

cont/....

for the second session the correct view was compared to another non-egocentric view of the display. (No attempt was made to counter balance for order of presentation. It is recognised that this places limits on conclusions that may be drawn).

Thus there were five variables that were being assessed:

(a) the number of toys

(b) the type of base boards

(c) age

(d) the position of E (opposite or side)

and (e) the absence or presence of the egocentric photograph. Hence (a), (b), (d) and (e) were within subject variables and (c) was a between subjects variable.

For all trials the photograph chosen was recorded.

Results.

Initially an analysis of the distributions of responses was made for the two positions of the experimenter. The distributions were practically identical so responses were collapsed over relative positions.

Table 12 records the number of subjects who correctly chose the photograph which corresponded to the experimenter's position. The results are given in terms of the type of base board A, B, C or D, the number of toys used, younger or older subjects and whether the egocentric view was present or not.

cont/....

Table12

Table shows the number of children who correctly chose the photograph which corresponded to the experimenter's position, given in terms of base board type A, B, C or D, number of toys used, 1, 2 or 4, younger and older subjects and whether the egocentric view photograph was present or not.

		Egocentric View Present				Egocentric View Absent			
		A	B	C	D	A	B	C	D
Younger	1	4	2	2	1	5	4	6	6
	2	1	4	2	3	3	7	4	5
	4	2	3	3	2	6	8	4	6
Older	1	3	2	2	3	6	5	4	7
	2	5	2	4	3	7	7	7	4
	4	3	4	2	2	6	2	6	5

The effect of the number of toys over matched bases was investigated using the number of subjects who made a correct response for each base x toy condition. An analysis of variance by ranks (Friedman; Seigel, 1956) was calculated for each of the four age x egocentric view present or absent combinations. No difference was found using the differences in ranking between three levels of display complexity as columns in the analysis. ($X^2 < 2$, $p > .05$ for all combinations).

cont/....

The effect of the type of base over matched toy conditions was compared in a similar manner. The columns of the Friedman analyses were the four types of base employed in the study. No difference was observed between bases (Friedman analysis of variance by ranks. X^2 all < 3, $p > .05$; Seigel, 1956).

Therefore neither display complexity or base board cues significantly effected performance in this instance.

The age effect and the egocentric view present v absent condition were compared using the number of correct responses (max. 12) made by each child. The age levels were a between subjects variable and the egocentric view present or absent a within subject variable (Weiner, 1970). No effect was discovered due to chronological age but a highly significant difference was observed between performance for the task depending upon whether the egocentric view was absent or present.

Table 13

Table shows results of a mixed analysis of variance using chronological age as the between subject variable (Age) and presence or absence of egocentric photograph as a within subject variable (Photograph).

Source	SS	df	M.S.	F	
Between S	143	19			
Age	2	1	2	1	n.s.
Error	141	18	7.8		
Within S	182	20			
Photograph	109	1	109	26.6	$p < .01$
Age & Photograph	0	1	0	0	n.s.
Error	73	18	4.1		

When the egocentric view was absent chance responses were made for the correct photograph (6.4 for the younger children and 6.6 for the older group). However, the number of correct responses dropped when the egocentric view was present (?.9 for younger children and 3.5 for the older) because the egocentric photograph was chosen more frequently.

Discussion.

The results indicate clearly that 'the confusion theory' for the tendency of a child to produce egocentric responses must be rejected. In a simple two-choice task the child chose the egocentric view more frequently than the correct view. Hence, although a child must certainly experience some confusion when viewing an array of six or ten photographs, the size of this array is not the cause of him choosing the egocentric photograph. Eliminating the egocentric view did not result in a switch to non-egocentric responding; choices were now merely at a chance level. Therefore we may conclude that, although the children were not able to attempt successfully the representational task of finding the view of another, they were able (inappropriately) to relate their view of the display with the photograph to which it corresponded. This is, of course, the conclusion reached by Piaget and Inhelder (1956), i.e. the children are within the pre-operational stage and, hence, because they are unable to appreciate that others have a different point of view, they choose the egocentric photograph. When the egocentric photograph is not present a random choice is made.

The children were unable to use the dimensional base cues even for the near-far dimension of the task. It was shown in

cont/....

Experiment 4 that for both the opposite and side positions of the experimenter, children performed to the near-far dimension as if they were making a sociocentric response (regardless of whether matching or sociocentric instructions had been given). The addition of photographs to the procedure appears, therefore, fundamentally to have changed the child's conception of the task. A similar conclusion was reached in Experiment 3 when a verbal descriptive procedure and picture selection were compared. Hence this adds to the evidence that egocentric responding may be specific to picture selection.

Further experimental work needs to be undertaken to clarify the role of the photograph response for the co-ordination of perspectives procedure. A comparison needs to be attempted between co-ordination of perspectives tasks using a similar display that do or do not entail photograph interpretation. By doing this we may get closer to discovering why children make egocentric responses. It was suggested in the present experiment that young children performed differently according to whether the photographic task included the egocentric photograph. An investigation should be undertaken to discover whether the difference is apparent only for children within the pre-operational stage or whether a similar effect extends through the middle years of childhood.

Experiment 6

Introduction.

The present experiment is the most extensive of the series, hence an attempt will be made to recapitulate some of the arguments and conclusions that have been made previously. Essentially Piaget and Inhelder (1956) regard the child's performance for the three mountains task as reflecting Piaget's general developmental model. Children choose the egocentric photograph because they are within the pre-operational stage of development, a stage during which their understanding is restricted. It is not until the child is able to appreciate that others may have a different view that he can attempt to build a representation of the view. Two distinct abilities are involved. Firstly, to be free of the constraints of the pre-operational stage and develop a sociocentric mode of thought. Secondly, to manipulate the internal dimensions of the display and free himself from the limiting tendency to fixate on one aspect of the model.

Previous experiments in this study have shown that the above concepts of egocentrism-sociocentrism and centration-decentration do not necessarily generalise to all tasks. It has been shown, for example, that the use of a verbal descriptive technique results in few, if any, egocentric errors. Only the introduction of the representation of the child's view in a picture selection task led to egocentric errors. A suggestion was, therefore, made that the results of Piaget and Inhelder (1956) were specific to picture selection and are due, in part, to the difficulties that young children find with the interpretation of of the two dimensional photographic representation.

In Experiment 3 we showed support for the finding of

cont/....

Keilgast (1972) that children made egocentric errors for a picture selection procedure even though they had previously shown themselves to be aware, during a verbal description task, that a non-egocentric response was appropriate. Little difference was found, too, in Experiment 4, between instructions that required a child to 'match' or 'to respond sociocentrically'. Results were shown to be consistent with Huttenlocher (1966, 1967). Although Piaget is concerned more with stages of development rather than age per se, the continuation of egocentric responding into the later years of childhood (e.g. Laurendeau and Pinard, 1970) does require some attention. The concept of 'inappropriate matching' was introduced as a possible alternative interpretation of these results. It resembles closely the 'inability to inhibit one's own view' of Nigl and Fishbein (1974).

In the present experiment we shall compare the three major procedural variables of the research literature for the same experimental display. A verbal descriptive technique will enable a comparison to be made between the results of earlier experiments in the series with a display that more closely resembles the Piaget and Inhelder (1956) original. Predictions made from the earlier experiments should point to children finding this task relatively easy and making few egocentric responses. However, children will have to do more than name colours in the present experiment. The concept of left-right in others will be an essential part of a correct response and we know from other research (e.g. Piaget, 1926; Laurendeau and Pinard, 1970) that children find this difficult. To assess the child's ability to co-ordinate perspectives without the need to interpret a two dimensional representation a model reproduction sequence will be

cont/....

incorporated. If the egocentric response is specific to picture selection we should expect few egocentric errors. An opportunity exists for evaluating the 'inappropriate match' hypothesis for this experimental phase. As the model is to be made by the child on a table at 90° to the stimulus display then the egocentric response and the matching response will be different.

Finally, picture selection will be used as a comparitive base line since it most closely approximates to Piaget and Inhelder's (1956) procedure. The opportunity will be taken to extend the results of Experiment 5 and compare the performance of children across an age range when the egocentric photograph is part of the photograph selection array and when it is not.

Comparisons will also be made of the three procedures both in terms of mean levels of responding and on a developmental stage model. The effect, therefore, may be judged of the relative influence for egocentric responding of

(a) that the only view of the display that the child sees is his own and this is the view he sees throughout

and (b) that the photograph of the egocentric view is always available for selection in the Piaget and Inhelder (1956) procedure.

The familiarisation sequence by which the task is introduced to the child has received sparse attention in the research literature. It is, however, certainly the most important stage in the experiment for, if a child fails to understand accurately what is expected of him, then interpretation of the results produced is not meaningful. The effect of movement on performance was discussed earlier (section 2.36, pg.61), in

cont/....

particular the study of Eiser (1974) who showed that prior exploration of the display as part of the familiarisation sequence significantly reduced the number of egocentric responses. However, Eiser (1974) used the same display for prior experience that she subsequently used for experimental trials. This reduces the co-ordination of perspectives from the anticipatory skill of finding a new view to a recall task of remembering a previously seen view. Her results are explicable in these terms. Only by using a different display for the prior training trials to that used in the experiment proper may we eliminate the anticipation-recognition confounding effect.

Two areas of pre-training are used in the present study. The child is made aware that others views are possible by showing him how a second display looks from different positions. It would be expected that a child who had been shown the differing views during the pre-training sequence would be less likely to produce egocentric responses for the experimental trials. A second area of familiarisation refers to the use children make of language. If children are given the appropriate language concepts of left-right and near-far during a pre-training experience then they would be expected to make use of these dimensions during the experimental trials. Children without the language may be aware that another has a different view but may not have the language concepts to express this view accurately. If we combine the two areas of pre-training we have four combinations of prior experience:

(a) both language and movement, the child shown the view from different positions and the

cont/....

view is described by the experimenter in terms of left-right and near-far. (L+ M+)

(b) movement only, the child is shown the display from different positions (L- M+)

(c) language only, the child remains stationary and the experimenter takes up positions and describes how the display looks from each (L+ M-)

(d) without language or movement, no prior training given (L- M-)

Aim.

To investigate the performance of young children when undertaking a co-ordination of perspectives task using

(a) three types of response

(b) the absence or presence of the egocentric photograph

and (c) different familiarisation sequences.

Method.

Subjects. The sample consisted of 216 children from maintained primary schools situated in largely middle class residential areas. The children were divided into three groups of 72 children with mean ages of 5½, 8 and 10½ years and an age range of plus or minus three months in each case. Equal numbers of boys and girls participated.

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Apparatus.

The display consisted of a yellow tin cylinder 11cm. high and 9cm. base, an inverted green carton 7cm. high, 7cm. at the base radius and narrowing to a radius of 5cm. and a red cardboard cylinder 8cm. high and 2.5cm. radius. They were arranged on a light blue cardboard base 50cm. radius that was placed centrally on a circular table 1m. in diameter (see fig. 14).

An identical set of materials were placed on an identical table oriented at 90° to the original table (see fig. 14).

Eight colour photographs (10cm. x 6cm.) were taken from points at 45° intervals round the table (A to G plus S in fig. 14). Mirror image photographs were manufactured for each of the points from A to G. Hence there were a total of 15 photographs in all. (see fig. 15).

Procedure.

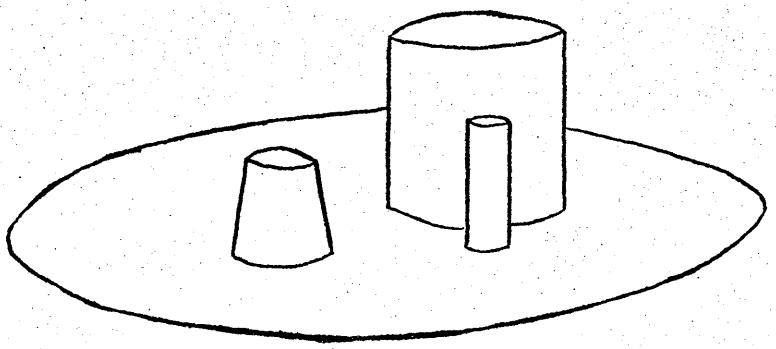
Familiarisation sequence. Prior to the experimental trials one of four familiarisation or pre-training sequences were administered which incorporated aspects of language and movement. The familiarisation display consisted of an opaque glass jar 14cm. high and 10cm. radius, a wooden square prism 8cm. high and 5cm. square and a box of matches 5cm. x 3.5cm. x 1.5cm. The objects were arranged on the blue base board taking the place of the experimental material. The four sequences were:-

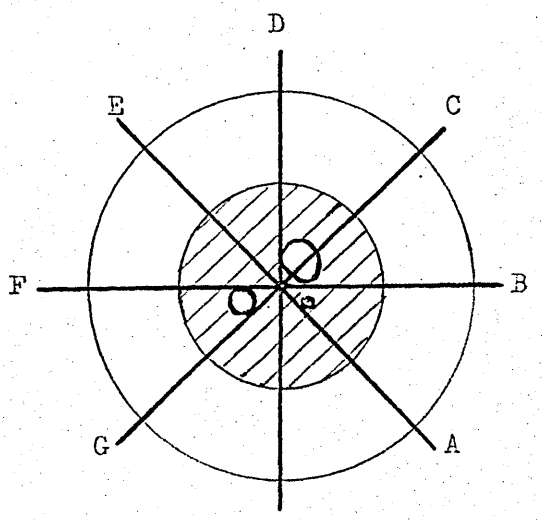
(a) the child sat at different places successively round the table and the experimenter, who stood behind the child, described how the model looked from each position, e.g. 'the jar is near to us at the front and on our left, the wood is at the front and

cont/....

Fig. 14

Sketches show the display, the orientation of the two tables and the seven positions of the experimenter.





Subject

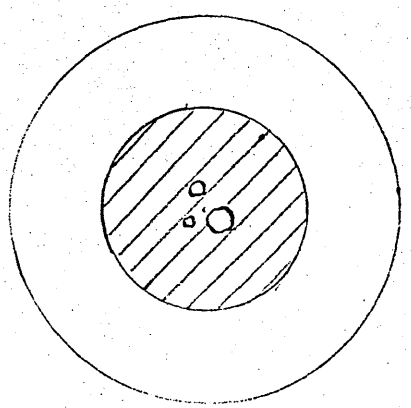
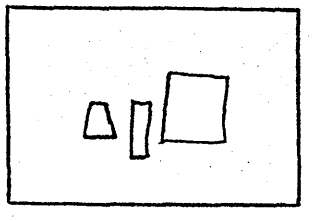


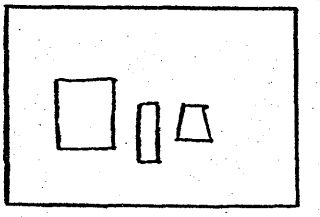
Table on which model was made.

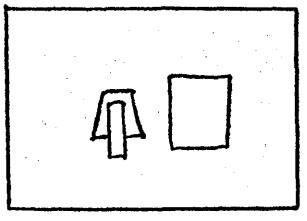
Fig. 15

Figure shows the fifteen photographs from which four were chosen for each photograph selection trial.

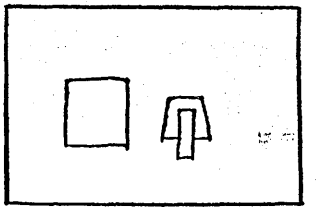


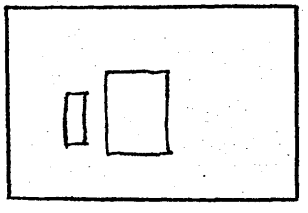
A 45° A'



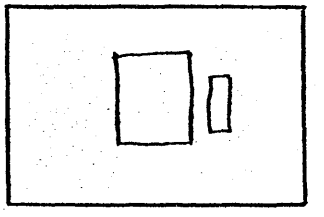


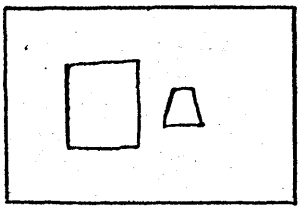
B 90° B'



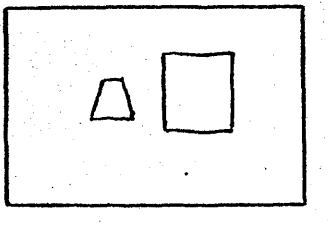


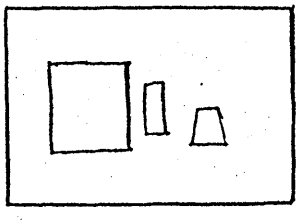
C 135° C'



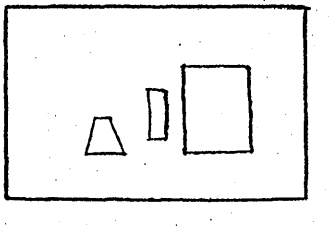


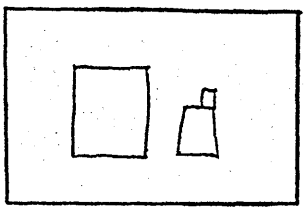
D 180° D'





E 225° E'

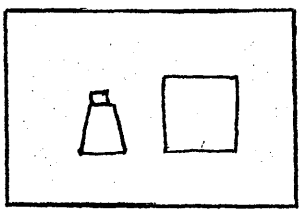


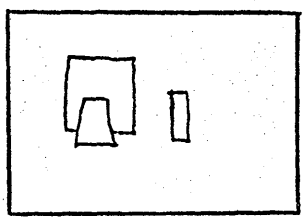


F

270°

F'

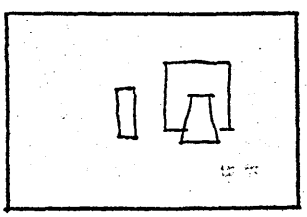


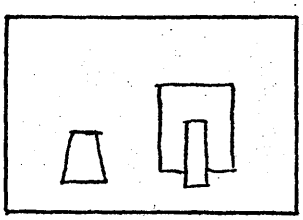


G

315°

G'





S

to our right and the matchbox is at the back and in the middle between the jar and the wood'. This sequence involves movement and language. (M+ L+)

(b) the child sat at the different places and observed the different perspectives with no description given by the experimenter. (M+ L-).

(c) the child sat at S (see fig.14) whilst the experimenter sat at different places and described what he could see in a similar manner to the example given in (a). (M- L+).

(d) the child sat at S and no movement or description was undertaken. (M- L-).

Experimental Procedure.

Following the familiarisation sequence the child was seated at S, the pre-training apparatus removed and replaced by the experimental material (fig. 14). The experimenter said that the child would have to work out how the model looked to him (E) from where the experimenter was sitting - he would have to do this in three ways:-

(a) he would have to tell E in words how the model looked from where the experimenter would be sitting - (the verbal description condition, V).

(b) he would have to make a model using his apparatus so that when the child looked at his model he would see just the same thing as the experimenter saw when he looked at the main model - 'so you see yours there just like I see mine from where I am sitting'. - (the model reproduction condition, Mo).

cont/....

(c) he would have to choose from some pictures the one that looked most like how the model looked to the experimenter from where he would be sitting - (picture selection condition, P).

(The order in which these instructions were given was varied to coincide with a pre-determined order of presentation).

Finally, the experimenter said that the child was going to have to pretend that he was the experimenter and try to find out how the model looked to the experimenter from where he was sitting. Before each phase of the experiment, and during each phase if appropriate, the experimenter briefly repeated the relevant instructions.

When the instructions sequence had been completed the three experimental phases were presented to the child in a pre-determined order. Trials for each phase were completed as a block before the next phase trials were administered.

The experimenter took the seven positions round the table (points A to G, fig. 14) in a random order for the verbal description task. The L+ familiarisation group were reminded about the dimensions that could be used, i.e. front-back and left-right, and prompted the child about the other dimension if only one was given.

A similar placement procedure was repeated for the seven positions and the model reproduction task. The child reproduced his model on the table at his side by turning his chair to face his model. At the end of each trial the three parts of the child's apparatus were pushed to one side so that each child started each trial from the same position.

cont/....

When the picture selection phase was presented to the child fourteen trials were undertaken in two groups of seven, i.e. points A to G in random order followed by points A to G in a second and different random order. Half of the trials included the egocentric photograph and half did not. The photograph array for each trial consisted of four photographs including (a) the correct view, (b) the mirror image of the correct view and (c) the view from the position opposite. If the egocentric view present condition was being assessed then the fourth photograph was of this view whereas the fourth photograph was chosen at random from the remaining photographs for the non-egocentric view condition. Hence if the experimenter occupied position B then the photographs shown to the child would be (a) the photograph from B, (b) the mirror image of the photograph from B, (c) the photograph of the view from the 180° opposite position, i.e. F and (d) the egocentric photograph, if appropriate, or a random photograph, say, from position D.

Design.

A multifactor design with repeated measures (Weiner, 1970) was employed in the present experiment. Each child undertook each of the three problem phases; thus task differences were a within subject factor. Between subjects factors were the three age levels 5½, 8 and 10½ years and the familiarisation sequences M+ L+, M+ L-, M- L+ and M- L-. The third between subjects factor was order of task presentation. The order was arranged according to a latin square, order 1 = VPMo, order 2 = PMoV and order 3 = MoVP. In each of the 36 cells of the age, familiarisation sequence and order factors were 6 children matched for mean age and sex (3 boys and 3 girls).

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Scoring.

The individual responses were scored according to the following criteria.

Verbal Description

(a) Correct response:- the child correctly described the display as it appeared to the observer using the dimensions left-right and near-far.

(b) Transitional response:- the child made it clear that he was aware that the observer had a different view of the display, e.g. "the yellow one is nearer to you than the green one" or "you can't see the green one" (both position C).

(c) Egocentric response:- the child made it clear that he thought the observer and himself had the same view, e.g. "the red one is nearer you" (position D).

(d) Other response:- the response did not fit clearly into one of the above categories or the child failed to make a response, e.g. "both the red one and the yellow one are near to you". (position D).

Model Reproduction

(a) Correct response:- the child correctly places his models on his table so that his display looks to him like the observer's display looks to the observer.

(b) Transitional response:- the child made it clear that he was making an attempt to reproduce the

cont/....

display as it looked to the observer but failed to reproduce accurately, e.g. the red model placed behind the yellow but the green model placed at the back and to the left.

(c) Egocentric responses:- the child made his display look to him like the observer's display looked to him.

(d) Matching responses:- the child matched his display with the observers, i.e. this always corresponds to the correct view from position F.

(e) Other responses:- the child responded randomly or failed to respond, e.g. all models placed in close proximity and in the far left hand quadrant of the base board regardless of the position of the observer.

Picture Selection.

(a) Correct response:- the child correctly chooses the photograph of the observer's view.

(b) Transitional response:- the child made it clear that the egocentric photograph was inappropriate yet failed to make a correct response. Frequently this response was a mirror image of the correct response.

(c) Egocentric response:- the child chose the photograph which corresponded to his own view. This response was clearly not possible for egocentric photograph absent trials.

cont/....

(d) Other responses:- the child chooses the randomly selected photograph. This response was not possible for egocentric photograph present trials.

Developmental Stage.

The developmental stage placement was based upon the response of greatest frequency with a minimum of four responses. Hence if a child made two correct, one transitional and four egocentric responses he was placed at the egocentric stage. If the scoring profile was less marked, eg. two correct, two transitional, two egocentric and one other, the child was placed at the transitional stage for verbal description and model reproduction. However, this response distribution is clearly random for picture selection since only four photographs were used. Children were, therefore, assigned to the failure to comprehend stage for picture selection.

RESULTS AND DISCUSSION.

Preliminary analysis indicated that the sequence in which the various response conditions were presented was not a significant factor. Accordingly, in all subsequent analyses, the data were collapsed over order of presentation.

Sociocentric responses.

An initial Age (3) x Familiarisation sequence (4) x Response type (4) ANOVA revealed significant effects for each man factor. However, both the Familiarisation Sequence x Response Type and the Age x Familiarisation Sequence x Response Type interactions were also significant. (Table 14).

cont/....

Table 14

Analysis of variance summary for correct responses for Age, Familiarisation Sequence and Response Type.

Source	SOS	df	MS	F	
Between S	2735	215			
Age (A)	1735	2	867.5	214	$p < .01$
Familiar-isation (F)	120	3	40	9.8	$p < .01$
A x F	52	6	8.6	2.12	n.s.
error between	828	204	4.05		
Within S	1849	648			
Response Type (R)	604	3	201.3	127.4	$p < .01$
A x R	17	6	2.8	1.7	n.s.
F x R	152	9	17	10.7	$p < .01$
A x F x R	108	18	6	3.7	$p < .01$
error within	968	612	1.58		

cont/....

Table 12

Analysis of variance summary for correct responses using Age, Familiarisation Sequence and Response types (omitting Verbal Description.

Source	SOS	df	MS	F	
Between S	2164	215			
Age (A)	1284	2	642	153	$p < .01$
Familiarisation (F)	14	3	4.7	1.1	n.s.
A x F	14	6	2.3	< 1	n.s.
Error between	852	204	4.2		
Within S	811	432			
Response Type (R)	335	2	167.5	152	$p < .01$
A x R	12	4	3	2.7	$p < .05$
R x F	2	6	.3	< 1	n.s.
A x R x F	16	12	1.3	1.2	n.s.
Error within	446	408	1.1		

cont/....

Analysis of variance summary for correct responses for Age and Familiarisation Sequence using the Verbal Descriptive data.

Source	SOS	df	MS	F	
Age (A)	447.6	2	223.8	91.7	$p < .001$
Familiarisation Sequence (F)	258.4	3	86.2	35.3	$p < .001$
A x F	133.9	6	22.3	9.14	$p < .001$
Error within	496.9	204	2.44		
Total	1336.8	215			

cont/....

Inspection of the mean data (fig. 16) suggested that these interactions were contributed primarily by differences in accuracy of verbal descriptions under some of the familiarisation conditions on the part of subjects in the two age groups. A further ANOVA, from which verbal description was omitted for all age groups, confirmed this interpretation (Table 15). In this analysis, main effects for Age and Response Type are still significant but only the Age x Response Type interaction reaches statistical significance. None of the effects involving the Familiarisation Sequence are significant. The Age x Response Type interaction is relatively small and is contributed primarily by differences in the relative magnitude of differences between response types at 10 years, compared with those at the other two ages. (Fig. 17). However, the rank order of accuracy under each response type is constant across age groups. There is a consistent effect for the egocentric photograph present/absent comparison with superior performance for all ages and all familiarisation conditions when the egocentric photograph was absent. The analysis of the verbal descriptive data showed significant main effects for Age and Familiarisation Sequence. The Age x Familiarisation Sequence is also significant (Table 16) and is due to differences in performance for the four familiarisation conditions at the five year level compared with the performance of eight and ten year olds. (see fig. 16).

The results appear to show that accuracy of performance by children at a co-ordination of perspectives task increases in

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Fig. 16

Mean No. of correct responses for each problem and age for the 4 familiarisation conditions.

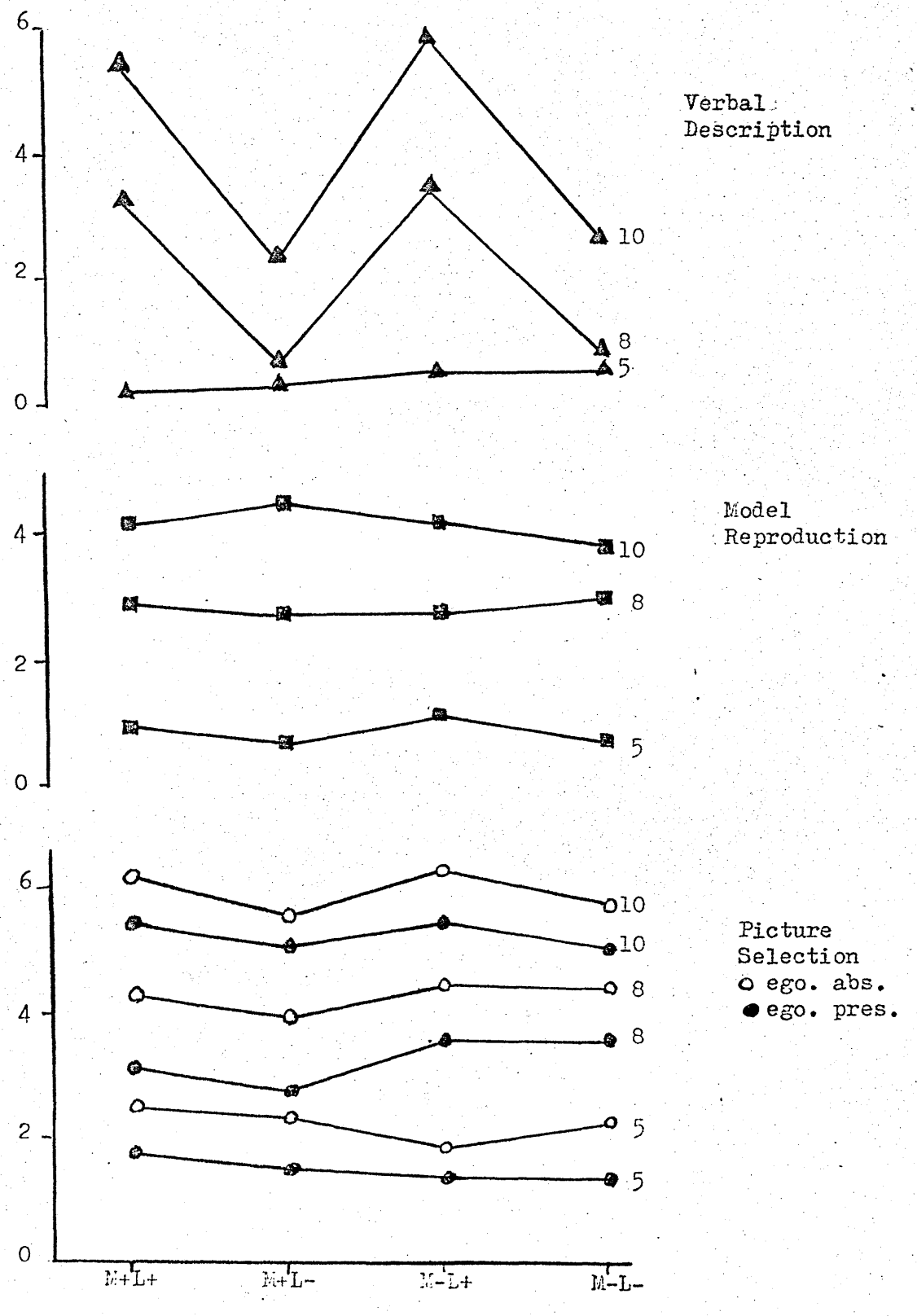
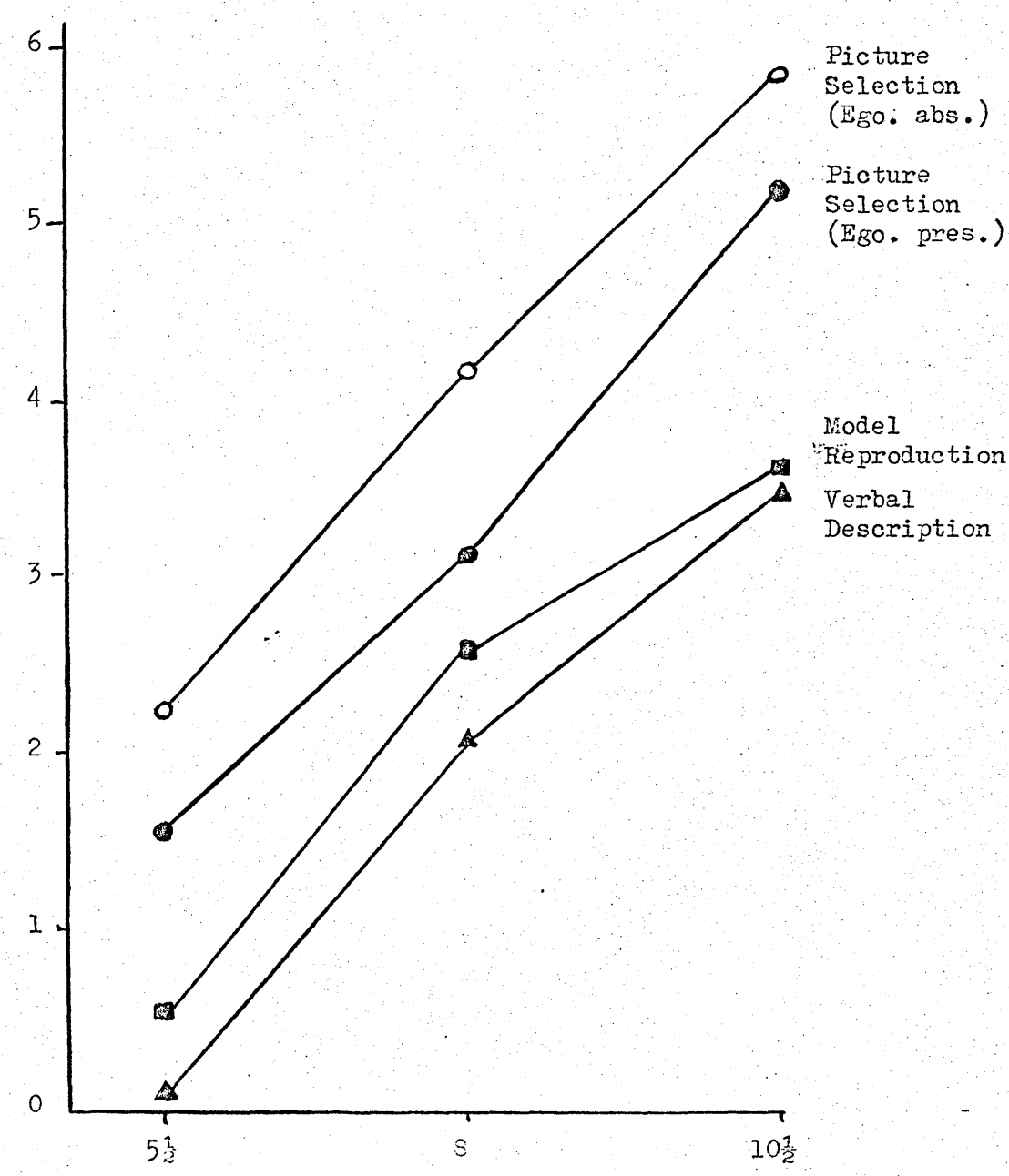


Fig. 17

Mean number of correct responses for each experimental task and three age levels.



an approximately linear manner. Although the Age x Response Type interaction was significant it was small and generally the approximate equality of performance differences between tasks at each age level is apparent. This suggests some support for the Flavell et al (1968) conclusion that the ability of a child accurately to predict the view of an observer is a 'general developmental skill'. The resistance of this skill to change by added experience is illustrated clearly by the failure of pre-training trials to significantly effect any of the tasks except verbal description.

The effect of the removal of the egocentric photograph from the response array that was investigated in Experiment 5 is confirmed in the present study. A significant decline in accuracy when the egocentric photograph was present was found for all ages and all familiarisation conditions. The effect at five years of age of the absence of the egocentric photograph in this experiment may be similar to the switch to random responding in Experiment 5. The mean number of correct responses for the egocentric photograph absent condition being 2.2 compared with a chance level of 1.75. However, a similar explanation does not seem appropriate for the two older groups when correct responding (means 4.2 and 5.8 for eight and ten year olds respectively) is significantly above chance level. When the egocentric photograph is present for the older groups it would appear to be interfering with the building of the new representation.

The relatively poor level of verbal descriptive performance contrasts with the results of Experiments 1, 2 and 3 when near perfect performance was achieved. The difference is due to the

cont/....

addition to the verbal descriptive task in this experiment of specific orientation responses. The child has to respond in terms of near/far and left/right rather than the colour naming of the earlier experiments. He has to discover how the display appears to the observer rather than what the observer can see. An awareness that another view is possible may not be translated into correct responding. This is shown clearly in the verbal descriptive data for familiarisation conditions. When the appropriate dimensions were given to the child his level of performance significantly increased. Only the older children were able to make use of the language cues, however, suggesting that the language of orientation has little meaning for five year olds.

Egocentric Responses.

An Age (3) x Familiarisation Sequence (4) x Response Type (3) [1] ANOVA revealed significant effects for Age and Response Type. However, both the Age x Response Type and the Age x Familiarisation Sequence x Response Type interactions were also significant (see Table 17). The second order interaction effect indicates that the effect for age and the effect for response type were not uniform across all familiarisation conditions. At five years, absence of movement round the display had the effect of markedly increasing the relative frequency of egocentric

cont/....

[1] Only 3 response types were used in this analysis because it was not possible for a child to make an egocentric response for the egocentric photograph absent condition of picture selection.

Table 17

Summary of analysis of variance for egocentric responses for Age, Familarisation Sequence and Response Type.

Source	SS	df	MS	F	
Between S	608	215			
Age (A)	178	2	89	43.8	$p < .001$
Familiar-isation (F)	6	3	2	< 1	n.s.
A x F	9	6	1.5	< 1	n.s.
Errors between	415	204	2.03		
Within S	1138	432			
Response Type (R)	365	2	182	121.3	$p < .001$
A x R	104	4	26	17.3	$p < .001$
F x R	12	6	2	1.3	n.s.
A x F x R	40	12	3.3	2.2	$p < .01$
Error within	617	408	1.5		

cont/....

responses under the photograph response condition. A similar effect is apparent at ten years, although here it is restricted to the familiarisation sequence involving absence of verbal description in addition to absence of movement. At eight years, however, there is no consistency in the influence of familiarisation sequences upon egocentric responding. Hence no clear developmental trend is apparent from the data in this respect (see fig. 18). The Age x Response Type interaction (see fig. 19) illustrates the differential rate of decline of egocentric responses for the three response types. Egocentric responses decline at the same rate for picture selection across the three ages. However, for model reproduction they fall rapidly between 5½ and 8 years but with a much less rapid decline from 8 to 10½ years. Indeed the mean number of egocentric responses was very similar for 8 and 10½ year olds under the model reproduction condition. Few egocentric errors were made for verbal description at any age level. Egocentric errors formed a far greater proportion of total errors for picture selection than for model reproduction. The percentage scores of egocentric errors to total errors for five, eight and ten year olds respectively for picture selection were 54, 48 and 39 whereas for model reproduction they were 30, 11 and 6. These results reflect the greater variability that it is possible for a child to show under the model reproduction procedure and the continuing influence that the egocentric photograph has on performance.

The significant age effect reported above indicates a developmental trend for egocentric responses to decrease with increasing age. This is a conclusion found throughout the

cont/....

Fig. 18

Mean No. of egocentric responses for the four familiarisation conditions.

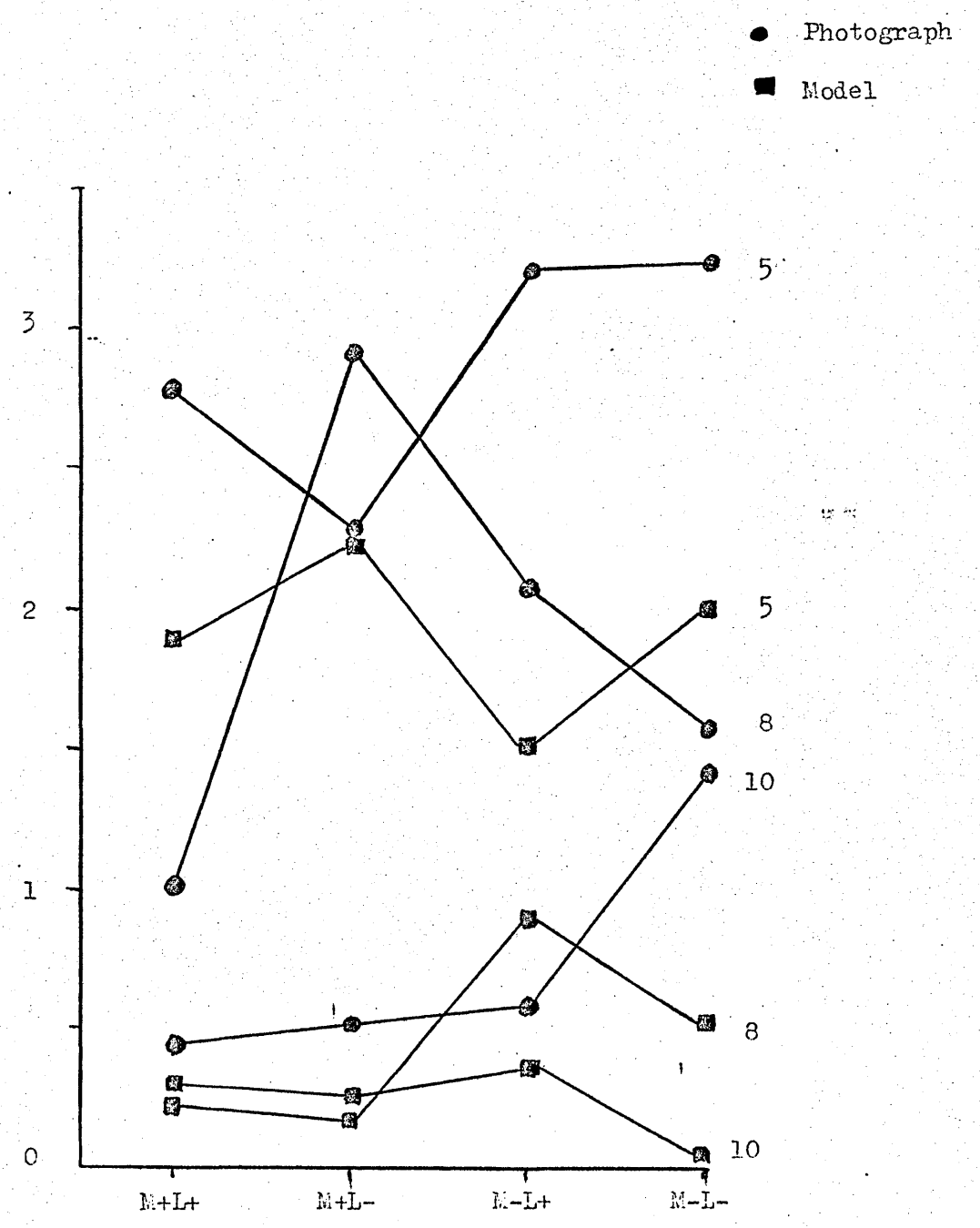
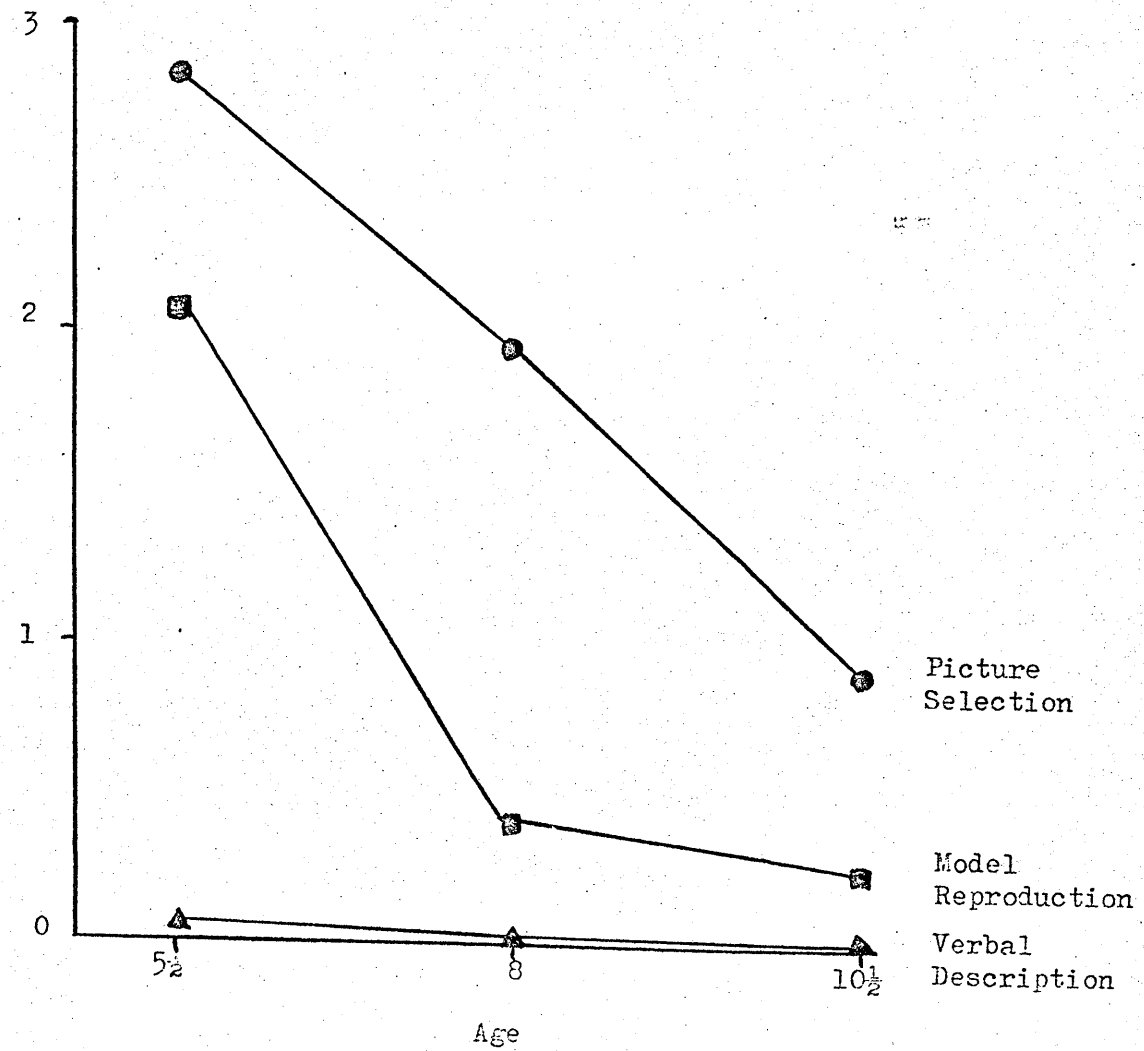


Fig. 19

Mean No. of egocentric responses for Age and Response type.



literature. Egocentric responses were made for model reproduction and picture selection throughout the age range. Hence this type of response is not limited to children of below a particular age. Stage development for Piaget is more important than chronological age however so this cannot be seen as critical for the Piaget and Inhelder (1956) stage development hypothesis.

No consistent effect was found for the familiarisation sequences, the egocentric response, like the correct responses, was highly resistant to modification by prior training procedures. Children responded egocentrically even though they had been made aware that different views of a display were possible.

The results illustrate clearly the differential effect of the child's view of the display and the external representation of that view, i.e. the egocentric photograph. Younger children appear to be influenced by the view that they see and find great difficulty in disassociating from it. Egocentric errors were made by the five year olds for both picture selection and model reproduction. However, the influence of the child's view wanes between five and eight years leading to a rapid decline in egocentric responding for model reproduction. No such decline occurs with picture selection which seems to decrease linearly between five, eight and ten years. The egocentric photograph, therefore, continues to exert an effect upon performance even with ten year old children.

Verbal description presents a totally different picture to the other procedures. A few egocentric errors were made

cont/....

by the five year olds but none were evident for the older groups. This is consistent with the findings from Experiments 1, 2 and 3 where few egocentric errors were also reported.

Matching Errors.

There were very few errors of this type for model reproduction: mean number of responses were 0.5, 0.15 and 0.15 at five, eight and ten year old age levels respectively. The 'inappropriate match' hypothesis must, therefore, be rejected.

Position Effect.

The distributions of the responses made by the children were also compared for the seven positions occupied by the experimenter (i.e. positions A to G, fig. 14, pg. 142). At the three age levels 72 children made a single response for each of the seven positions and for each of the four experimental procedures. The graphical data (figs. 20 to 23) show the frequency with which children made

(a) correct responses (C)

(b) mirror image correct responses (C')

and (c) egocentric responses (E),

plotted for the seven experimenter positions. (The three response categories are not exhaustive; transitional and other responses were omitted).

The verbal descriptive data (fig. 20) show an increasing differentation between C and C' responses over age. Few responses of either type were made at $5\frac{1}{2}$ years. (Most verbal responses at $5\frac{1}{2}$ years were within the 'other' response category).

cont/....

Fig. 20

Frequency with which children made correct (C), mirror image correct (C'), and egocentric (E) responses for the verbal descriptive stage over the seven positions occupied by the experimenter.

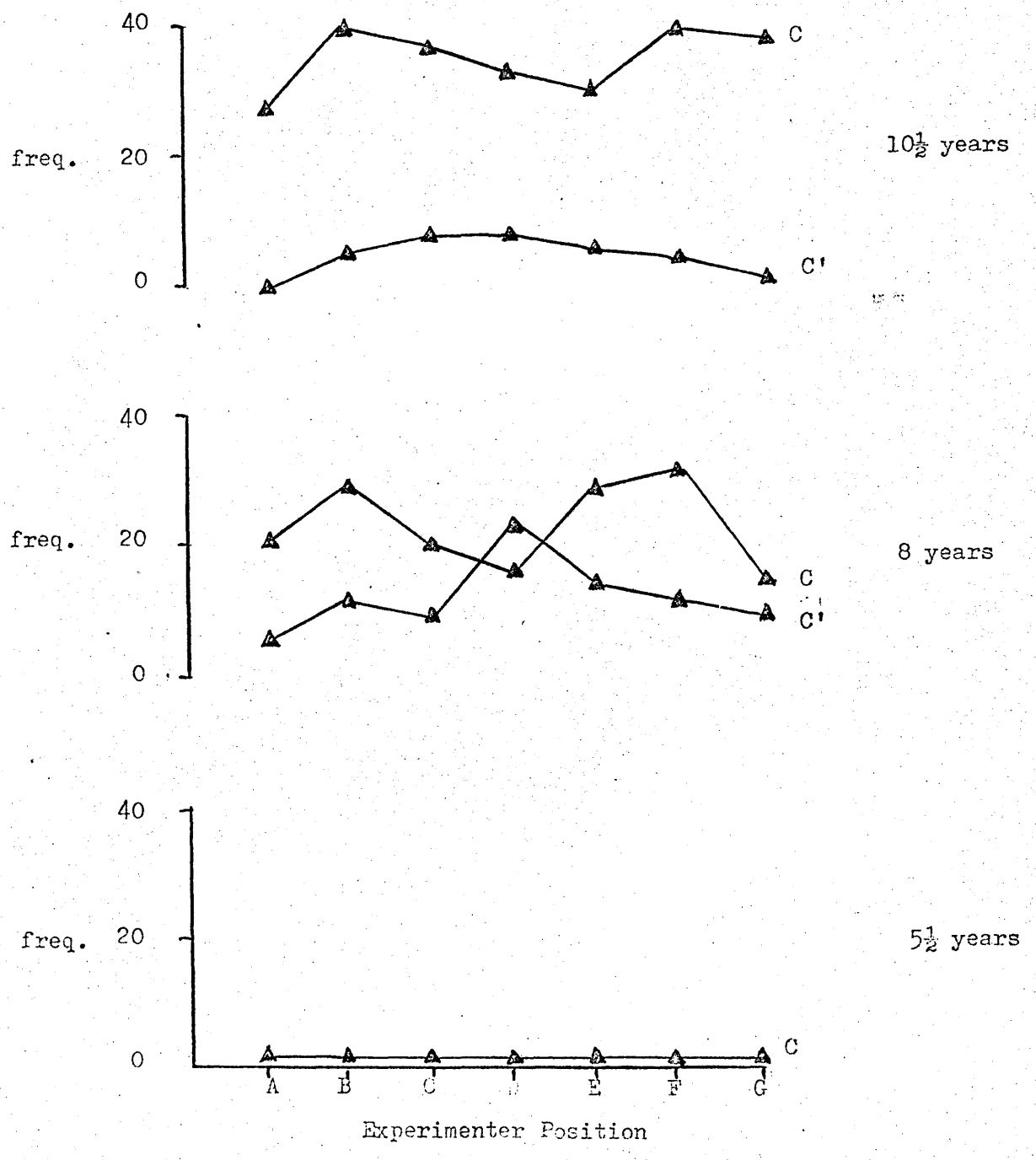


Fig. 21

Frequency with which children made correct (C), mirror image correct (C') and egocentric (E) responses for the model reproduction task over the seven positions occupied by the experimenter.

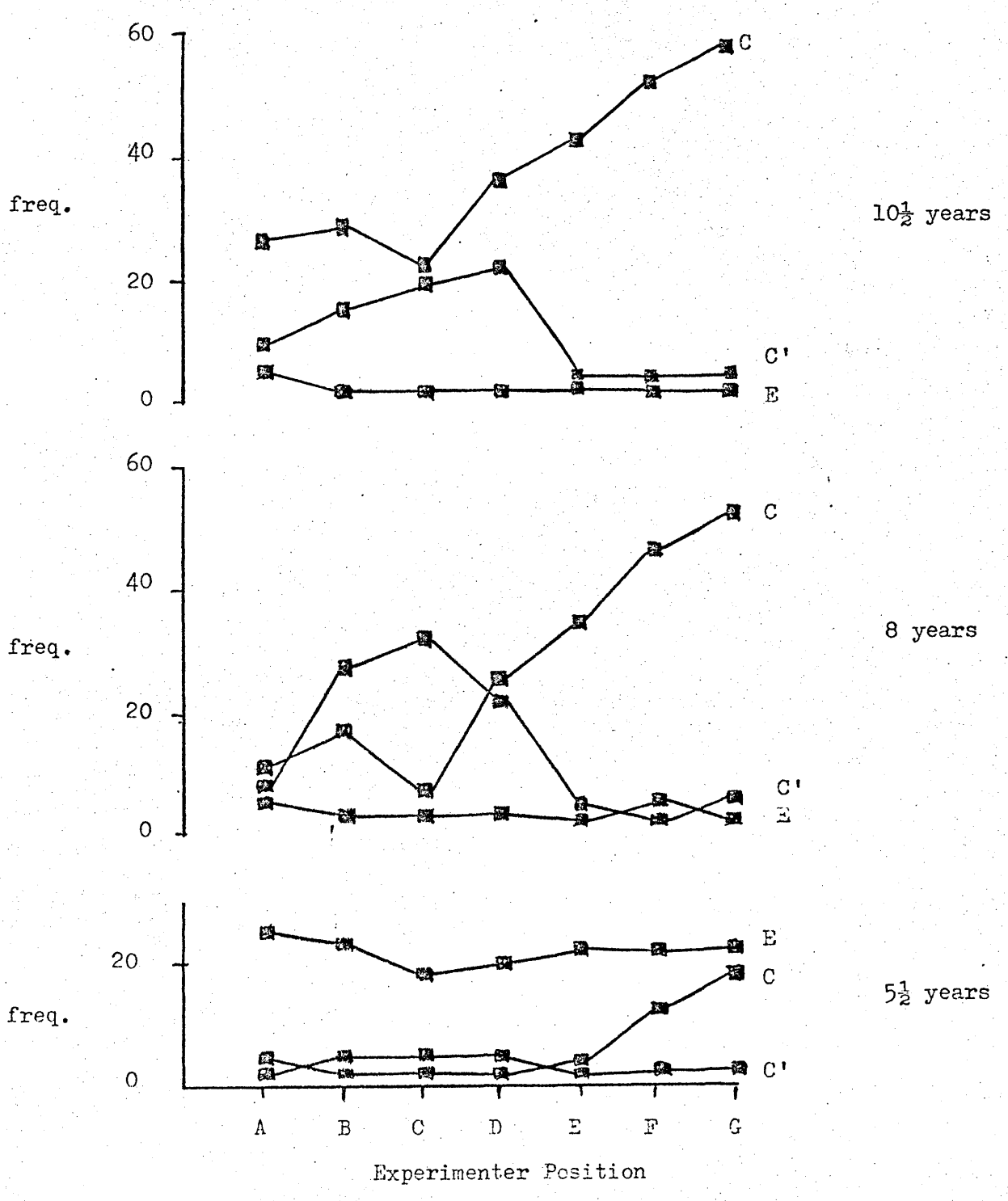


Fig. 22

Frequency with which children made correct (C), mirror image correct (C') and egocentric (E) responses for the picture selection task (egocentric photograph present) over the seven positions occupied by the experimenter.

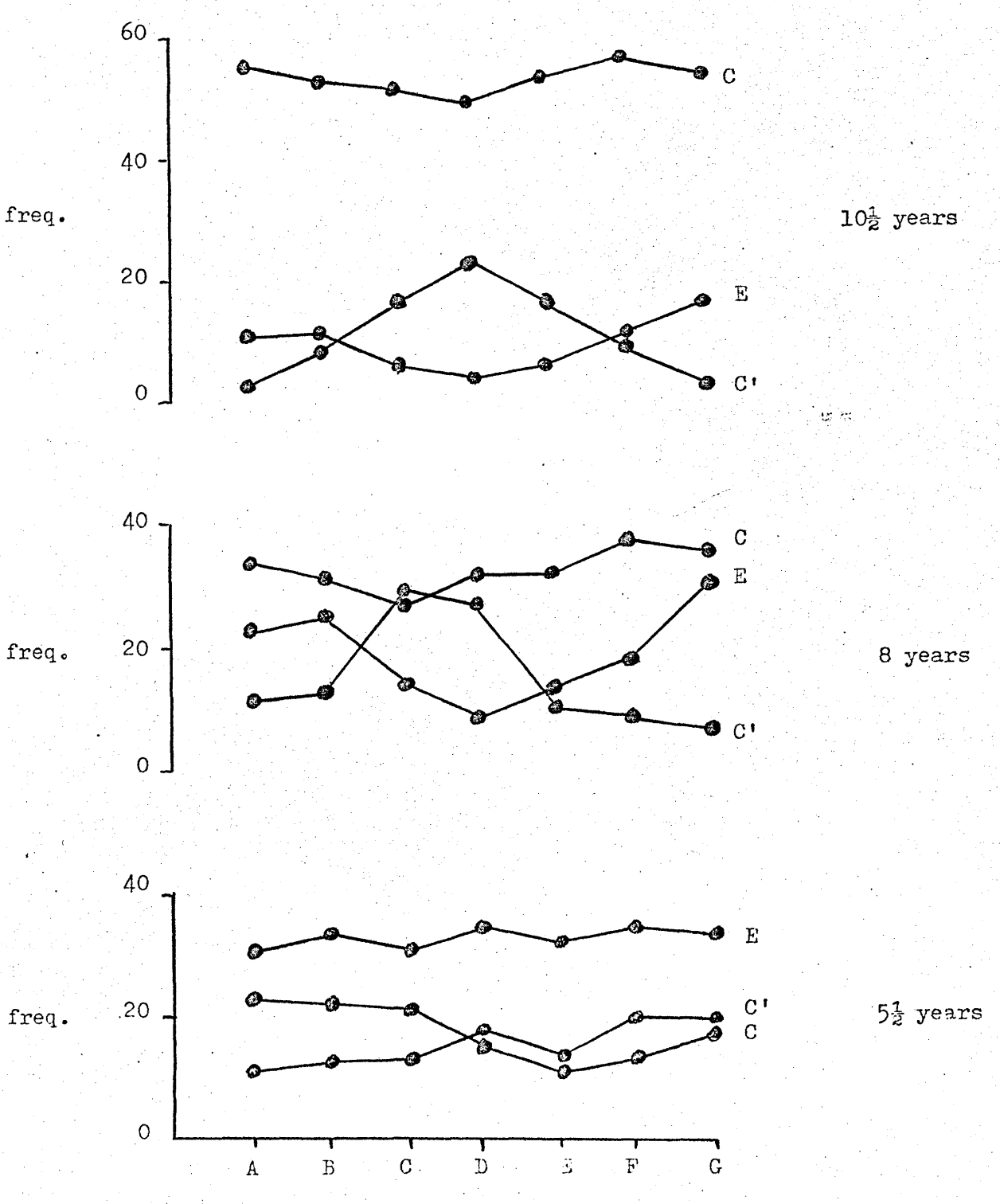
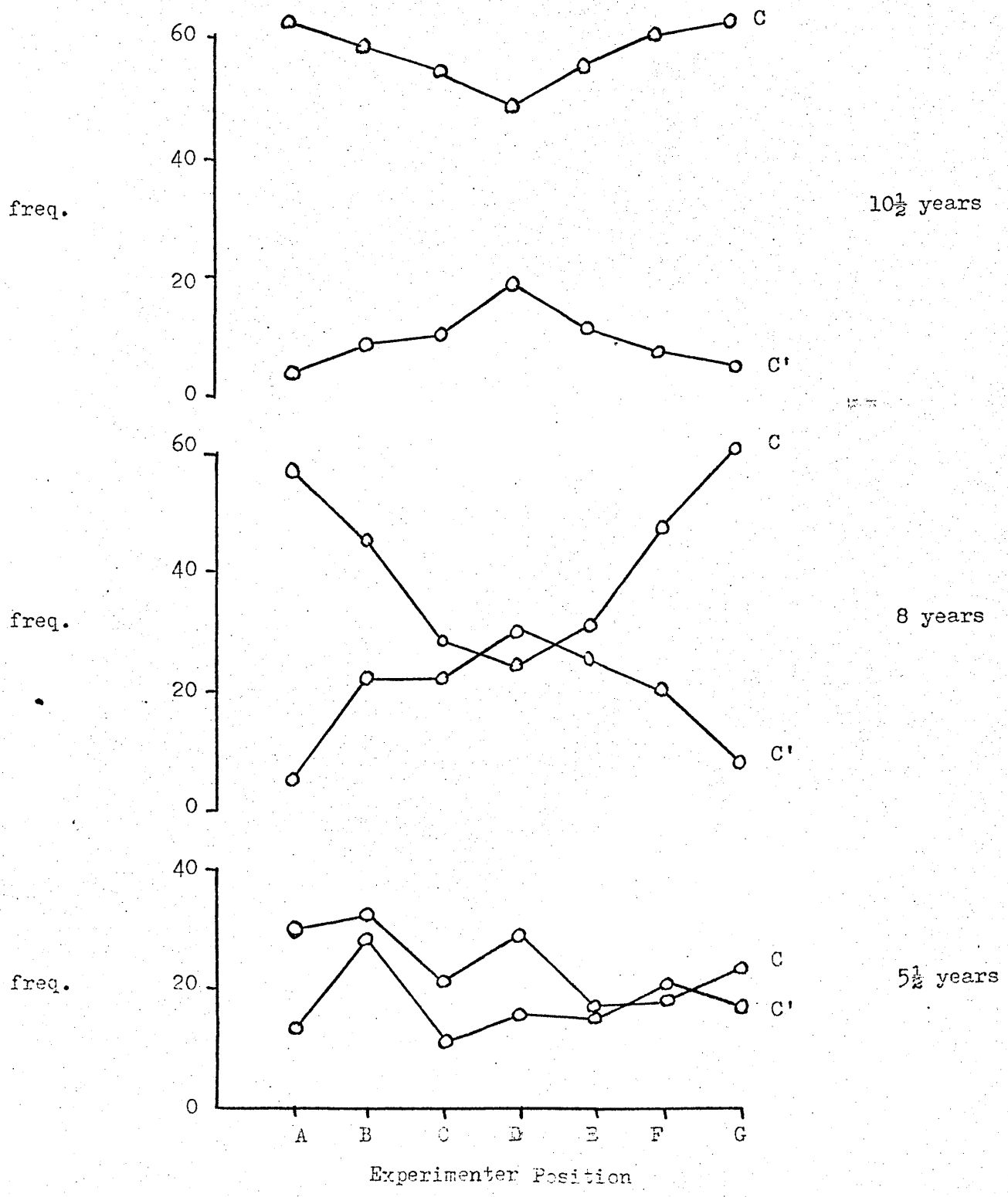


Fig. 23

Frequency with which children made correct (C), mirror image correct (C') and egocentric (E) responses for the picture selection task (egocentric photograph absent) over the seven positions occupied by the experimenter.



By 8 years the task was more meaningful but the distribution of C and C' responses were similar. At 10½ years, however, the C and C' distributions were separable. This development is predictable in terms of the child's development of left and right in others. The likelihood of making a C or a C' response was independent of the position of the experiment. It would seem probable, therefore, that the child is not attempting to build a representation of how the display looks to the observer but rather is associating specific aspects of the display vis-a-vis the observer.

Consideration of the model reproduction data (fig. 21) shows the C response to have a clear similarity response profile for the three age levels and the C' response to have similar distributions for 8 and 10½ year olds. The asymmetry of the C and C' responses for model reproduction differs markedly from the symmetry found for C and C' responses under both photograph selection conditions (figs. 22 and 23). The primary difference between the two procedures in terms of relative position relates to the child reproducting the model on the table at 90° to the original. Picture selection from the array was made in a position between the child and the stimulus display. The distribution differences found suggest that the point where the response is made may effect performance.

Comparisons between the distributions for the two phases of picture selection given an indication of the effect that the presence of the egocentric photograph has on performance. The distributions of the C and C' responses are similar at five years of age whether the egocentric photograph is absent or present.

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At 8 and 10 years, however, when the egocentric photograph is absent the child makes the majority of left/right errors for the experimenter in the positions opposite the child. This produces an inverted U shaped curve for C responses. When the egocentric photograph is added to the selection array the distribution of C responses is similar for all positions. Hence the child's performance for a co-ordination of perspectives task using photographs is dominated by two factors. Firstly, he tends to make left/right errors for positions of the observer opposite to the child. Secondly, he tends to make egocentric errors for positions close (in angular terms) to himself. The emergence of these factors is predictable in terms of the Piagetian model.

The positions effect data appears to show that a distinction may be made between verbal description on the one hand and model reproduction and picture selection on the other. Performance for verbal description was independent of the position which the observer occupied whereas the distributions for model reproduction and picture selection showed distinct effects for observer position. This suggests the possibility of the child using a different mechanism for verbal description to that for model reproduction and picture selection.

Developmental Stages

Allocating the children to a developmental stage according to their most frequent response (Table 18) shows that most five year olds failed to understand any of the tasks set. A high proportion, however, showed themselves to be aware that the observer had a different view by making transitional responses to verbal description. A significant number of these children

cont/....

Table 18

Frequency with which children were placed at each developmental according to age and experimental procedure.

Verbal Description	5	8	10
Incomprehension	40	7	2
Egocentrism	1	0	0
Transitional	31	44	28
Decentrated	0	21	42

Model Reproduction	5	8	10
Incomprehension	47	3	8
Egocentrism	20	3	1
Transitional	5	46	20
Decentrated	0	20	43

Picture Selection (egocentric photograph present)	5	8	10
Incomprehension	37	6	2
Egocentrism	26	12	4
Transitional	4	24	6
Decentrated	5	30	60

went on to make egocentric responses for model reproduction (McNemar Test $X^2 = 4.13$, $p < .05$) or picture selection (McNemar Test $X^2 = 11.9$, $p < .001$). It would appear, therefore, that the egocentric response is not 'a substitute solution to an otherwise insoluable task' (Aebli, 1966). Rather this paradoxical result replicates and extends the findings of Keilgast (1971). The finding was repeated at the 8 year level but was limited to egocentric responses for picture selection following transitional responses for verbal description (McNemar Test, $X^2 = 8.14$, $p < .01$). Few children were placed at the egocentric stage for model reproduction at 8 or 10 years and for picture selection at 10 years although egocentric placement did occur for both procedures at all age groupings.

The frequency of placement of children at the final decentered stage increased for all procedures through all age levels. Decentered placement was, however, considerably lower for verbal description and model reproduction compared with picture selection. This result contrasts with the previously reported high level of verbal functioning in earlier experiments of this series. The reasons for this have been discussed in detail in the section concerned with correct responses. (pg.149), and related to the inclusion of specific responses of orientation.

Model reproduction and picture selection exhibit a clear developmental sequence from egocentric through transitional to decentration. No such sequence is observable for verbal description where only one child responded most frequently with the egocentric response. For verbal description children pass from an inability to comprehend to the transitional stage without the intermediate egocentric stage.

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The developmental stage data clearly show that the egocentric stage is not specific to picture selection. Rather model reproduction and picture selection seem to be part of the same process. Verbal description, however, appears to be related to a different mechanism. It is possible that the two processes may relate to the distinction that Piaget makes between perception and representation with verbal description being part of the former whilst model reproduction and picture selection are part of the latter.

Summary.

Support for the Piaget and Inhelder (1956) conclusions in the present experiment was equivocal. Positively, developmental stages were found for both picture selection and model reproduction. The three stages of egocentrism, transitional and decentration were equivalent to the stages reported in the original study. With this finding we have shown that egocentric responding is not specific to the picture selection sequence but generalises to another procedure. The marked resistance of egocentric responding was a feature of this experiment as it had been for Experiment 3. The type and quality of the prior training experience made no difference to the frequency of egocentric responding.

Negative evidence is drawn mainly from the verbal descriptive data. Very few egocentric responses were made for verbal description hence no support was found for the three stage development shown in Piaget and Inhelder (1956). It was also shown that egocentric responding (and placement at the egocentric stage) could occur for both model reproduction and picture selection even though children had shown themselves to

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be aware that this response was inappropriate. Transitional responses for verbal description could precede an egocentric response for the other procedures. Hence depending upon the response made under investigation a child could be described as egocentric or non egocentric.

The evidence appears to show that there is a difference between a child's performance for verbal description and his performance for model reproduction and picture selection. The difference may relate to the perceptual-representational distinction made by Piaget and Inhelder (1956) and described at the outset of this study (pg. 1).

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General Discussion.

The results of each of the experiments comprising the present study were discussed in detail subsequent to the individual presentations. Hence, in this section only a summary of the general results will be reported referring back as necessary to the relevant earlier findings.

The primary aim of this study was to assess the validity of Piaget's general cognitive model to the conclusions reached by Piaget and Inhelder (1956) for the co-ordination of perspectives. In the three mountains experiment children within the pre-operational stage when asked to find an observer's view of a display, tend to choose the photograph which corresponds to their own view. This egocentric choice is said by Piaget and Inhelder (1956) to show the inability of children at this developmental stage to reflect upon their own thoughts. Hence the children believe that their own thoughts, feelings and perceptions are similar to the thoughts, feelings and perceptions of another. As, however, children learn in social situations that this interpretation is inaccurate so a sociocentric mode of thought develops and they learn to free themselves from their own perception of events. When free from the limitations of pre-operational thought children may become increasingly successful at predicting another's view. By the end of the concrete operations stage they are usually highly proficient at this skill. Implicit in this analysis are two interacting processes

(a) the development of sociocentrism

cont/....

and (b) the progression from centration to decentration.

It is the essence of the Piaget and Inhelder (1956) hypothesis that it is not until the egocentrism of the pre-operational child has been overcome that he may be aware that others have a different view. Although the experimental evidence that Piaget and Inhelder (1956) quote is limited to the 'three mountains experiment', it is implicit in their conclusions that similar findings should result irrespective of the experimental procedure or materials. The earlier experiments in this study (1 to 4) were designed specifically to test the generality of this conclusion.

The simplest display possible was employed in Experiment 1 in order to reduce to a minimum the cognitive load of the task. Children of four and five years were well able to make a correct verbal response and predict from a group of imaginary observers which had the same view as themselves and which had a view that differed. Fewer than 10% of the critical responses could be called egocentric. Increasing the complexity of the display (Experiment 2) did not effect the results. A high level of correct responding was again evident when children made a verbal response to discover the views of three observers when looking at an asymmetric display. An attempt was made to assess the relative effect of different dimensions. Support was found for the conclusions of Laratsos (1973, 1974) regarding the concept of 'top-point' that reflected the greater salience of the vertical compared to the horizontal dimension for young children. For Experiment 2 as with Experiment 1 very few egocentric responses were made. The next experiment in the sequence (Experiment 3)

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compared two experimental procedures using the same display; verbal description and picture selection.

As with Experiments 1 and 2 so also with the verbal descriptive phase of Experiment 3 very few egocentric responses were made. However, when children were required to choose the observer's view from four pictures of the display (including the child's view) they frequently chose the egocentric picture. This was so for initial and final picture selection trials even though between the two phases a verbal description stage had been given. Children responded almost perfectly for the intermediate verbal description yet some continued by choosing the egocentric photograph for the final stage. Egocentric responding was highly resistant to change with similar frequencies for initial and final stages. There was, however, at the same time an increase in correct responding. The increase was due to partially correct (sociocentric) solutions being converted to the correct choice. Nonetheless, although the children were aware that an egocentric response was inappropriate as evidenced by the correct verbal responses for the central verbal descriptive phase, many of them subsequently chose the egocentric view in the picture selection task.

These findings, together with the results reported in the literature for single model studies (Lewis and Fishbein, 1969; Fishbein et al, 1972; Strayer et al, 1973 and Massangkay et al, 1974), indicate that young children, whom on the basis of age would be assumed to be within the pre-operations stage, are aware that an observer has a different view of the display. They may, in many cases also be able to predict what the observer sees. Extreme doubt must, therefore, be expressed about the generality

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of the Piaget and Inhelder (1956) conclusions. If young children of four years of age are able to deduce verbally the correct view of an observer, then it is not valid to assess these children as egocentric in the specific terms of the three mountains experiment. Simplification of the display and response leads to correct responding. It was not until the concept of pictorial representation was introduced in Experiment 3 that children made egocentric responses. This response was highly resistent to change even though children were apparently verbally aware that it was inappropriate. Although Experiments 1 to 3 are not to do with co-ordination of perspectives per se (i.e. all use single model displays), the conclusions are important for the Piaget and Inhelder (1956) findings. The results of this initial group of experiments suggest that the egocentric response may be specific to the photograph selection procedure of the three mountains experiment rather than a function of the child's stage of cognitive development.

Experiment 4 linked elements of the development of sociocentrism investigated in the first three experiments with the analysis of the co-ordination of perspectives of the final two. The experiment was an attempt to evaluate the effect of the type of instructions given to the child. Evidence was presented which suggested that, when the visual perceptual parameters between the display card and the response card were high, the type of instructions given made no difference to the response produced. When, for example, the display card is in a left/right orientation with the observers and child sitting on opposite sides of the table, the child responds by keeping the

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colours 'in-line' and leads to less variability in performance than for the near-far dimension. (Bryant (1974) argued that the 'in-line' and 'out of line' dimension was the significant dimension for discrimination tasks of this kind). The child responded in a similar manner whether the instructions required him 'to match' or 'to respond sociocentrically'. Results for both types of instructions were similar to those reported by Huttenlocher (1966, 1967). The inappropriate matching to sociocentric instructions in part of this experiment is consistent with a concept proposed by Nigl and Fishbein (1974). They regard egocentric responding as being due to the inability of the child to inhibit his own view of the display rather than being related to the child's stage of development as Piaget and Inhelder (1956) conclude.

The results thus far suggest that the original model proposed by Piaget and Inhelder (1956) to account for the co-ordination of perspectives (see pg. 30) is inadequate, particularly with regard to verbal material. We have shown, for example, that children do not make egocentric responses when a verbal response is required and seem to be aware that the observer has a different view of the display. Only when drawings were introduced did the children make egocentric responses. Two parallel processes seem, therefore, to be suggested, one primarily verbal and the second pictorial with a concept like 'inability to inhibit the representation of one's own view' being part of the latter process but not of the former. (see pg. 183).

The final two experiments investigated the co-ordination of perspectives. Experiment 5 showed the effect of the presence of the egocentric photograph on performance. When the choice of photographs in a two choice photograph selection was either

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the correct or an incorrect (but non-egocentric) photograph, children responded with equal frequency to both. The introduction of the egocentric response to replace the incorrect photograph led to a significant decline in correct responding: the egocentric photograph was chosen more frequently. Hence children of a similar age who responded sociocentrically for Experiments 1 to 3 could not choose the correct photograph even in a simple two choice situation. This experiment enables the 'confusion theory' explanation for egocentric responding to be rejected. With only two photographs from which to choose, the correct and the egocentric, children picked the latter more frequently. An additional point of significance refers to the failure of children to use the extensive base and toy cues that were available in this experiment. This suggests that for young children to make use of the cues of an asymmetric display they have to undertake some prior training (e.g. Fishbein et al, 1972). It also adds substance to the comparison made between the Fishbein et al (1972) findings for a multiple toy display with the results of Piaget and Inhelder (1956). (see pg. 73). The children of Fishbein et al (1972) were trained to find and use the most significant element of a photograph whereas Piaget and Inhelder's (1956) children chose the most prominant feature.

The main experiment of the series (Experiment 6) was an attempt to investigate in detail several aspects of the co-ordination of perspectives. It was an endeavour to bring together the early results in this series, particularly with regard to verbal descriptive techniques, with a procedure that more closely resembled the Piaget and Inhelder (1956) study.

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Three major procedural variables - verbal description, model reproduction and picture selection - were contrasted, using the same stimulus display. Support for Piaget and Inhelder (1956) was equivocal. Positively, distinct developmental stages were discovered for both picture selection and model reproduction that repeated the egocentric - transitional - decentration sequence of the original study. This finding for model reproduction was important since it showed that the selection of the egocentric view was not specific to the use of the two dimensional representations of the display in picture selection. It was also shown that egocentric responding was resistant to change (as with Experiment 3). The type and quality of a prior training experience made no difference to the frequency of egocentric responding. Children responded equally, regardless of whether the prior training sequence involved showing and describing various views of a (second) display or whether no such experience was given (i.e. the child began immediately with the experimental trials.

Evidence contrary to Piaget and Inhelder comes mainly from the verbal descriptive data. Children made very few egocentric errors for verbal description and, therefore, did not follow the egocentrism - transitional - decentration sequence of the other response modes. Support was found for Keilgast (1971) (and Experiment 3) that egocentric responding may occur for model reproduction or picture selection even though the child has shown himself aware by making a transitional response for verbal description, that an egocentric response is inappropriate. This evidence is given added credence by the Age x Response Type interaction found. Egocentric errors (and children placed within the egocentric stage) decline rapidly for model reproduction

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between five and eight years. The decline is less marked for picture selection. Hence some children made transitional responses for verbal description but egocentric responses for model reproduction and picture selection at five years. At eight years, however, some children were placed at the transitional stage for verbal description and model reproduction yet made egocentric errors for picture selection. Depending, therefore, upon the response made under investigation the same child may be described as either egocentric or non-egocentric.

There are two primary external influences upon the child associated with the display. Firstly, the view of the display as seen by the child is the same throughout the experiment. Secondly, the picture or photograph of the child's view is available for the picture selection procedure. The former is involved and, therefore, may influence verbal description, model reproduction and picture selection whereas the latter is part only of the picture selection sequence. The differential rate of egocentric functioning between model reproduction and picture selection in Experiment 6 (the Age x Procedure interaction) enables an evaluation to be made of the relative influence of these factors. It would appear that the view of the display as seen by the child is an important influence on the youngest children for egocentric errors were made for both model reproduction and picture selection at 5½ years. At eight years of age, however, few egocentric responses were recorded for model reproduction. The presence of the egocentric photograph continues to effect performance for picture selection with older children. This is most clearly shown by the egocentric photograph absent/present data.

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It would seem, therefore, that for the traditional picture selection task of Piaget and Inhelder (1956) a two factor process may be in operation linked with the child's view and the representation of the child's view. During the pre-operational years the child finds it difficult to disassociate himself from the view that he can see and hence is likely to build or select the egocentric view. (Cognitive egocentrism). When older he can build a new view for model reproduction but the presence of the egocentric photograph 'interferes' with the building of a new representation for picture selection. The 'failure to inhibit one's own view' (Nigl and Fishbein, 1974) was clearly shown in Experiment 6 not to be due to 'inappropriate matching'.

The verbal descriptive data for Experiment 6 provide evidence which suggests the path to reconciliation between the findings of the many single model studies, including the earlier experiments in this series, and the consistent egocentrism reported for studies similar to Piaget and Inhelder (1956). The differences in performance refer to the distinction that Piaget makes between perception and representation reported at the outset (pg. 1). He distinguishes between the figurative and operative aspects of knowledge. The former concerned with the immediate mental image and linking with the perceptual features of an object. The latter relating to the 'internalised actions' performed upon the representation of an object in order to facilitate its reproduction. The verbal descriptive procedures of Experiments 1, 2 and 3 are essentially perceptual rather than representational. It is clear that the task set in Experiment 2 (pg. 93) can be solved by the child tracing the line of vision of the doll. When the task becomes more difficult

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as in the horizontal - vertical comparison of Experiment 3 (pg. 104) the child makes more errors but the errors are explicable in perceptual rather than representational terms. In Experiment 6 performance falls dramatically but the task remains perceptual. The child has to discover, in terms of the dimensions of right/left and near/far, the relationship between the observer and the display. He does not have to reconstruct a representation of the display; he merely notes how specific aspects of the display relate to the observer. The task is difficult because the dimension of left/right is involved and children find particular difficulties with this dimension.

We may, therefore, suggest a revision of the Piagetian model for the co-ordination of perspectives discussed in detail above (see pg. 27). The model is similar initially with the child's need to comprehend the task set. Assuming understanding he then has to be aware that others may have a different view of the display. Failure to appreciate this will lead to 'true egocentrism' regardless of the procedural task employed. It is at the point at which the child is attempting to discover the other's view that a divergence of solution paths occurs. Verbal descriptive procedures use a perceptual technique and relate specific aspects of the model vis-a-vis the observer. The model remains before the child. Under picture selection or model reproduction, the original display is not available, only representations of that display. Hence the task requires more than the identification of the observers view and necessitates the inclusion of operative aspects for solution. When attempting to co-ordinate the dimensions of the display the most clear representation will be of the child's own view. Thus this may

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well interfere with building the new view. If the child finds difficulty inhibiting his own view then the child may respond in an apparently egocentric fashion even though he is aware perceptually that the own view response is inappropriate. It is only when the child can efficiently inhibit the representation of the egocentric view that a child may successfully co-ordinate perspectives.

The way ahead appears to be two fold. Firstly, we need to know more about how a child builds an internal representation and interprets the dimensional aspects of a two dimensional photograph. Whether (and why) he builds a representation in terms of left/right and near/far as verbal labels or whether it is stored iconically. The developmental trend in the strategy used has to be assessed and a differentiation made as to whether the child's growing ability to co-ordinate perspectives relates to a change from dependence on iconic strategies to verbal techniques or whether it reflects a growing ability to understand how things look from different positions (Bruner, 1964; Bruner, Olver and Greenfield, 1966; Brainerd and Heuvel, 1974).

Secondly, we need to know the cause of the continuance of egocentric responding for picture selection and why the representation of the egocentric view interferes with the reconstruction of the observer's view. It would appear probable that the egocentric photograph is more likely to interfere with the process of inhibiting one's own view if the stimulus display, the response array and the child are 'in line'. When, for example, the model was made in Experiment 6 at 90° to the stimulus display few egocentric or matching responses were made by older children. A comparison could be made between the 'in line' orientation of the photograph array, with the photographs in

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front of the observer and with the array on a table at 90° to the stimulus display. The influence of the two-dimensional photograph representation could be assessed by replacing the photographs with models as with Nigl and Fishbein (1974). Their photograph array was replaced by a model array in which models of the display from different positions represented the views from different perspectives.

Summary and Conclusions

The aim of the present study was to assess the validity of the general cognitive developmental model of Piaget to the conclusions Piaget and Inhelder (1956) reached about the co-ordination of perspectives. It was also an attempt to reconcile the wide variation of findings in the literature with the Piaget and Inhelder (1956) results. It is clear from the review of the literatureand the experiments of the present study that the cause of a pre-operational child choosing his own photograph in the 'three mountains experiment' is not solely a function of his essential egocentrism as described by Piaget.

The contrary evidence has three themes. Firstly, the single model studies (e.g. Lewis and Fishbein, 1969; Fishbein et al, 1972) which showed that young pre-school children could be trained to respond sociocentrically in simplified co-ordination of perspectives procedures. Secondly, the verbal descriptive studies (e.g. Experiments 1, 2 and 3) in which young children responded sociocentrically and made few, if any, egocentric responses when the display was simple; adding to the complexity of the display (Experiment 6) led to transitional responses. Thirdly, egocentric responses have been shown to continue into the later years of middle childhood (e.g. Laurendeau and Pinard, 1970; Experiment 6). If cognitive egocentrism is a function

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of an ongoing developmental stage and, hence, the child believes all observers to have the same view of the display then the child should present as egocentric regardless of the experimental procedure or the complexity of the display. It has been shown to the contrary that the degree of egocentrism shown by a child relates to both procedural and display variables. Procedures with a high visualising content, i.e. picture selection were more likely to lead to egocentric functioning than were verbal descriptive response modes. Piaget would use the concept of décalage to account for performance differences between model reproduction and picture selection. The stage developments are equivalent yet occur 'at different ages across the ontogenetic span'. (Flavell, 1963). Verbal description, however, has a totally different developmental pattern.

The above evidence, however, may be countered by two adaptations of the original model proposed by Piaget and Inhelder (1956) (see pg. 27). The revised model incorporates a two channel process linked to Piaget's explicit distinction between perceptual and representational thought. (Piaget, 1969). Single model procedures and verbal descriptive techniques do not require the child to build a representation of the view as seen by the observer. Rather he is required to relate perceptually specific aspects of the model vis-a-vis the observer. Since the child does not have to build a representation he makes few egocentric responses. The need to account for the continuance of egocentric responding is important for, although Piaget regards stage development as more critical than age factors, children who should be approaching the formal operatives developmental stage have been shown to produce egocentric responses. The concept of 'failure to inhibit one's own view' (Nigl and Fishbein,

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1974) appears to be an appropriate addition to the representational pathway of the revised model and would enable the model to account for the continuance of egocentric responding. It is recognised that this is a post hoc explanation but specific predictions that may be made from the revised model are discussed below.

Further research is necessary to clarify how a child builds an internal representation of the display and how he decides whether to use an iconic or verbal strategy. Developmental changes in strategies used may add evidence for the validity of the revised model and the relationship of the representational - perceptual distinction within the model to the production of egocentric responses.

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