7th. VC Batch : 1990-1992

~~VCMSR-7~~(A) VCMSR - 7

Special Projects

1) R. Venkatesh : Child's perception of space
2) R.S. Joglekar : Methodology of documentation of slide/Lecture and Audio/Visual.
3) (Mrs) Geeta Joshi : Coordinated collection & documentation of environmental land-marks in the city - Bombay.
4) Dinesh Katre : Comic book as a medium of communication.
5) Anirudha Joshi : Editing for educational films.

FIVE ONLY

⊛ 15/6/93 - Others have not given as yet.
Sharmila mayekar, Amrit Kaur (Recd on 20/8/93), Anand Bhandarkar, Neeta Mugwe (Recd. very late :. loose) & Sreekumar

Late Receipts

(6) Neeta Mugwe : Methodology of planning grids in context with the Indian Standard Paper Sizes and typographical style sheets showing use of grids with special reference to magazines in Devanagari (Marathi) (kept at end)

(7) Amrit Kaur : Study of stereotype in book publication Design - Spine of books [Kept at the end.]

(8) Sreekumar, G.V. : Documentation of Calligraphic works in Malayalam (Guide RoK?)

⊛ Late given in 2001 & in hardbound form [hence kept separately nearby this volume.]
[It looks like other VCD/VCPR thesis.]

V Imp

VENKTESH

SPECIAL PROJECT

CHILD'S PERCEPTION OF SPACE

By

R. Venkatesh

Guide

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APPROVAL SHEET

This special project entitled 'Child's Perception of Space' by R. Venkatesh is approved in partial fulfilment of the requirement for award of the Post-Graduate Degree of Master of Design in Visual Communication.

Guide :

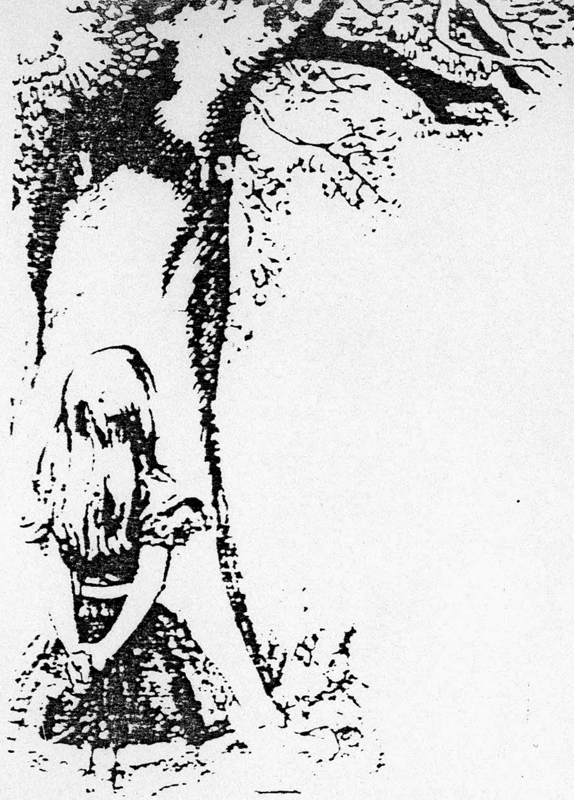
Examiner :

Date :

Acknowledgements

I thank Prof. Mohan Bhandari, who gave me profound insights into anything that we set about to discuss, for all the reading materials that he took pains to gather for me and for all the suggestions that he made towards the project.

R. Venkatesh
March, 1992



"Curiouser and curiouser!" cried Alice. "Now I'am opening out like the largest telescope that ever was! Good-bye, feet!"

Alices Adventures in Wonderland
Lewis Carroll

One can make sense of the child's spatial development by viewing it as a gradual co-ordination of two types of position specification - the self related specification on the one hand, the landmark specification on the other. Certain errors exhibited by the child in the course of development can be attributed to the child's reliance on invariant landmark relations instead of a combined use of both the types of spatial codes.

The Child's Representation of space by Paul Harris

Piaget's observations on the growth of children's concepts of space are sufficiantly potent to act as a starting point for us to think afresh about how children, and hence adults, come to exercise the control they do over the space they occupy. One thing is clear, we weren't born with rulers in our hands and yet we move from from this lack to a state, some years later, when the ruler in our hand offers one particularly powerful control, amoungst many others. During the transition our experience and insight grow: our ability to choose, to manoeuvre and to decide, increases: our particular culture invites us to engage in particular skills rather than others. Eventually we respond in a way which is recognizably within the cultural milieu.

The oppurtunities for variety have increased and it has become more and more important to look at and think about relationships in and between objects applicable over a wider and wider variety of situations. The growth of topology as a study is a manifestation of this diverse and expansive activity. Once called *analysis situs*, the study of place and position, it is not concerned with measurement but with the more general ideas of connection, closeness, inclusion and neighbourhood.

The child's discovery of space
by Jean and Siminne Sauvy

OBJECTIVES

To understand the changing conception of space with the process of growing up.
By growing up we mean growth through the phases of infancy, childhood, adolescence and adulthood.
We shall restrict my area of study to childhood.
But no study can be understood in absolute or isolated terms. So for developing a counterpart for comparison we shall study similar behaviours in young adults.

MAINSTAY

Hence the task involved in the project would be
to discover the ~~concept of space~~ amoung children of age group 6-10
to evolve prompting devices to get responses
to try and see a pattern or a common denominator amoung all the material we gather
as a counterpoint study one of the other stages in the same manner and by way of comparison, understand our core area by way of indirect affirmation and reaffirm [illegible]

SCOPE AND BACKGROUND

L[illegible]ning ab[illegible] the space aro[illegible] the [illegible] children mainly happens in two ways. F[illegible] the matter of convenience we [illegible] call the comprehension through pla[illegible] materials, domestic spaces aro[illegible] [illegible] [illegible]rmal learning and the learning through geometry as in mathematics and to some extent geography both in class rooms as the formal one.
This comprehension is either object recognition - the one usually from outside and space recognition - the one from within.
The scope then in this research is to understand the act of visual recognition and comprehension.

TASK

The prompting devices discussed earlier will be in two forms:
Q[illegible]tionnair
Themes on which the respondents will be

INTRODUCTION :

When people are asked what they mean by space, they usually answer in terms of vastness, space travel, extending out from earth's surface, wide open vistas.... This is a natural response.

There is another prosaic use of the word space. It is used to illustrate such phrases as 'Make space for me', 'Is there any space?', 'Watch this space!', etc. The word is usually associated with some activity or other.

These two notions of space are directly related to each other since people when asked 'What do you think space is?', answer with the more intangible notion of vastness, because they are being asked for a description of something in isolation while it has always existed, linked with an associated activity - gardening, sitting around, car parking, advertising and so on.

A third way of thinking about space is by way of measurement which we come to control in the grown up stages. This is in response to the complexity of relationships that he perceives, he defines spaces. For instance surfaces are defined as two dimensional spaces made up of multiple distances and so are volumes.

In the end, the word 'space' has always implied some action that is possible. In the present day world the possibilities for actions are so diverse and of such different kinds that we have to realize that no one definition will do for 'space'.

Classifications, denotions :

The Topological Space (Relational)

- involves concepts of continuity and discontinu
  neighbourhood
  region and boundary
  open and closed
  interior and exterior
  disjointed and connected
  with and without holes

The Projective Space (Referential)

- left and right
  in front of and behind

The Euclidean Space (Measurementa1)

- Space of distances and measures through the medium of geometry.

Our area of work shall largely remain in the premise of the topological space or the relational space and to some extent spaces defined by projective devices. Euclidean space is a sophistication which does not replace topological space, for there is no doubt that measurement space remains topological. Topologic properties are more general than the more specific properties of measurement.

Need for this Exercise

An exercise of this sort allows us to deepen our intuitive understanding of space. This understanc of space can be used in an investigation of the way children grow, think and feel.

Growth, perception and intelligence are influencec by one's exercise in finding interconnections in complexities. These ideas of connection, closenes inclusion and neighbourhood needs a background of spatial thinking.

This need is due to the pressing demands of our own times, in which complex systems are becoming more and more widespread. In order to make these systems intelligible, there is an increasing tendency to translate them into charts, diagrams and graphs. These graphical representation are of a spatio-logical kind because they translate logic relations into s patial forms.

Hence a study of this nature would enable us to understand the concept of space in the process of growing up, an understanding that will help us in controlling and modulating.

CHILD'S PERCEPTION OF SPACE

Some things come before numbers. Sorting, matching and so on are activities which are essential before the child can move easily into counting and other aspects of number work.

It is the same with the child's ideas about space. Topology- the study of the general properties of space, including nearness, connection and continuity- provide the key to the early experiences needed for understanding the space around them.

From this the child moves on to more complex devices in understanding, such as left and right, infront of and behind and later on measurements.

We shall see how important, this topological understanding of space is to child's growth and intelligence. As mentioned earlier topology concerns itself with the more general properties of space. These understanding of very concrete terms as some place or object as being near or far away from some other, are the first things a child grasps.

Paul Harris in 'The Child's Representation of Space' writes,

"Thus my first claim is that to act upon an object, the child must code its position relative to his own current position, and that such a specification must be constantly altered so that it remains up to date.

A second problem that the child must solve is a memory problem. To find his way to the kitchen, to school or even to find an hidden object, the child must remember where things are. The child could solve this problem by noting where things are to self. Were all object positions specified this way. the upheaval in our mental geography every time we moved would be enormous. A solution to this difficulty is to specify the position of one's own body but in relation to what I shall call 'adjacent landmark' or 'framework features'.

One can make sense of the child's spatial development by viewing it as a gradual co-ordination of these two types of position specification - the self related specification on the one hand, the landmark specification on the other. Certain errors exhibited by the child in the course of development can be attributed to the child's reliance on invariant landmark relations instead of a combined use of both the types of spatial codes.

Based on several experiments conducted on children reveal that the infant treats the landmark code as an overly stable system, and fails to update it even when the object has moved to a new position. Reliance on this landmark code tempts the infant to neglect the more accurate but less stable self-related position code which guides his initial activities towards visible objects. Accurate search ultimately requires a co-ordination of these codes".

The same is true with other properties like closed, continuous, inside/outside and even present/ absent- all of them to do with some kind of logic in space. This spatio-logical understanding arises out of the concrete facts around the child.

This understanding extends into more abstract relationships such as mother, father, relatives, neighbor and so on. Mother the closest, father closer and a neighbor not so much as compared to the first two. And as he grows up, more and more complex relationships present themselves before him for which the primary spatio- logical relationships serve as the base.

It further extends over language acquiring skills where complex interconnections need to be understood.

"It is not only in readily available abstract mathematical objects that one can see the importance of this work.In language, in argument and in relations with people one finds a complexity of interconnections that needs a background of appropriate spatial thinking. One could argue that in the west we have some times allow too linear, too measurable a view of space to prevail, so preventing us from working easily with the complexities that actually face us.

In the future these ideas will develop and become more important as we become better acquainted with the appropriate methods- for instance, the word 'graph' is now coming to mean something more widely applicable than the familiar x- and y- axes at right angles. Someone has recently described a graph as a 'picture with order' and, if such a graph gives extra clarity, then so be it.

Mathematics has long been thought of as the expressed consequence of the perceptions of relationships. As these expressions change, with more and different relationships being expressed in ways accessible to more people, we can expect a growth in the use of these ideas in attempts to illumine the way we think and how we come to think.

Bill Brookes., Lecturer in Education, Southampton University.

Parallely child's perceptions of space are influenced by the physical environment that they grow in. This influences have far reaching implications and stay on in adult stages as a few anthropological studies reveal.

"Let us now compare the environment and the virtues of the Sioux with those of the Yurok. As described, the Sioux roamed the plains and cultivated spatial concepts of centrifugal mobility, the horizons of their existence coinciding with the buffalo's roaming and the hunting grounds of superior enemies. The Yurok lived largely in or at the mouth of a narrow, mountainous, densely forested valley, and,as if making a virtue of a geographic pattern, confined themselves within

strict territorial borders. To them, 'the world' was disc of about 150 miles in diameter, cut in half by the Klamath River, and defined by cardinal directions: there was an 'upstream' and a 'downstream' ,a 'towards the river' and an 'away from the river' , and then, at the end of the world an elliptic 'in back and around' . The Yurok ignored the world beyond and ostracized as 'of ignoble birth' anyone who showed a marked tendency to venture into alien territories. Instead, they 'cried' and 'prayed' to the horizons which they thought contained the supernatural regions from which generous spirits sent the stuff of life to them: above all, salmon."

Erik H. Erikson 'Environment and Virtues'

Apart from the above discussed issues of topological understanding and the influence of physical environment on the perception of space, social and cultural influences also affect the concepts of space as in the case of the Manus tribe of New Guinea.

We shall in this study enquire into the topological concepts of space through experiments on representation of child's percepts of space.

Literature

A study of this nature presents us with a vast body of research work in the fields of psychology and anthropology. Psychologists have concerned themselves with the way children perceive and finally come to represent them and the various factors that govern them in doing so. On the other hand anthropologists have analysed, how childrens' and hence adults percepts are influenced by the physical environment, social and cultural upbringings etc.

In the context of this exercise it became necessary to present them in full, so that they provide a setting/backdrop for the exercise.

The child's discovery of space

Jean and Simonne Sauvy

From hopscotch to mazes:
an introduction to intuitive topology

Translated from the French by Pam Wells
with a new introduction by Bill Brookes

All our activities are extended and all our thoughts take place in what modern thinkers call 'space–time'. Although there is a level at which they cannot be dissociated, the concepts of space and of time are sufficiently separate in everyday sensory experience for us to be able to speak of 'space' and 'time'.

The mastery of space is essential for man. In general, it is achieved without too much trouble, but occasionally difficulties arise. This happens, for example, when we emerge from an Underground exit into an unfamiliar part of the city or when we have to interpret, say, the information on a road sign telling us how a motorway interchange works, or the plan showing us how to get to one particular stand in an exhibition on several floors. At such times we may detect a certain inflexibility in our faculties of perception and interpretation, as though they had not received enough training to be able to solve the problems set.

Before we could achieve any sort of mastery of space and build it up into a familiar framework, it was necessary for us as children to discover step-by-step its relational properties. This discovery, as developmental psychology shows, is by no means instantaneous, beginning with the first coordinated movement of the young baby and ending, in principle, at adolescence. We say 'in principle' because, as has just been indicated, the adult sometimes encounters difficulties of a spatial kind.

It seems likely that these difficulties can be attributed to gaps in the education received during childhood and pre-adolescence, for traditional education is concerned only marginally with helping children to 'construct their space'. When it does so, through the medium of geometry, it is almost always confined to Euclidean space, that is, the space of distances and measures which is only one of the three aspects of 'total space' – the topological, the projective and the Euclidean.

Without anticipating the body of the book let us make clear, for those readers who are only imperfectly familiar with mathematical language, (in the elementary sense of the term) that we describe as *topological* relationships in space which involve the concepts of continuity and discontinuity, neighbourhood, region and boundary, open and closed, interior and exterior, disjoint and connected, with and without holes, etc.

The studies of several psychologists – and in particular those by Professor Jean Piaget of Geneva – have shown that these *topological* relationships are grasped by children even before *projective* relationships (left and right, in front and behind, etc.), let alone *Euclidean* ones.

If the educational system shows little interest in topological relationships, this is no doubt due to the assumption that the roots of these relationships are sufficiently well acquired by children in the course of their everyday activities and games so that these provide the young children with numerous opportunities of familiarizing themselves with topological experience. Through [illegible] bounded by wal[illegible] that these [illegible] which the people surrounding them come and go. Later they learn to distinguish objects according to the kinds of outline they possess – a banana, because it is 'open', cannot be confused with a bracelet, which is 'closed'. Later still, when they can walk about independently, they practise following lines, jumping across boundaries, or moving a pebble from one square to another in a game of hopscotch.

However, these acquisitions are made in a more or less haphazard way, depending on whether or not a favourable opportunity arises. Accordingly, the gaps are numerous and distinctions, some of which may be essential, are not always made: for example, the difference between an object with a hole in it (through which a string can be passed) and an object which is hollow. The links needed to unite neighbouring concepts are not always forged, and the work of integration and arrangement, characterizing all knowledge which has been truly assimilated, is not always carried out by children in the midst of their spontaneous activities.

Children could learn more easily, and better results could be obtained, if those in charge of their education and, in the first instance, parents, were to enlarge the range of situations relating to topology, to vary their scale and to temper their difficulties.

This intervention presents few problems for two essential reasons:

1 An introduction to topological space does not require reference to straight lines or to measurement and is therefore accessible to children at a very early stage.

2 Learning situations – as the reader will discover from the pages which follow – can very often take the form of games or attractive exercises which the adult has no trouble in presenting.

From this, an educational trend has developed in recent years, particularly in some primary schools in England, America, Canada and France.

If this trend has only become apparent rather belatedly, it is probably for historical reasons, for the essentials of topology, as a systematically studied branch of mathematics, were not developed until the nineteenth century, whereas Euclidean geometry had been developed quite thoroughly by the Greek mathematicians long before our own time.

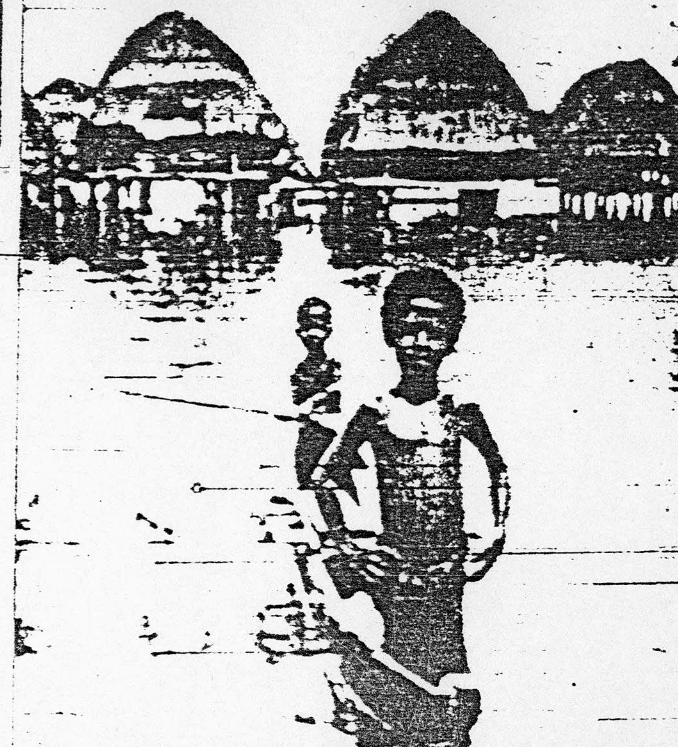
In addition, the psychological studies by the Geneva school, who were the first to demonstrate the importance of the acquisition of topological concepts in the development of intelligence and their precedence in time over projective and Euclidean concepts, are relatively recent – 1948 saw the first publication of the Geneva school (Piaget, Inhelder and Szeminska, 1960).

Finally, even though the current interest in topology is almost entirely the result of the dual evolution of mathematical and psychological knowledge to which we have just referred, it has received an additional impetus from the pressing demands of our own times, in which complex systems are becoming more and more widespread. In order to make these systems intelligible, there is an increasing tendency to translate them into charts, diagrams and graphs, from the road signs for motorway interchanges mentioned above through computer wiring diagrams to flow charts for business projects. These graphical representations are of a spatio-logical kind because they translate logical relations into a spatial form.

We have said enough to see the importance, both for ourselves and for our children, of anything which allows us to deepen our intuitive understanding of space. With this in mind the present work has been conceived with the dual purpose of extending the information available to adults who wish to keep up to date and to teachers who would like to provide a well-balanced education for the children in their care.

Growing Up in New Guinea

Margaret Mead



Conversation turned on who was oldest, who tallest, who had the most burned beauty spots, whether Nane caught a turtle yesterday or today, when the canoe would be back from Mok, what a big fight Sanau and Kemai had over that pig, how frightening a time Pomasa had on the shipwrecked canoe. When they do discuss events of adult life it is in very practical terms. So Kawa, aged four, remarked, 'Kilipak, give me some paper.' 'What do you want it for?' 'To make cigarettes.' 'But where's the tobacco coming from?' 'Oh, the death feast.' 'Whose?' 'Alupu's.' 'But she's not dead yet.' 'No, but she soon will be.'

Argumentative conversations sometimes ending in fisticuffs were very common. They had an enormous passion for accuracy, a passion in which they imitated their elders, who would keep the village awake all night over an argument as to whether a child, dead ten years, had been younger or older than some person still living. In arguments over size or number, attempts at verification were made, and I saw one case of attempted experiment. In the midst of several exciting days, during a death in the village, I had less time than usual for meals, and a can of fruit, of a size usually consumed at one meal, did for two. Pomat, the little table boy, commented on it, but Kilipak, the fourteen-year-old cook, contradicted him. I had never divided a can of peaches between two meals. All the other boys, the children who haunted the house, the married couple who were temporarily resident, my two adolescent girls, were drawn into the argument, which lasted for forty-five minutes. Finally Kilipak declared in triumph, 'Well, we'll try it out; we'll give her another can of the same kind tomorrow. If she eats them all, I'm right; if she doesn't, you are.'

This interest in the truth is shown in adult life in various ways. Pokenau once dropped a fish's jawbone out of his betel bag. Upon being questioned, he said he was keeping it to show to a man in Bunei who had declared that this particular fish had no teeth. Another man returned from working for a scientific-minded German master to announce to his astonished companions that his master said New Guinea was once joined to Australia. The village took sides on the question and two young men fought each other over the truth of the statement. This restless interest in the truth takes its most extreme form when men try out the supernatural world; disbelieving the results of a séance, they will do something which, if the séance were true, would endanger their lives.

So the form of children's conversation is very like their elders' – from them they take the delight in teaching and repetitious games, the tendency to boasting and recrimination, and the violent argument over facts. But whereas the adults' conversation turns about feasts and finances, spirits, magic, sin, and confession, the children's, ignoring these subjects, is bare and dull, preserving the form only, without any interesting content.

The Manus have also a pattern of desultory, formal conversation, comparable to our talk about the weather. They have no careful etiquette, no series of formal pleasantries with which to bridge over awkward situations; instead meaningless, effortful chatter is used. I participated in such a conversation in the house of Tchanan, where the runaway wife of Mutchin had taken refuge. Mutchin had broken his wife's arm, and she had left him and fled to her aunt's. Twice he had sent women of his household to fetch her, and twice she had refused to return to him. On this occasion I accompanied her sister-in-law. The members of her aunt's family received us; the runaway remained in the back of the house, cooking over a fire. For an hour they sat and talked, about conditions at the land market, fishing, when certain feasts were to be held, when some relatives were coming from Mok. Not once was the purpose of the visit mentioned. Finally a young man adroitly introduced the question of physical strength. Someone added how much stronger men were than women; from this the conversation shifted to men's bones and women's bones, how easily broken the latter were, how an unintentional blow from a well-meaning man might shatter a woman's frail bone. Then the sister-in-law rose. The wife spoke no word, but after we had climbed down into the canoe, she came slowly down the ladder and sat in the stern. This oblique conversational style is followed by some children when talking with adults. They make prim little statements which apply to any topic under discussion. So Masa, when her mother mentions a pregnant woman in Patusi, remarks, 'The pregnant woman who was at our house has gone home.' She is then silent again until some other topic gives her a chance to make a brisk comment.

The adults give the children no storytelling pattern, no guessing games, riddles, puzzles. The idea that children would like to hear legends seems quite fantastic to a Manus adult. 'Oh, no – legends are for old people. Children don't know legends. Children don't listen to legends. Children dislike legends!' And the plastic children accept this theory which contradicts one of our firmest convictions, the appeal of stories to children.

The simple narration of something seen or experienced does occur, but flights of fancy are strictly discouraged by children themselves. 'And then there was a big wind came up and the canoe almost upset.' 'Did it upset?' 'Well, it was a big wind.' 'But you didn't go into the water, did you?' 'No-oo.' The insistence on fact, on circumstantial accounts, on accuracy in small points, all serve as checks upon the imagination.

So the storytelling habit, the delight in story, is entirely absent. Imaginative speculation about what is happening on the other side of the hill, or what the fish are saying, is all completely lacking. And the 'why?' element in children's conversation with adults is superseded by the 'what?' and 'where?' questions.

THE CHILD'S REPRESENTATION OF SPACE

Paul Harris

Other speakers have discussed the child's difficulties in translating a mental representation into an external representation. I shall ask instead: what can we learn about the child's mental representation of space from the way he acts in space or from the way in which he constructs an external representation? In particular, the child's representation of the position of an object will be examined.

When he specifies the position of an object, the child must solve at least two problems. First, if he is going to act upon an object he must specify where it is in relation to his own current position. For example, if he is to reach accurately for an object, he must specify whether the object is straight ahead, or to his left or right, how far away and so forth. Even if the child simply wants to fixate something in the corner of his eye, he must be able to specify its position in relation to his own current fixation point - its direction and degree of radial eccentricity.

Eye movements and their co-ordination with head movements highlight one important requirement for the child's specification of position. Children are mobile organisms. Even from birth their head and eyes move spontaneously. This must mean that if the child is to specify the position of an object accurately, he must keep changing that specification simply because he constantly alters his own position vis à vis any given object.

Thus my first claim is that to act upon an object, the child must code its position relative to his own current position, and that such a specification must be constantly altered so that it remains up to date.

A second problem that the child must solve is a memory problem. To find his way to the kitchen, to school or even to find a hidden object, the child must remember where things are. The child could solve this problem by noting where things are in relation to self - for example: straight ahead and at a certain distance - and then altering this specification whenever he moved to a new position. I think it is obvious that this system cannot be used for more than a few objects. Were all object positions specified in this way, the upheaval in our mental geography every time we moved would be enormous. A solution to this difficulty is to specify the position of an object not in relation to the current position of one's own body but in relation to what I shall call adjacent landmark or framework features (Bryant, 1974: Butterworth, 1976).

This is a more stable system because if the child remembers, for example, that his toys are in a given cupboard, he does not need to change this specification every time he moves. His toys remain "in the cupboard" irrespective of his own position. Similarly the cupboard remains "in the attic". Such a nested system can be extended indefinitely.

I shall argue that one can make sense of the child's spatial development by viewing it as a gradual co-ordination of these two types of position specification - the self-related specification on the one hand, the landmark specification on the other. Certain errors exhibited by the child in the course of development can be attributed to the child's reliance on invariant landmark relations instead of a combined use of both types of spatial code.

Such an analysis can be used to explain the child's difficulties in three areas: search errors during infancy, errors in perspective-taking tasks, and thirdly, the child's misunderstanding of complicated spatial terms such as "in front of" and "to the left of".

SEARCH DURING INFANCY

Can the infant specify the position of an object accurately in relation to self? If we ask this question of the newborn baby, the easiest action system to study is the eye movement system. Recent studies from different laboratories (Harris & Macfarlane, 1974: Macfarlane, Harris & Barnes, 1976: Aslin & Salapatek, 1975) confirm that the neonatal eye movement system codes target direction. The neonate makes an eye movement upwards, downwards, to the right or left depending on the location of the peripheral target.

The very young infant also acts appropriately if we examine other motor systems: he co-ordinates both head and eye movements in localising peripheral targets (Tronick & Clanton, 1971) and having fixated such peripheral targets can reach accurately toward them (Bower, Broughton & Moore, 1970: White, Castle & Held, 1964). He can also act appropriately toward objects which alter their position relative to the self - for example, by avoiding potentially colliding objects (Ball & Tronick, 1971) or by remaining fixated upon laterally displaced objects (Tauber & Koffler, 1966).

These studies show that the infant exhibits spatially-adjusted activity with the various motor systems of eye, head, hand and body. To what extent a unitary spatial code serves these disparate motor activities is not yet clear. It is possible to conclude, however, that the infant can specify position relative to self from an early age in one or more ways. In this respect the human neonate is similar to many other species (Ganz, 1975).

When the infant and an object are displaced relative to one another, accurate spatial action is still possible because the new position of the object can be specified by the perceptual system. For example, if the infant turns away from an object straight ahead of him its new peripheral position ought to be specified given the evidence cited above concerning saccadic eye movements toward peripheral targets. Similarly if the object moves from the straight ahead position the optomotor-reflex (Tauber & Koffler, 1966) or pursuit tracking is initiated (Harris, Cassel & Bamborough, 1974) indicating that the change of position is registered. These pieces of evidence support the claim made at the outset: for spatial action to be accurate, it must be guided by a flexible spatial code - one in which prior specifications of position are rapidly and continuously replaced or up-dated to conform to the current situation. It is assumed here that afferent input provides the usual source of information for achieving such flexibility. This input is presumably visual in normal circumstances, since the visual modality provides continuous feedback concerning change of position, but recent evidence (Bower, 1976) indicates that auditory surrogates are possible.

What happens when such perceptual feedback is eliminated - or to put the question in more familiar terms - how does the infant deal with hidden objects? For hidden objects there is no perceptual feedback to specify any change in their position relative to self. To solve this problem I propose that the infant begins to use a landmark code, instead of remembering that the object was "straight ahead" when it was covered by a cloth, he now takes note of the cloth itself and remembers instead that the object is "under the cloth". As argued earlier this is a more stable code, because if he turns away from the cloth, the object position is still accurately specified - it is still "under the cloth". Conversely, if he remembered that the object was "straight ahead" and then turned to the right, the object would no longer be "straight ahead". The only problem with the landmark code is that it appears to tempt the child into perseverative errors.

In a recent review of the development of search during infancy, Harris (1975) noted the ubiquity of perseverative errors at different stages of search. Having successfully found the object in one place, the infant returns there by orienting head and eyes (Bower, Broughton & Moore, 1974) or by reaching to the same place (Harris, 1973; 1974) even when he sees the object move or disappear elsewhere. Piaget (1954) interprets these responses as egocentric errors - the infant assumes that the object can be made to appear at a given place simply by repeating a response that worked before; the infant acts as if the object's position will accommodate to his responses rather than accommodating his responses to the actual position of the object.

The hypothesis proposed here is that the infant treats the landmark code as an overly stable system, and fails to update it even when the object has moved to a new position. Thus he returns to cloth A even if he sees the object disappear at cloth B, or he turns to the end of a tunnel from which an object has previously emerged, even though the object is visible at the entrance to the tunnel.

A recent experiment by Lucas (1975) provides a neat piece of evidence in support of this argument. The to-be-hidden object was first placed near cover A. In one condition the object was placed directly in front of cover A, and in a second it was placed to the side of cover A. Accordingly we can expect infants to encode the object/cover proximity relation more readily in the first condition than in the second condition. A second cloth B was then moved over the object, and this cloth and the object were moved across the table. Cloth A remained in its original position. Lucas (1975) found that infants were much more likely to search for the object at cloth A and to neglect the actual cover, cloth B, if the object had initially been directly in front of A. This evidence suggests, then, that previously encoded landmark relations are treated as invariant even when they have actually been altered. This result is not easily explicable in Piagetian terms. The infant has never acted at cloth A, so his search at A cannot be interpreted as the repetition of a previously successful search response.

This account can be extended to explain a variety of other findings concerning the infant's search for hidden objects (Harris, 1976). For the moment the general conclusion can be stated: the infant gradually makes use of landmarks to specify the position of an object. Reliance on this landmark code tempts the infant to neglect the more accurate but less stable self-related position code which guides his initial activities towards visible objects. Accurate search ultimately requires a co-ordination of these two codes.

EXPERIMENTS

Nature of Experiments

Having defined the premise of the study as topological space perception, an initial ability towards conceiving space, experiments were designed to bring out the more general properties of space such as concepts of region, boundary, interior, exterior, neighborhood etc.

Various possible themes on which the respondents will be asked to draw, and their possible reactions were thought of.

The general idea is to prompt them to represent space that they are used to by way of living, playing, studying, contextually and their relations in spatial terms.

This exercise was expected to reveal their understanding of the inside and outside, the scale, their mobility through them, the spatial interconnections, places dear to them and the devices that they use to locate a particular thing in space and represent it.

The two aspects of this whole exercise are perception and representation. Often these two things form an inseparable whole, as one is influenced by the other. Representation will quite likely lead the children into clearer understanding of their perceptions or in the least make them aware of its presence or the lack of it.

A task of this nature is assumed to have been conducted on the particular group of children for the first time as the maximum they get to represent in their school days are a few animals, objects, and landscapes in a more cliched term, in their drawing classes. Perhaps repeated exercises on the same group may lead to such dangers.

On the other hand a demand of this nature evokes mixed feelings of confusion and ambiguity. For instance, when asked to draw their home, some went on to draw the general and most primitive imageries of a house, while a few others saw to that they drew their own homes. There was a third group of children who merely drew what the children around them drew.

Spontaneous reactions are lesser and they are understandable for one, a short term interaction like this one, fails to inculcate enough confidence in the children to feel free and come out with spontaneous and true reactions. Two, the disadvantage of working under a school setup. Already children are informed by their regular teachers who command a good respect and/or fear (the latter more than the former) to perform by way of drawing to a couple of visitors. They are asked to behave themselves, not to trouble the visitors and be 'good'. Three the clarity of understanding in children is not uniform, partly due to the lack of time we ought to have spent with them to make them understand clearly and partly due to the limitations and inabilities of communicating with them.

These above mentioned observations roughly sum-up the nature of the experiments and the problems involved before we move on to the actual experiments and their inferences.

The Experiments, Observations and Inferences

The experiments were conducted on two different age groups in order that they become counterparts to each other. This will, by way of comparison, help us in understanding the changing perceptions of space and their representations.
The two age groups were eight and fourteen years. These were conducted in two different sessions of independent age groups.

FOURTEEN YEAR OLDS

General observations

There was an overall sense of apprehension for quite sometime after they were asked to draw 'the place they live in'.

Surprisingly there were very few doubts and queries as they began to draw. The few doubts involved clarifications about 'whether it should be drawn as seen from the top or what if the play place is within the house or what is the extent (boundary) of the place and so on, all of them very unclear about their own expectations.

This can be attributed to the nature of the task that they are being asked to do, probably for the first time, coupled with more intangible notions of space that they already have.

The drawing process was marked by lack of surety and extensive use of eraser. (the latter perhaps an usual activity with any drawing process)
The finished drawings reveal the strategies that the children have adopted to represent the place that they live in.

First of all the overall conception of the terrain is more or less clear. This quality should be attributed to the age of the children, as we will see later, how children of a younger age group lack thi There are definitive landmarks to position their location, with whose relation to, other details and less prominent spaces are mapped. Here mention should be about the level of detailing in the drawings. They are of a more pronounced nature, inconsistent and with no particular attention to any one thing.

Various representational techniques are either used in isolation or in combinations to acheive the desired effects. More imposing structures like multi-storeyed buildings, mountains, trees assume a perspective or atleast a frontal view, while planar surfaces like gardens, roads, grass patches and playgrounds are reduced to mere two dimensions. One can conclude that sufficient height and to some extent weight (or in other words volume) to give a perception of depth.

Naming/labelling the places (such as 'my house', 'this is my school', 'this road takes me to the school' etc.) as an additional information to their drawing is prevalent. The reason could be lack of confidence in the content of visual information in their own drawings or the habituation by way of drawings that the curriculum demands or both.
A curious thing that seems to have happened in most of the drawings is the importance given to friend's place. This occupies as important a position as their own homes and occur in the drawings irrespective of the distance separating them.
By and large the representation of places are true to their realistic existence, but in a few cases 'gabled

roof and a chimney' imagery are seen while some other displayed 'setting sun behind the mountains' image as the backdrop to their drawing. This is due to certain notions that children seem to carry, of 'art' and 'drawing' and should be regarded as having anything to do with their conception of space.

Another interesting observation is that of the way they represent the play-grounds. Mostly they had kids playing the game of cricket. This should be because of the current theme of interest prevailing in this season. (world cup '92) But what is important is the way in which they are depicted. While some are completely planar views showing positions, others are a combination of ground in plan and players in perspective. Often the scale is arbitrary and inconsistent.

Some specific cases

Some specific cases of the drawings reveal interesting insights into their perception of space. In one case the kid ha tried to represent a bird's eye view of the place that he lives in. Owing to the complexity of the drawing involved and the difficulty of visualizing such a view, the drawing remained incomplete. But the kid had successfully completed his own home, its boundary and the adjoining play area.

In another, there was an absolutely graphical representation of the place as a plan. An inquiry revealed that he had indeed come across such a depiction. Hence here, there was drawing from the memory and his understanding of it with respect to his place of living.

In abetter example combining both the above mentioned, a sample contained a key drawing of the place in an inset while the predominant part of the drawing explained a detailed portion of it in perspective. Here we see a very advanced and fine observation of space which gives him good control over his representational techniques.

Prominent landmarks such as revolving gates, clock tower, main gate, school building etc., are first located, with reference to which, other details are drawn.

In conclusion we see that the understanding of a given space, in this age group is quite clear in terms of the spatial relationships. Getting the details, scale and perspective correct depends mostly on the level of their skills.

EIGHT YEAR OLDS

The eight year olds were more ready to draw and hardly had any doubts about their task. It was ofcourse difficult to explain to them about the task-'to draw the place they live in', as it is. Hence it became necessary to break them into components that make up the place such as home, school, roads etc. This was done by way of prompting them to find out for themselves what made their place.

Then there was the realization, partly after their response, that these components, though constituted the whole did not actually amount to the actual whole.Partly also the children lacked the understanding of spatial relationships that we talked at length in the previous age group and tended to draw the components in isolated terms. There were some attempts to spatially connect them. Obviously the level of manual dexterity was much lesser than the fourteen year olds, but were more spontaneous and uninhibited.

Homes would be often drawn from images of home as having 'gabled roof and a chimney' than actually homes. In such actually drawing homes attempts, multi-storeyed buildings were conceived as a mesh of grids with random openings with least details. Human figures feature prominently along with the play equipments.

As these components, the home, the school, and the play space are represented in isolation, we get very little or no clue of their sense of spatial thinking, understanding of the scale and strategies they follow to position these spaces. A few cases which attempt to position them spatially in relation to each other also fail, leading us to conclude that spatial understanding is underdeveloped or lacking at this age.