Expression, Representation and Drawing in Early Childhood

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THESIS CONTAINS VIDEO

Abstract

Using detailed longitudinal studies of 43 children, the thesis describes the onset and development of important modes of expression and representation, in children 0 - 5 years of age, and focuses especial attention on one of those modes - drawing.

The study shows that the beginnings of drawing, far from being haphazard, meaningless scribblings are, on the contrary, highly intentioned acts which have structure and organisation.

Whilst not extensive, the main findings of the present research are supported by other recent studies made independently but in parallel to that of the present author.

The work shows that drawing development cannot be accounted for solely in terms of imitation of cultural models, nor in terms of motor-skills development alone. Rather, the present account shows that infants use mark-making and drawing as one member of a family of early symbolic modes which they spontaneously generate to form descriptions of reality. The study traces drawing development from its origin in early infancy - in the actions the infant performs upon objects in the physical environment, and also in the actions performed within an interpersonal, psychological environment formed between infant and caregiver. Using detailed micro-analysis of recorded observations (video, film and still-photographic techniques were employed, as well as continuous transcription of these in longhand-journals) a description of drawing development is constructed which shows the child moving through a series of modes of representation, each having its own internal infra-structure and powerful meanings for the child.

The study shows that at every level, from the earliest mark-making, to the graphic descriptions of objects and events, the child is generating powerful representational and expressive modes which many

research paradigms and methodologies have missed but which in fact play an essential part in the development of cognition and affect. The important implications of this for education are considered.

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Introduction

The intention of this thesis is to show that early mark-making is a part of an array of expressive and representational responses the young child spontaneously generates to represent events and objects and also to express feelings about these events and objects. Evidence will be offered to show that a complex of little understood behaviours is organised by the child into a family or cluster of actions which he or she uses in a systematic way, to create descriptions of reality. This family of expressive and representational modes forms a background for the child's understanding and use of symbol systems.

It is hoped that these descriptions of emergent symbolisation will aid our understanding of (a) drawing; the contribution it will make to learning and development, and (b) part of the process by which children move from the kind of thinking which is embedded in their actions, to the use of symbols and signs (Donaldson, Grieve and Pratt 1983).

The present research forms part of a shift in the approach of developmental and cognitive psychology. Recent studies in these fields have revealed startling (and hitherto unsuspected) capacities in the neonate and young infant. These innate capacities, or propensities, take the form of visuo-motor progammes for spatiotemporal perception and interactions (Bower 1974, 1982; Spelke 1985) and also capacities to engage in social relations with another human being - usually the caregiver (Trevarthen 1975,1987). Such studies have shown that the infant, far from being the famous "tabula rasa" or empty slate, as was once thought, has, on the contrary,the basis for conceptions about objects and events (Bower 1974, Spelke 1985). Moreover, recent work on early social interaction shows the infant not as the passive recipient of fixed and predetermined cultural forms and values, but on the contrary, reveals the infant as playing a central role in the generation of culture itself (Trevarthen 1979).

Until comparatively recently psychology has tended to emphasise the inabilities of the infant - the supposed deficits in his or her cognition. The revolution now occuring in our understanding of infant cognition constitutes a powerful model and stimulus for this author's work, since the present study seeks to illuminate the sense and systematicity of behaviours which, until recently, have either received scant attention, or else have been described in terms of haphazard, reflexive and essentially meaningless actions. It will be shown that within a psychological space created between infant and caregiver, the infant develops expressive modes which serve as an interface between action and symbol. Studies on the relationship between gesture and language have been helpful here (for example Condon 1975; Petitto 1987,1987a; Trevarthen 1984).

The present research reveals the organisation and structure within sensorimotor actions and shows how early 2D graphic behaviours evolve at this level, in the first months of life.

Recent work on language acquisition has also provided a powerful framework for the present study. In common with John Willats' research on drawing (for example Willats 1983, 1985) the present work shows that drawing development is, in certain respects, akin to language acquisition. Of special significance has been the interpretation of language acquisition as an essentially creative process (Chomsky 1965, 1966; Bickerton 1981). Such models have been valuable paradigms for the present work since this too uses evidence which shows that the acquisition of drawing skills cannot be accounted for solely in terms of imitation of cultural models.

Recent studies in neuropsychology have also been relevant in this regard. It would appear that the basis of representation is driven by programmes housed in cortical and subcortical structures (Young 1978). Along with the recent work on language aquisition, the research in

neuropsychology supports the hypothesis that early representation is driven by internal programmes which are not wholly reliant on the availability of cultural models.

The idea that symbolisation is driven spontaneously by the child is central to the present study. However, this should not be taken to mean that this programme can run efficiently either in a hostile environment or in a cultural vacuum. On the contrary, these programmes are such that they are very sensitive to ambient culture and any changes which occur within it. These ideas have enormous implications for education. Development, according to this view, is best encouraged within an interpersonal environment, so designed as to map sensitively onto these internally driven programmes.

Part 1 (Theoretical Framework and Literature Review: New Studies in Cognitive and Affective Development) will locate the present research on the origin and development of early representation within these recent studies of intellectual and emotional growth. The failure of traditional accounts to provide an adequate theoretical base for a more complete understanding of children's drawing will be introduced in Part 1 of this work and developed more fully in Part 2.

Part 2 (Theoretical Framework:Drawing) will consider some of the traditional accounts of children's drawing (Luquet 1927) as well as some of the recent experimental work on children's drawing. It will be shown that these studies do not adequately convey the significance of graphic representation in childhood. Part 2 will establish the need for methodologies which, like the present author's, are designed to capture information about the important uses and meanings the children themselves develop for graphic media.

Part 3 (How Meaning is Given to Drawing) will use the longitudinal data to trace and describe the formation and development of a group of actions developed by the infant within an interpersonal arena between

the infant and caregiver (Petitto 1987; Trevarthen and Grant 1979). The data will be used to build a description of how these actions are developed, not only for their instrumental or pragmatic effects on the world, but also for their communicative and expressive values. The present work will go on to describe how this cluster of actions is developed by the infant to form early mark-making gestures.

Part 4 (Action and Marks) will extend this account and go on to show how the child organises these actions into packages of behaviours which acquire powerful expressive and symbolic values. The process in which the consequences of actions - the pigment traces - are themselves regarded by the child as representational structures will also be described.

Part 5 (Deep Structures) describes how the graphic structures developed by the child constitute one form of certain deep structures he or she is also discerning in other actions, events and objects. The significance of this in terms of the organisation of the child's perception and representation will be discussed.

Part 6 (Interpersonal Basis for Representation) will use analysis of this author's slow-motion video sequences of children's painting and drawing episodes to form a description of the interpersonal basis for representation. This part will locate the emergent graphic forms described earlier within a psychological space formed between infant and caregiver. The influence (so frequently misunderstood) of a society's images and other cultural artifacts upon individual development will also be located within this psychological arena.

The Conclusion will consolidate the author's thesis that early mark-making is not (as many assume) the mere meaningless, motoric prelude before configurative drawing is acquired. On the contrary, evidence will be used to support the theory that early mark-making is an important expressive and repesentational mode which serves as a powerful tool for

the child's formation of descriptions of the world. Evidence will be used to suggest that the structural principles which guide representation are universal. Moreover, the evidence of this writer and that of other's (for example Eisner 1985) will be offered to support the claim that drawing forms part of a system of representational modes whose development is, in many societies, either crippled or curtailed. The educational needs that these findings suggest will be emphasised.

Methodology and Data

For reasons which will be outlined in Part 1 and 2, certain research paradigms have not always been helpful in illuminating the nature and significance of early drawing and its development. Much of the current experimental work divorces drawing from its roots in the child's holistic symbolisation. Also, many studies of children's drawing have been based on collecting and analysing finished drawings, rather than attending to the processes out of which these drawings arose. Consequently, the present writer has designed research methodologies capable of capturing, within informal, interpersonal settings, naturalistic data about children's spontaneous symbolisation as it ensues. This approach has revealed the uses to which children themselves put graphic materials, and the understandings they develop in so using them.

Regarding the reliability of the data, as Wolf, Rygh and Altshuler (1984) write of replica play, it is the very "...fullness of the performance..." involving "...a combination of manipulation, construction, gesture and language..." which gives reliable indices of type and level of meaning of the actions (Wolf, Rygh and Altshuler 1984, p.199).

The data consist of (a) 3 highly detailed longitudinal studies of 3 children, 2 boys and 1 girl, (Ben, Joel and Hannah) from their earliest days of life to their present ages of 7, 14, and 17 years of age (only the period between 0-5 years of age will be studied) and (b) studies made over a 2 year period of 40 children between 3 and 4:6 years of age in a nursery class in London.

(a) The Longitudinal Studies These consist of every single drawing and painting produced by the 3 children, from their first mark-making (4-6 months approx.) to the ages of 7, 14 and 17 years. These drawings etc. are stored chronologically and number perhaps 15,000 separate pieces. Only the period between 0-5 years will be studied.

Some of their 3D work has also been collected, but most of it has been photographed (colour - transparencies or video). These constructions are in Lego, wooden blocks, cardboard, clay and other materials.

Most drawings, paintings and 3D constructions studied in this research were made spontaneously by the children. The data consist however, not only of analyses of end-products, but include several thousand recorded observations of the drawing and other processes through time. This is rather important as many of the representational processes cannot be distinguished in the finished drawing or painting.

The observations were made at least 2 or 3 times a week and record drawing and play episodes. These observations were recorded in longhand and/or audiotape and/or videotape. The length of observations ranges from 5 minutes to 2 or 3 day periods.

Longhand Journals

These comprise 600,000 words approximately for each child, to date.

Audiotapes

These consist of about 500 hours. Some of this has been transcribed into longhand.

Videotapes and Film

300 hours: Video and photographic techniques were developed which were naturalistically sensitive and which did not disrupt the children's activity. The children became aquainted with recording equipment and behaved unselfconsciously. Super 8 sound film was also used in the recordings made of Hannah's first days of extrauterine life. Some of this has been copied (mute) onto videotape. Slow-motion techniques and frame-by-frame analysis has been used to analyse drawing production, motor skills and the complex interplay of intentions that occur within a young child's painting or drawing episodes. Some of this material has

been transcribed into longhand.

Colour-Transparencies

About 5,000: of drawings and symbolic play episodes. These are stored in chronological order for each child.

Main Themes and Conceptual Concerns

These are teased out of this mass of naturalistic data, providing a complex picture of the development of some aspects of early symbolisation. The main themes were itemised and filed in microcomputer in chronological order for each child. Each item on the computer file commences with the initial letter of the child's name, followed by his/her age in years, months and days, followed by a summarised observation, ending with the page number, and/or an audiotape reference number, and/or a videotape reference number, so that the entire observation can be located.

(b)Supporting Studies made over a 2 year period of 40 nursery class children of different class and racial backgrounds

The observations mainly consist of 40 hours of video-recorded drawing and painting sessions. Again, all these drawings etc. were produced spontaneously. The drawings etc. were also collected and stored chronologically.

Expression, Representation and Drawing in Early Childhood

Part 1

Theoretical Framework and Literature Review: New Studies in Cognitive and Affective Development

The author's research proposes a model of development of 2D graphic representation which is very different from that offered in many other accounts, both traditional and new. In order that the orientation and significance of this study be appreciated, it is important to locate the work within the larger context of a change that has occurred in our understanding of children's thinking. This part of the study then, will describe some of recent research which includes studies of neonate cognition; studies of early social interaction; studies in language acquisition, and studies in neuropsychology. From such studies is emerging a new model of human development of which this author's work on early representation and drawing forms a part.

Until comparitively recently, psychologists have described development in terms of the child's supposed deficits. Accounts of cognitive development have, in the recent past, tended to emphasise the child's limitations -what he or she was (apparently) unable to do. Many studies-both old and new - of children's drawing, are examples of deficit models of child development. These will be described later, but such models are in fact part of a larger inability to recognise the sense and systematicity children's early behaviour and thinking.

As Donaldson, Grieve and Pratt (1983) have said, during the first half of the 20th Century research seemed to indicate serious shortcomings in young children's ability to reason. This trend however has

recently changed. Donaldson, Grieve and Pratt (1984) cite some of the reasons for this paradigm shift. For example, recent studies have shown that very young children, and even neonates (Bower 1974, Spelke 1985) have abilities which were once unsuspected. Ingenious experiments with newborns revealed astonishing problem-solving capacities; babies were able to learn, and to organise their own behaviour. Newborn babies showed special interest in the behaviour of human adults -particularly the mother (Bower 1974, Stern 1977, Trevarthen 1980, Richards 1980).

An important factor contributing to this change of orientation to learning and development has been the increasing complexity of possible descriptions of the interrelations between our genetic endowment and the environment. Whilst our genes might provide a ceiling to our intellectual development, studies both of the neonate and of the young infant show that different kinds of environment have vastly different effects on the growing organism. Bower, for example, says that "...early learning opportunities affect later learning. Learning ability, initially shaped by innate mechanisms, can decline if it is not exercised. The development of learning ability thus seems to decline if it is not exercised. The development of learning ability thus seems to depend on an innately generated set of mechanisms and the opportunity to use these mechanisms in a psychological environment..." (Bower 1974, p.12). Bower is writing about the neonate, but he goes on to say, "We shall see this pattern repeated again in development" (Bower 1974, p.12). Learning then, depends on context, and especially, as again recent research has shown, interpersonal context.

Several recent studies have revealed the neonate as a social being (for example Stern 1977). Of especial importance to the present work has been the growing body of evidence which shows the interpersonal basis for representation. The neonate has been shown to come into the world pre-disposed to engage in social relations with another human being -

the caregiver - usually the mother (Stern 1977, Hubley and Trevarthen 1979; Trevarthen 1987).

Over the last 10- 15 years the realisation has grown that language and thought develop within the context of human relations (Bruner 1974, Trevarthen 1975, Stern 1977). "In most interpersonal contexts, there is an interplay of different human purposes, and early childhood thought is interfused with purpose and the recognition of purpose." (Donaldson, Grieve and Pratt 1983, p.4).

Again this has been shown to be true of the neonate and the young baby. Trevarthen (1979) and others have shown that even the new-born baby takes part in early social interchanges with his or her caregiver - usually the mother. These are complex duologues requiring an "interactional synchrony" (Condon 1975, p.87) between the vocalisations, facial expressions, and actions of caregiver and child.

Trevarthen (1984, 1987) has suggested that the infant is able to enter into these proto-conversations with its mother because of a capacity (encoded in neural mechanisms) to couple precisely the rhythmical periodicities of its own internal programmes of movement with those of its mother. Trevarthen writes of mother and child as participating in shared acts of cognizance (Trevarthen and Hubley 1979). In order to counter possible criticisms that such social behaviours on the part of the infant might be the product of mere copying or training, Trevarthen made experiments using closed-circuit video in which mis-matches were contrived between adult's and infant's contributions to the dialogue. Such experimental work strongly suggests that in these interchanges the infant controls a complex of behaviours which are "...held together by emotional states of mind..." (Trevarthen 1984,p.144). Trevarthen's and Stern's work has suggested that it is within this psychological "bubble" (Stern 1977, p.29) constructed between caregiver and child that meaning is first attributed to actions and then to objects and the handling of

objects. Such studies have suggested to the present writer how representational and expressive values might also be given by the infant to mark-making actions and materials, within this intersubjective arena.

The probability that the neonate plays an important part in the "creation of culture" (Trevarthen and Grant 1979, p.566) challenges imitation-models of learning and behaviouristic approaches to education. Such studies by Trevarthen and others have been of great importance to the present work, since these authors offer an alternative to models based on either biological or cultural determinism.

There follow from this some rather important implications for curriculum design. These will be addressed later.

Language Acquisition

The realisation that learning develops in an interpersonal context has been of especial importance to our understanding of language acquisition. Noam Chomsky's work on linguistics has been a strong influence in changing attitudes amongst researchers toward the development of the young.

There are some important parallels between language acquisition and drawing development. Of special importance to the present study has been the work of those who have shown that language acquisition is not simply a "copying" process but is essentially creative.

Chomsky (1965, 1966) has provided a theory in which the development of spoken language depends on the acquisition of increasingly complex language rules. A similar proposal has been made about drawing development (Willats 1983, 1985).

Chomsky's is an innatist theory which holds that the child acquires language by being exposed to linguistic information, much of which Chomsky originally thought to be unreliable as a model for the infant. Chomsky argued therefore that if the child is able to sort out the

relevant linguistic data from the irrelevant, the child must possess a Language Acquisition Device (LAD). This device was claimed to contain a family of linguistic rules which were innate and transmitted genetically. These rules would have to be universal, in the sense that they would not specify a single language, but would delimit the forms any human language might adopt. In this way a limit is set on the amount of hypotheses a child would be obliged to generate and select from in order to arrive at his/her mother tongue.

However, according to Bickerton (1981) the predictions that the generative theory makes are not born out; i.e. the child does not move through the use of syntactic structures in an orderly progression from the simple to the more complex. So, by the mid 1970s Chomsky had modified his theory to one which presumes the child to have a "predisposition" to generate language rules. Emphasis started to be placed on pre-linguistic communication; extra-linguistic knowledge; and the role of mother-child interaction. By 1979 the linguistic data was no longer thought unreliable but, on the contrary, carefully shaped and contextually adapted for the infant by the caregiver. For example, Bruner (1976) was saying that the infant was essentially taught to speak by his/her mother.

Bickerton's (1981) research however concerns the study of generations of infants who learnt a language their mothers did not possess. This language was Hawaiian Creole.

Bickerton has investigated the creation of a new language. He describes how, between 1500 and 1900 European colonialists created, on tropical Hawaiian islands, autocratic societies, usually around the production of sugar. These societies were ruled by a tiny minority of Europeans whilst the great mass of the workforce consisted of peoples who possessed many different languages. The speakers of these different languages developed a primitive contact language - "pidgin" - which was

expanded to become Creole. Bickerton writes that there was only a superficial resemblance between this new language and the European "parent" languages. Even this slight resemblance was "...mainly because the bulk of the vocabulary items were drawn from that source, and even here, there were extensive phonological and semantic shifts" (Bickerton 1981, p. 2). Significantly, he goes on to say that "In the area of syntax, features were much less traceable" (Bickerton 1981, p. 2).

Bickerton claims that for the development of the original pidgin to occur at all, the infants would need to acquire new rules of syntax. "...children are supposed to derive rules by processing input (with or without the help of some specific language-learning device); in this way, they arrive at a rule system similar to, if not identical with, that of their elders. If this were all children could do, then they would simply learn the pidgin, and there would be no significant gap between the generations. In Hawaii, at least, we have empirical proof that this did not happen - that the first creole generation produced rules for which there was no evidence in the previous generation's speech" (Bickerton 1981, p. 6).

Bickerton concludes from this that "...all members of our species are born with a bioprogram for language which can function even in the absence of adequate input" (Bickerton 1981, p. 1).

This present writer's own studies of the origin and development of representational and expressive modes, including drawing, suggests the distinct possibility that these modes too may be initiated and organised by such a bioprogramme. The data from the present research reveals the developmental trajectory of representation to be of such stunning complexity, and to be so dissimilar in important repects from the input available within the interpersonal environment, that the possibility that this development is driven by an internal bioprogramme, is an extremely salient one. The children I have observed seemed to possess

"infrastructural motivation" - to use Bickerton's (1981, p.234) terms - to produce 2D structures which were quite different from those available in the cultural pool, and moreover, to produce these forms in spite of certain pressures placed on them sometimes by adults, to produce quite different ones.

The existence of such a bioprogramme does not preclude the more important elements of the generative theory of syntax. Increasing control, and purposeful use of expressive and representational modes would require expanded metacognition involving awareness of the rule-bound structure and potentialities of these modes as systems.

As will be shown in Part 2, such a model of drawing development is far different from certain others, particularly those of authors who conceive of development as a process of imitation. The de Villiers' work on language also indicates the limitations of the imitation model. As they say, "It can be most disconcerting to have a fifteen-month old who you know can manage only a handful of English words come through from an adjoining room, look you in the eye, point back into the other room, and say: 'Gongong dingdong baba da?' You cannot escape the feeling that the child has created a language of his own and if you possessed an English-Childish dictionary he would tell you something quite profound" (de Villiers and de Villiers 1979, p.26).

These authors go on to speculate about the structure and syntax of early babbled sentences and their relationship to the first words. This relationship may parallel, in some important repects, the relationship between scribbling and the first configurations.

Bickerton also makes the point that as well as "innate language equipment" we have "... a wide variety of learning strategies and problem solving routines which are applicable to a range of situations far broader than language. It would be absurd to suppose that in the presence of data classified as 'linguistic', all these routines and

strategies should simply switch off" (Bickerton 1981, p.144).

To acquire language then (or any symbolic system) we use all the help we can get.

This brings discussion to another important theme of the present research which has to do with gesture as a base for symbol use. Relevant here are recent studies about the status of gestures as language. Laura Petitto's (1987, 1987a) work on gestures and language in apes and children has been especially helpful here.

Petitto asks some important questions about the relationships between gestures and language. What is the role of gesture in the acquisition of language? What is the relationship between gestures and the first words?

In a talk at the Cognitive Development Unit in London (28 May 1987) she discussed current theories about gestures and language. One model proposes a gestural, pre-linguistic stratum onto which language is mapped. According to this model, gestures and language are fundamentally similar.

The theory that gestures form a base for language is, however, insufficiently supported by data. The basic notion in this theory is that a gesture equals a word. But is this true? Petitto asks: To what extent do gestures represent objects? Do gestures indicated objects of a particular class or kind? Do gestures have a syntax? Do parents understand the gestures of their children? Do gestures have a wide variety of functions, or are they used in a similar way in similar routines?

Some of Petitto's research involved studies of three profoundly deaf children and three children with normal hearing between 9 months and 24 months of age. It turns out that both deaf and hearing children use gestures in the same way except, significantly, the deaf children babble in sign language. This finding would seem to lend weight to the idea

that babbling is an important precurser in language development. It also supports the idea that the beginnings of symbolisation are not imitated from external systems but are self-generated from within and capable of being transported across sensory communication channels.

In fact, Petitto argues that the use of words is fundamentally different from the use of gestures. She concludes that we are not justified in saying that gestures are the names for objects. She discovered that gestures are mainly used in conjunction with objects. This was true of both deaf and hearing children. In children between 12 and 13 months, her work suggests that gestures are indexical, in the sense that they are essentially the same as actions used with the object - meaning that we are not justified in thinking of these gestures as representations. The gestures are associated with objects and object-use, but are not metaphors for them.

Petitto lists three types of gesture: natural, instrumental and symbolic.

1. Natural. These are banging , hitting, swatting, pulling. These gestures have also been described by Matthews (1983, 1984, 1986, 1988). This writer, like Petitto, has noted their enormous pragmatic effect on the world. Petitto says that a single gesture is interpreted by parents in very different ways. Each gesture has variable meanings according to context. Whilst not being equivalent to words, they do acquire enormous communicative power. Like Petitto, this author has catalogued these gestures, traced their development and their use as expressive vehicles. Matthews (1983, 1984, 1986, 1988 and the present research) has described their effects on different materials, especially their trace-making effects when performed on pigments of various kinds. Petitto says that the children do not use these gestures as communication - these are actions which the child associates with objects. They are, according to Petitto, not the names for things but the sensorimotor schemes described

by Piaget.

2.Instrumental. These are used for one function alone; requests. They are spontaneous. The object must be in view. The form of these gestures is part of the activity - there is no symbolism. Again the present author has recorded this type of gesture. They are different, says Petitto, from American Sign Language. Parents also use these. They are not the names for things.

3.Symbolic. In the children Petitto studied there were few gestures used symbolically. The onset of these symbolic gestures was at 18-20 months. An example would be the twisting of a hand to represent unscrewing a lid.

These gestures are intentional, communicative, referential and representational - but they are different from children's names for things. Matthews (1983, 1984, 1986, 1988 and in the present work) has also recorded symbolic gestures in the very young child.

Petitto goes on to ask, why do children gesture? Her own answer is that gestures form an intermediary interaction system. This is partly a system of self-control. Gestures, as Petitto defines them, belong on a continuum which starts with crying - not on a continuum of language.

The gestural behaviour is associated with objects and so extends a child's knowledge about objects and their potentialities. In this respect, gestures are like language, but, according to Petitto, are not the same as language. Petitto illustrates this distinction by describing how the infant at 7 months is pointing; moves on to language; and then brings in a few symbolic gestures.

It is important to appreciate of course that Petitto is employing a very strict and exclusive definition of gesture as symbols. She is looking for a one-to-one correspondence between an action and a word. For the purposes of the present research this might be a too narrow and iconclastic approach. There is a level at which, using a broader

definition, one can see, within an interpersonal context, a complex of gesturing between infant and caregiver in which meanings are understood and shared. Taken out of this context gestures are robbed of their syntax and organisation within what is essentially a 4 Dimensional language. Perhaps one of the reasons why Petitto tends to undervalue the symbolic use of gesture and to minimise the role of gesture in language acquisition is because she seems to have limited her study to arm-movements (though she does mention facial expression). When we observe the child moving his/her body freely in space and time it is possible to describe a level at which gestures do form a part of early representation.

Central to the present work is the evidence that the child uses gesture in play to convey (in both senses of carrying and communicating) expression, mood and emotion. In particular, the present work reveals quite clearly that drawing has its origins in dynamic gesturing.

In spite of reservations indicated above, Petitto's work on gestures as an intermediary interaction system remains powerful for the present work. The present writer is indebted to her painstaking analysis and taxonomy. Her model corresponds with this author's view that the dynamic 4D modes of expression and representation are an interface between action and symbol.

Play

As one approaches more closely this interface (as the present study proposes to do) it becomes apparent that play is implicated in the child's formation of a 4D symbolic language. The events unfolding at this interface can only be fully comprehended when one realises that the child is alternating between two distinct orientations to media.

On the one hand, the child is learning and practising dynamic routines; perceiving the results of these routines in terms of their residual effects (in drawing this takes the form of pigment traces) and learning how to repeat these actions along with their effects.

On the other hand, the child is able to temporarily disengage from the constraints of the medium and develop permutations - new progammes of action which are imbued with symbolic potential (Garvey 1977; Smith et al 1984).

It should not be thought that the child first accommodates to objects and the handling of these, and only later detaches meaning from action and words from objects (Vygotsky 1966) so freeing them for symbolic use. The processes postulated by Piaget of accommodation and assimilation seem to be entwined together from early infancy. The objective world is itself a consequence of that intersubjective reality created between infant and caregiver.

Some of the ideas of Neo-Freudian psychology are here reconciled with modern developmental psychology, for this psychological space is also the "transitional area" described by Winnicott (1971, p.1). Within this area there occurs a fusion of the objective and subjective. The child handles the objective world but perceives it subjectively. In the play world the child engages in "...a dialectic relationship to an extra-subjective reality" (Lorenz 1971, p.89). This subjectivity is carried over into the individual's relationship with his/her own actions which in themselves become viewed as actors making entrances and exits into symbolic scenarios now being constructed by the child alone.

So it is then that the expressive modes to be described within these pages have their genesis within a psychological arena of play. In play - and only in play -can meaning be constructed. Without play there can be no true symbol use. In play the child monitors the processes involved in the attainment of goals. This developing

metacognition is a necessary part of becoming a competent symboliser. Play then, is indispensible for the child's creation of symbolic systems. In play, the elements of skilled techniques can be temporarily uncoupled from the constraints of current adaptive situations and investigated as dynamic structures in themselves. New patterns of action can be formed. "...having abstracted features from the task (play task or problem-to-be-solved) the animal constructs an action pattern by serial ordering of the constituent parts (the difference between play and problem solving is in the salience of the goal itself. In the latter, the goal is all important, whereas in play the essential activity is the process of assembling the components)..." (Sylva 1977, discussing Bruner, p.60). In the case of play with language, this enables the child to explore the variety of ways linguistic elements and extra-linguistic context interlock. This is an important example, for this process in parallelled in the child's exploration and synthesis of graphic structure.

Organised motor control becomes in play a language in itself. In play, objects and events; the locomotion and propulsion of the complex, multi-articulated human organism; the skilled handling and use of objects - all these become combined in various ways to form part of the fluid syntax of this 4D language. According to Bruner (1972) the player learns how to extract rules or principles from objects and processes, rather than learning their specific features.

The present study will show the child building an "analogue" (Wolf 1983 personal communication) spatio-temporal reality in which - in the particular example of drawing - mark-making materials themselves become the "pivotal" objects (Vygotsky 1966, p.547 in Bruner, Jolly and Sylva 1976) around which symbolic phenomena is generated. To use another of Wolf's terms, the child "transports" concepts developing in imaginative play over into the arena of drawing and painting (Wolf 1983 personal

communication).

Both Bretherton's (1984) and Wolf's (1984) studies of play have been important to the present work. Bretherton (1984) suggests that the study of symbolic play involves a study of the development of event representation. In her account, events rather than single objects might be schematically represented in the brain. If so, symbolic play involves the re-telling, or re-presentation, of experiences in terms of "...temporo causal relations among actors, recipients, objects and locations " (Bretherton 1984). Bretherton seems to conceive of the internal event representation as "scripts" (p.6) but it could be that these also involve imagery.

Whilst the research cited by Bretherton would suggest that "empty-handed miming" is rare in infants below 21 months (Bretherton 1984, p.20), evidence from the present writer suggests that this is not so. It may be that narrowing the focus down to infants' use of empty-handed gestures which mimic the handling of objects conceals a very rich source of early gestural symbolisation. Whilst the young child frequently employs an object or toy as a "prop" to sustain the act of representation, the child's use of body parts or actions as symbolic vehicles in themselves may not be as rare as some researchers might think. Wolf and Grollman (1982) have suggested that the child's use of objects in play, or conversely, the child' preference for empty-handed play may be a function - not of development - but of cognitive style. Such an idea is a very salient one for the present writer. That expessive values are attributed to body actions, which in play become themselves the actors, forms an essential feature of the present study.

Internal Representations of Events and Objects

Bretherton's model suggests the primacy of representations of events over those of objects. This theory proposes representations of objects

and their constituent parts are derivatives of event representations. According to this view, the development of symbolic play reflects the development of event representations.

This model is important to the present writer since his research data shows that frequently the encoding of the structure of objects is a consequence - even a by-product - of drawing programmes designed to encode the structure of events. The internal representations which form the basis of the external forms, are developed in the child's active engagement with the environment. Again, Trevarthen's (1984) studies of the development of human locomotion and motor control have been of fundamental importance to the present work. Human actions, saliently extended in 4D, require an interplay between neural structures, corporeal environment and the extracorporeal environment. The brain is required to develop what is essentially a creative response to the demands of governing this interplay of forces. This actually encourages growth at a neural level (Trevarthen 1984, Blakemore 1988). Therefore, provision for the child's interaction in an apropriately enriched environment is a necessity for brain growth itself.

Human locomotion, according to Trevarthen, forms the basis for our conceptions of events and objects (Trevarthen 1984). The prediction of impending events at the periphery of our complex biodynamic structures, as we move through our environment, initiates descriptions of supporting (or retarding) surfaces; their inclination; specifications of surface texture, degree of luminence; descriptions of edges, corners, indentations, protuberences. This involves reciprocal interchanges and collaborations between all sensory modalities; visual, auditory, proprioceptive, somesthetic, kinaesthetic. This creates a totality of perception out of which internal descriptions are formed.

Trevarthen uses the example of picking up or catching a falling object. This involves descriptions or models not only of two different

converging vectors, that of the subject and that of the falling object, but also descriptions which coordinate information about size, mass, form, texture and location or velocity .

It could be then, that representations of objects are derived from those of actions. This would not be a one-way process however. Reciprocally, perception of object specifies certain actions which can be performed upon it. This requires that the organism detect "affordances" within objects or situations (Gibson 1979, p.127). Gibson's work on the ecology of visual perception has been important to the present study, and it is to his work that we now turn.

It is within our active engagement with the environment that we extract our knowledge of deep structures or invariants (Gibson 1979, p.13, 168). Using Gibson's theoretical framework, this author has created a picture of the infant actively seeking out such invariants; that is, deep structure which persists throughout certain transformations.

The data of the present writer reveals the infant's active detection and representation of the same or similar deep structures or invariants across a range of different media or contexts; in 4D play and in 2D graphic structure. It will be argued that it has been the failure to recognise such legitimate - and indeed profound - representation in children's drawing (and other forms) which has led to these important modes either described in terms of deficits, or else dismissed altogether as meaningless.

Work by David Marr (1982) on visual perception has also been valuable to the present author in developing descriptions of emergent representation. Marr, using descriptions of artificial intelligence, has shown how humans might build internal descriptions of the world from optical data.

The differences between these two authors are not irreconcilable.

Their work and its relation to children's drawing will be more fully addressed in the next part.

Neuropsychological Studies

Recent work in neuropsychology has also lent support to the ideas of the present writer who, like others (Bower 1982, Spelke 1985) propose a model of development in which the child enters the world already equipped with certain propensities. Development, in line with some of these current theories, is to be conceived of as an unfolding programme, initiated and generated by neural mechanisms in the child which cause him or her to actively seek out those very stimuli required in order that these propensities be activated.

Such a concept has profound implications for educational planning. The basis of representation would seem to be driven by programmes driven by mechanisms housed in the cortical and subcortical structures. Young (1978) conceives of organisms as being in themselves representations of the environments through which they live.

Such research has served as a powerful stimulus for the present writer since it provides the neurological basis for a curriculum which is based - not on the imposition of external and arbitrary paradigms which do violence to developmental processes - but on internal standards and objectives of the human organism itself (Young 1978).

Development is to be seen as an interaction between processes within the child and the extracorporate environment; this environment being considered both in its physical and interpersonal manifestations. This latter aspect is of great importance, for interaction is taken here to mean that between the neuropsychological environments of separate individual human beings. For this reason the present research also looks toward current thinking in psychology which has stressed the interpersonal basis for the acquisition of culture (Trevarthen and Grant

1979, Trevarthen 1987); to those who conceive of the learning process as essentially formed within an interaction between persons (e.g. Wells 1983) and toward the developmental models of the curriculum proposed by some educationalists (Eisner 1985, Blenkin and Kelly 1988).

The Relationship Between Writing and Drawing

Other recent studies of relevance to this author's work includes work on emergent writing. In the present study, consideration will be made of the child's differentiation between those visual symbols which are configurative - the 2D structure specifying more or less directly to the perceptual system a shape derivative of the entity to which it refers - and visual signs - 2D structures which bear no direct physical relation to their referent, but which are arbitrary, conventional, and which have to be read. The former modes include depictions of various kinds; the latter consists of written and printed words, numbers and other mathematical signs. The present work shows the infant and the very young child actively investigating and differentiating between a plethora of objects ranging from those which are clearly 3 Dimensional to rather flat objects on flat planes. In doing so, the infant (at least in Western cultures) encounters "virtual" objects - surrogate objects which include images, depictions, symbols and signs.

In children's drawing we see the child sorting out the distinctions between arbitrary signs and pictorial symbols. Reid (1983) describes a new approach to reading and writing which identifies these processes as new kinds of language learning - rather that skills predominantly perceptual and motor.

The present study reveals that the child's concept of print is often worked out in - and is certainly aided by - drawing. Letters and numbers are generated by the child, along with a myriad other forms in drawing. This generation of graphic structure initiates further detection,

within the visual environment as a whole, of 2D shape.

Reid (1983) writes that, in addition to working out how words are related to the environment, part of the child's task in understanding print is to work out how words are related to each other. This process again recalls that which occurs in children's drawing. The child moves through various approaches to the synthesis of lines, marks, shapes and colours within the drawing itself, plus their relationship to phenomena external to the drawing.

The present author's studies reveal some of the explorations made by the young child in which the boundaries between drawing and writing are made to blur - sometimes intentionally so. (See also Ferreiro and Teberosky 1983; Bruce 1987). This particular avenue of reseach looks very interesting for future reseach. It is often said by researchers in developmental or emergent writing that the child simply knows the difference between symbol and sign. Put in its simplest form this assertion is most unsatisfactory, both from a theoretical point of view and also when contrasted against empirical data. As the present writer has said elswhere:

"In drawings, the very young child sometimes appears to use letter forms and other types of configuration interchangeably. This does not necessarily mean of course that the child does not realize that letter forms are different in some sense from other kinds of configuration, but it does show that children use them in a personal, symbolic, even ideosyncratic way in their drawings. This suggests that any differentiation they do make between letter forms and other configurations is probably different from that made by adults" (Matthews 1988, p.180-181).

It is important to know how far such interchange or fusion of symbol and sign occuring in children's early mark-making is accidental, or if the child is experimenting purposively - actually playing with

the nature and structure of graphic semiotic systems in themselves. If this is so, then even young infants are using meta-languages in a manner not unlike the exploration made by certain modern artists of the structure of painting as a language in itself. Such a notion is not at all far-fetched. It is a logical necessity supported by this writer's evidence.

Reid's (1983) work looks also at the child's conception of the representation, in print, of speech. The present writer has made some discoveries about the child's transformation of vocalisations and other sounds into 2D visual forms. These will be discussed in Parts 5 and 6 of the present work within the context of descriptions of children's painting and drawing behaviours.

Mathematics and Drawing

Whilst the present reseach cannot study in depth the development of the child's mathematical understanding, it is proposed to consider the context of this development where it pertains to the young child's holistic representation, expression and drawing.

Mathematical understandings can be seen to issue from the same source as do those other intwined elements of cognition; the dynamic, configurative, spatial, rhythmical and the musical. The beginnings of these understandings are located within those spatiotemporal events which - as will later be described - constitute the infant's early painting and drawing experiences.

Conclusion to Part 1

The present research will trace the different transformational systems through which the child moves; modes of geometry which can be dynamic and gestural; or which have topological implications, or which have projective possibilities. It will be suggested that these are

probably not best understood as emerging in a linear, hierarchical sequence, but form a complex of interrelated and available modes from early infancy. The present study will suggest - using the empirical data - the reasons behind the child's selection and use of one and/or other drawing system. Descriptions of these drawing systems will have implications for other aspects of the development: those relating to logicomathematical, linguistic/narrative, spatiotemporal, configurative and musical.

Finally, although this writer has found only a paucity of information in the literature on children's drawing which has helped shed light on its significance, there have been some notable exceptions to this. The work especially of Athey (1980); Smith (1983); Wolf and Fucigna (1983); Court (1989); Golomb (1974, 1989 personal communication); Haas (1988 personal communication) and Costall (1988) has been extremely helpful. While much experimental work on drawing has tended to obscure rather than reveal, again there have some exceptions to this. I am, for example, indebted to John Willats whose work on drawing systems has been invaluable (for example Willats 1983, 1984, 1985, 1989). Francis Pratt has also illuminated some drawing strategies in his experimental work (for example in Phillips, Hobbs and Pratt, 1978). I am also grateful all these researchers for their advice, criticism and encouragement.

Also, some of the experimental work of others (awaiting discussion) turns out to be useful when viewed within a quite different theoretical framework than was perhaps envisaged by the researchers who produced it.

The work of all these writers will be discussed in appropriate places during Part 2 of this study when special attention will be focused on the act of drawing itself.

It must also be stated here that the scene has been set for this

study by Bruner's work on enactive representation, and Piaget's on sensorimotor intelligence. The present author departs from Piaget's theory both in respect to Piaget's model of hierarchical stages, and specifically Piaget's ideas about children's drawing. However, his powerful description of sensorimotor behaviour remains an excellent framework for this author's discussion of the origin of symbolisation. In particular, Piaget's concept of schemes and schema whilst modified in the present account, forms an essential background for the present work. Also fundamental to this work is Piaget's concept that thought is interiorised action. This is an idea which will be discerned at the root of the present author's theory of early representation.

Expression, Representation and Drawing in Early Childhood

Part 2

Theoretical Framework: Drawing

Until recently, most research on children's drawing has been concerned with analysing configural end products. Some representations however, cannot be discerned in the finished drawing and have gone virtually unnoticed (exception of Athey 1980, Wolf and Fucigna 1983). One example of this, made during the so-called "scribbling" stage", is the representation of the movement of an entity rather than its shape. This has been referred to as action representation by Matthews (1983, 1984, 1986, 1988, 1989). The methodology developed by the present author has been designed to illuminate this and other modes of early representation which have hitherto escaped detection in the conventional experimental research paradigm. It seems to some of us working in drawing research that much experimental work, valuable though it is in teasing out some of the task demands and strategies involved when children draw, has been insufficient in describing the role of drawing - and particularly early mark-making - in development. It also seems that the gifts which experimental work has offered are in any case only fully appreciated by those who have a more holistic understanding of early symbolisation. Such invesigators seem to be in a better position to realise the significance of the various threads of cognition and are therefore more able to locate these within the large weave. Part of the shortcomings of much of the classic and also some of the recent work on children's drawing has been its separation from the holistic context of children's other developing modes of representation. The present study will offer evidence to suggest that the true nature of children's

drawing and the contribution it makes to intellectual and emotional development, cannot be fully comprehended unless it is considered and studied as one element in a complex of representational and expressive behaviours.

In this study, rather than presenting children with artificial drawing tasks conceived of by an adult experimenter, and which impose limiting parameters on the child's behaviour, the purpose has been to record spontaneous drawing, in which children either conduct their own experiments; or set their own objectives - most of which are inaccessible to the blunted probing of much current experimental work. The present work has avoided simply projecting art theories onto finished drawings. Rather, techniques have been designed to illuminate the theories the children themselves are constructing with their drawing. The methodologies developed by the present writer have revealed that early drawing in not deficient or meaningless (as comparison with certain adult models of drawing will inevitably suggest) but is in fact an extremely powerful vehicle for symbolisation.

First of all it is necessary to trace some of the theories which underlie research on children's drawing. It is important to understand some of the concepts out of which the design of some traditional and recent approaches have arisen. All of these have had their effect on education.

The inadequacies of certain paradigms will be highlighted, and this author's alternate model proposed.

From the outset of the research, this writer was struck by the intensity of involvement of the children in their drawing. They seemed to be exploring and experimenting with modes of representation, sometimes in a startlingly systematic manner.

I reviewed the literature in the hope that some light might be shed on the behaviours I was observing.

Literature Review: Some Conflicting Theories about Drawing

When I first reviewed the available literature some key points emerged. Firstly, certain processes I was recording were not mentioned at all. There was a paucity of information concerning what appeared to me to be key experiments made by very young children in symbolisation. Explorations made by the children which were clearly very important to them seemed to have received scant attention by most investigators. Secondly, the whole area of research on children's drawing seemed to be a conceptual muddle. It was riddled with contradictions. On the one hand, the impression obtained from some writer's (for example Franz Cizek 1921 and Rhoda Kellogg 1969) is that children's drawing development is a naturally unfolding creation which flourishes best when left quite alone. The extreme version of this view is that the effects of surrounding culture are thought to be wholly destructive. Cizek was undoubtedly correct when he claimed that children were creative in their drawing (Willats 1989). However, neither he or his followers were able to define clearly the nature of that creativity. Cizek and others seem to imply that children's art is to be protected from the influence of society which is thought to actually stifle development. From this position, adult culture - including teaching - seems to be considered nothing more nor less than a contaminant which will destroy a natural growth.

In this model then, development is conceived of as occuring in splendid isolation from any cultural input or influence and, in fact, most forms of input are shunned.

On the other hand there were (and are) those who view children's drawings in terms of its supposed deficits. This stance has had a long tradition. For example, Walter Smith, an art educator of the 1880's, had this to say of his 3 year old daughter:

"Whilst the firmness of her natural touch is something

tremendous...Her mental disadvantages arise from an altogether to exalted opinion of her own works, causing a self satisfaction which hinders her progress and blinds her to defects in style and her imperfect execution; and she is wildly indignant with me at any faults I point out, and simply turns round and thrashes me if I point out a faulty line" (Walter Smith, quoted in Eisner and Ecker 1966 p.4).

While there may be, as Eisner notes, some gentle irony here, nevertheless this view of children's drawing is derived from an adult conception of what constitutes a skilled graphic act.

More recently, the Luquet/Piaget conception of the young draughtsperson was that of a "failed realist" displaying "synthetic incapacity" (cited in Freeman 1972, p.133.) Many modern researchers consciously or unconsciously adopt the same position.

Such deficit models are the result of contrasting children's early drawing against adult drawing systems conceptualised by the researchers to a greater or lesser degree of clarity. Some models adopted by some researchers are extremely vague, composed of only muddled assumptions and prejudices; others are derived (again, consciously or unconsciously) from adult geometrical systems. The inevitable consequence of this has been that when a young child's drawing is measured against geometrical (or other) paradigms about which the child knows nothing, it shows up in a rather poor light.

A great problem in the psychological literature on drawing has been that many of the researchers have only a limited and naive understanding of art. However, lack of understanding of art has been only part of the difficulty. Negative accounts of children's drawing are actually part of a general tendency prevalent until very recently to describe the child's intellectual development in terms of his/her limitations. As has been described in Part 1, such models have been recently challenged by new studies which reveal the remarkable abilities of the neonate and the

young child. This has caused a change of orientation in developmental psychology.

The present work on children's representation and drawing is intended to supplement this new approach which has shifted the emphasis from what children cannot do to what they can.

Copies, Stereotypes, Canons and Schemas

As regards drawing, the deficit model here enlists for its shaky support a hazy paradigm about the supposed nature of drawing itself. Implicit in much work on drawing is the vague idea that drawing is a kind of copying process. This notion is rarely made explicit by the investigators concerned who, perhaps lacking consciousness of it, cannot question it.

The "copyist" model of children's drawing operates in two main ways: One version says that children's drawing develops only insofar as the children can "copy" surrounding cultural artifacts i.e., other people's pictures. From this position runs the idea that children initially produce meaningless "scribbles" which they later abandon when confronted with "real" pictures. Their own drawings are adapted so as to increasingly resemble pictures of others, children and/or adults.

A slightly different copyist model is that drawing in itself is a process of somehow "copying" from perceived visual arrays. In some important ways this attitude is even stronger than the cultural model version. It will be shown however, that no version of the copyist model can account for the development of drawing as we actually see it unfolding through childhood.

Copyist notions of drawing are still very much prevalent today. In modern research on children's drawing it is disguised in various ways. Freeman (1980, 1989) seems to be saying that children do not mediate their drawing production through their own internal representation but

just match percepts of shape against referent. This seems again like a copying process, but in this case one which has been shifted back to the copying of internalised shapes. Freeman has done much to illuminate drawing but, like others, he discredits children by saying that their minds are not involved in drawing. Whilst finding fault with both Piaget's conceptual framework and his experimental design, nevertheless he holds ideas (unstated but implicit) akin to Piaget/Luquet notion that young children, in their drawings are "failed realists". Golomb (1980) has also noted Freeman's copyist idea.

The cultural-copy notion can be found in the work of Wilson (1984, 1989). His account of drawing development emphasises the impact of all-pervading culture on the child, and implies that children's drawing is largely a copying process, dependent on a cultural "image pool" (Wilson 1984, p.29 and 1989). It will be shown later how unsatisfactory this is as an explanation for the structure we find occuring in children's drawing.

Allied with the copyist notion of drawing is that of the stereotype. This idea can also be traced through much of the literature on drawing and has repercussions throughout all levels of education.

The assumption is that children's spontaneous drawing development consists of a mere accumulation of a vocabulary of stereotypes. Again, there are some variations on this theme. One version is that children acquire their stereotypes from surrounding cultural models. Invoked here is the copyist notion: children copy shapes they find in the pictures of others, either in those of children or those of adults. They are then supposed to mindlessly repeat these regardless, apparently, of their own perception of the unique specifications of the forms to which their notionalised stereotypes refer.

Another version is that the individual creates the stereotypes himself or herself, again mindlessly repeating them to denote, in a

telegraphic manner, a wide range of phenomena, again regardless of his/her own perception of the phenomena.

Wilson (1984,1989) seems to invoke both these versions in his account of children's drawing.

Now, while we do on occasions see children using 2D forms which might quite legitimately be described as stereotypical, it will be shown that Wilson and others are quite wrong to attempt to account for all drawing development in this way. After studying many thousands of drawings and drawing episodes of the very young, the present writer concludes that the stereotype is one of the great myths which have developed in the folk-lore on children's drawing.

To complicate matters still further, some researchers tend to blur the term stereotype with two others -the canon (or canonical drawing) and the schema. These three terms; schema, stereotype and canon are often used as if they were interchangeable, which they clearly are not.

This lack of focus signals a deep misunderstanding about early representation which permeates education and art-education. One tendency which has emerged in Britain in recent years in the teaching of drawing is to conceive of the child's drawing schemes in extremely negative terms. The child's programmes of visual search, far from being recognised as the means by which he or she forms internal models of reality, are demoted to the level of visual prejudices or handicaps. A rather limited approach to objective drawing is often adopted - usually revolving around some form of still-life drawing. The justification of this is argued in terms of challenging the child's so-called stereotypical graphic responses. In its most extreme form, this method bars all approaches to drawing other than recording from nature.

The ways in which children are allowed to explore the objects presented in this approach to objective drawing are often severely restricted. With large collections of objects dominating most of the

centre of art-studios, even children's movements around the room itself are severely constrained (Atkinson 1989, personal communication).

At secondary level this approach is very dangerous, but it is especially destructive when it influences early childhood education. The bizarre situation of nursery children being criticised for painting their daffodils purple is cause for serious alarm!

This approach is often termed "close observation" or even "direct experience". (This latter term is especially ironic, since, as will be argued, the method frequently disrupts an entire dimension of the real "direct experience" of the child).

As will be described, the present writer's evidence reveals the child's schematic repertoire as a series of systematic and intelligent solutions to representational problems. Yet commonly, in the use of "close-observation" or "direct experience" methods, a deficit model of children's drawing is involved, in which the child's schematic repertoire is falsely identified as a limited and limiting vocabulary of stereotyped forms. The remedy for this supposed malady is to force children into a mode of projective drawing - usually a naive perspectival mode - which, apart from any other considerations, is a peculiarly Western-Ethnocentric position to adopt. Typically, unusual 2D and 3D structures are deemed deviant forms which teaching must somehow `correct` yet the child evolves such drawing systems independently of similar systems utilised at other times and in other places by adult artists. It is both ironic and tragic that such structures whilst canonised when they exemplify the art of cultures spatially or temporally distant, are condemned in our own children.

Such abuses of children's graphic representation stem from ignorance about the uses to which children themselves put graphic media; the understandings they themselves bring to the "trace-making effects" (Michotte 1963, p.289) of drawing. Unless one can identify, with some

degree of confidence, the representational problems which children themselves consider important and themselves address; unless one can identify the type of information children themselves consider essential to be encoded into a drawing, then one is in no position to plan effective educational provision. The so-called "reforms" of education in this country are likely to exacerbate these problems.

The view that children's drawing tends toward restricted stereotypes is common amongst psychologists as well as educators. The Piaget/Luquet error has already been mentioned, but more recently van Sommers writes of the "tyranny" of children's graphic schemas which he feels are rigid strategies which actually "retard" children's development (van Sommers 1984, p.173).

Such notions are the product of wholly inadequate theoretical frameworks. If drawing is assumed (consciously or unconsciously) to be solely the encoding of 3D "frozen" arrays (Gibson 1979, p.269) into 2D, then children - especially the very young - are rather poor at this. However, supposing children are attempting to use drawing for altogether different purposes?

Whilst Smith and Fucigna (1988) in an important study have offered evidence that some new discoveries about transformational/denotational systems may be elicited from children by their drawing from nature, the ill-conceived, hit-or-miss, force-feeding of still-life drawing to children who are using their graphic schema with wholly diffferent intentions, is unlikely to be anything other that destructive.

In many cases it turns out that what is being demeaned, when children draw, cannot really be their lack of observation - sometimes their drawings are packed with observational information. No, as Willats (1985 personal communication) has pointed out, what in fact is under attack is the type of information and the way in which this information is encoded.

It is the systems of representation that are being criticised - not the children's observation, as such, of nature.

As will be described in the study, the development of drawing involves the creation, by the child, of a number of drawing systems (Willats 1977, 1981, 1985). These systems are not readily available within the child's cultural environment and thus are truly creative solutions to the problems of transforming 3 dimensional arrays - and 4 dimensional sequences - into 2D.

Children's drawings made in some of these systems may look very curious indeed, and it is the use of these systems which is frequently misinterpreted as evidence of one or more of the following deficiencies within the child: deviancies in the child's model of reality, or in his/her visual system; lack of motor control; inattention or even "laziness".

Is it the case that some are saying, in effect, that if only children really paid attention to the visual array, then they would depict it in some kind of perspective? The confusion seems to arise from the untenable philosophical position that there is one absolute visual reality which is attainable independently of the representations which encode it.

Children then, are being asked to make their drawings "more like how things really look."

But how do things really look?

We cannot talk about visual reality without recourse to to representations in which it is mapped and what - if anything - makes one system "better" than another is a vexed question, as we will see.

As will be made clear in this study, the "imaginative" and the "objective" are not distinctly different, unrelated modes. All drawing involves a mental reconstruction of phenomena (Gablik 1976). All drawing then, involves imagination.

As Arnheim (1954, 1974) and more recently Willats (1985 personal communication) have said, leaps in drawing development do not result from "better" observation as such, of nature, but from the child detecting ambiguities or indeterminacies arising out of the drawing process itself.

Imitation or Self-Generation?

Arnheim (1954) has said that the copyist notion is based on the philosophy of naive realism. This philosophy maintains that "... there is no difference between the physical object and its image perceived by the mind...the work of the painter or sculptor is considered simply a replica of the percept" (Arnheim 1954, p.155). He writes that this notion was not fundamentally changed by discoveries about optics; the retinal image merely took the place of the physical object; the artist merely "copying" the projected retinal image.

However, if this theory were true (Arnheim argues) one would expect projective realism to appear in early art forms of the world, and also in the first drawings of young children. We see, however, the reverse of this: projective realism is a late development in both the history of the world's art and in the drawing of young children. As Arnheim points out, neither the early representations of the child or those of humankind itself are in any way copies of retinal images. (This is not to say however, that neither very young children or the cave-dwelling artist never capture scene-specific information in their drawings. The representation of such information is not, however, a copying process. That the very young have the capacity to encode scene-specific information will be later made apparent).

Willats (1983) has pointed out that the standard Luquet/Piaget account of children's drawing (which will be described later) "...depends either on copying the appearance of the scene, or on

reproducing known stereotypes" (Willats 1983, p.78). He goes on to say that "...on the other hand, painting and drawing are often thought of as quasi-magical processes, with which it would be sacrilegious to interfere, and which would wither at the touch of scientific investigation. This may be because, although it looks as if it ought to be very easy to copy the appearance of the real world, it actually turns out to be incredibly difficult. At the root of these contradictory attitudes towards the visual arts lies the mistaken belief that art depends primarily on skill in copying" (Willats 1983, p.78-79).

Language

Willats continues by making an analogy between language acquisition and drawing development. Until recently many accounts of language acquisition were also based on a copyist principle. As Willats says, language was thought of as a "heap of words" (Willats 1983, p.79) with each sound carrying an isolated, individual meaning associated with an individual object. It was therefore thought that children learnt to speak by copying the sounds made by their parents and those around them, and associating these sounds with objects by constant repetition" (Willats 1983, p.79).

More recent accounts of language acquisition (Chomsky 1966; Bickerton 1981) have shown that the copyist model is inadequate as an explanation for language acquisition. Imitation alone cannot alone account for the way children operate and apply language rules. "...Such a theory is at best incomplete, for it leaves out important determinants of speech development in children" (de Villiers and de Villiers 1979, p.28).

From the earliest sounds, through to babbling, and then to the first combinations of words, vocalisations are generated by the child which are not to be heard within the child's sonic-environment. Babbling seems

to have an internal syntax or structure quite unlike any vocalisations the child might hear, and this is true of the first phrases and sentences. These are unique, spontaneous and rule-bound solutions to the problem of making meaning in speech.

Likewise, copyist models of drawing cannot account for some of the strange visual structures produced by children and which are not to be found within the child's visual environment but which are - for the child - essentially creative solutions to representational problems.

It seems likely that both language and drawing development are driven by programmes within the child. These programmes might involve the generation of language rules or structural principles. The production and use of these structural principles is complex, imitation playing only a part. It is not so much that the child's drawing imitates external forms but rather that the forms perceived in the environment by the child are precisely those generated within his/her family of representational modes.

Further analogies can be found between drawing and language development. The present writer has studied children's earliest mark-making and so-called scribbling and found it to have complex internal structure, both in formal terms and also in terms of expressive values. This structure prefigures and shapes its later configurative values. With some notable exceptions (including Athey 1980, Wolf and Fucigna 1983, Smith 1983) the relationship between so-called scribbling to configurative representation has been little understood.

Significantly, in psycholinguistics, the relationship between babbling and the first words is also little understood: "Surprisingly, there has been almost no study of the babbled sentences of children who can already say a few words even though such a study might illuminate the child's early mastery of speech. For example, is any aspect of the babbling consistent across similar circumstances? Do the same word-like

sequences turn up in the same eliciting circumstances? This kind of consistency would suggest that the child constructs his own words for objects and events at the same time that he learns words from the adults around him...Even if the speech sounds vary from occasion to occasion, does the intonation pattern of the babbled sentences seem appropriate to their apparent communicative attempt?...one wonders if some children use intonation in their babbled sentences before they apply them to their single-word utterances. These questions are part of a larger issue: what is the relationship between babbling and the child's first words?" (de Villiers and de Villiers 1979, p.26-27).

It seems essential to investigate the level of so-called scribbling asking similar questions to those asked by the de Villiers about babbling.

Evidence will be offered to suggest that drawing development is influenced right from the outset by an internal capacity to generate structural principles. As these principles are part of a developmental continuum, and as what happens at the beginning must necessarily have a profound effect on what happens later, it is less than satisfying that Wilson (1984) should use studies of 9-12 year olds to stand for the development of "...very young children" (Wilson 1984, p.5 and 1989). During a time span as long as this, a sequence of vastly different representational concerns emerge, each phase with its own internal sense and structure. It is very misleading to lump all these together and use the blurred amalgam as evidence of culturisation. In arbitrarily mixing age-groups from the kindergarten to 12 year olds, a quite false model of drawing acquisition is invoked. By using this method, it is possible to find evidence which support almost any argument about development.

One expects children as they grow to be affected (in ways which the present study will describe) by pictures surrounding them. It is necessary, however, to seek the principles which shape the

development of a symbol system, and this requires we look toward its earliest manifestation.

Wilson acknowledges the universal phenomena of the formation in early childhood of a collection of shapes or "graphemes", to use Oliver's (1974) term; but he seems to consider this to be a formal vocabulary, or set of building blocks underlying later configuration, rather in the manner of Kellogg (1969) whose work will shortly be described.

To follow Wilson's argument seems to lead us to the curious situation where the child would require one set of rules for the formation of universal graphemes which would then be replaced by a quite different set of rules to account for cultural influence. In the light of all other aspects of symbolisation, such a process seems most unlikely.

We remain indebted to Wilson for his demystifying of children's drawing. His highlighting of the mutual contradiction between the romantic notions universalism and individualism is a point well taken, and one which Malvern (1989) has made. Wilson is also quite right to reject the romantic notion that drawing can develop and flourish in a social or cultural vacuum. According to him, drawing development in isolated communities is, on the contrary, a stunted, atrophied growth. However, whether the crucial factor here is of a deprivation in the form of a missing cultural pool of ready-made images, is questionable. Within Western civilisation rich in imagery, certain basic kinds of social and physical impoverishment kill many areas of intellectual and emotional growth. The deprivation here is not one of visual arts. Inundated with a culture's imagery, many remain impoverished. Certainly the child needs interaction with the environment; the point is precisely why and how this takes place. Clearly children are influenced by their particular cultural environments, but just as clear is the fact that they do not

copy everything. The real question is what mechanisms influence the child's selection and use of forms from culture's images.

What are the rules which determine this interaction? The relationship of the child's word's and images to the words and images of others' is a complex one. A culture rich in visual arts does not guarantee "enriched" drawing by its children - far from it - but significantly, neither does an environment impoverished in visual arts always deny it. Extracorporeal environments are surroundings which may include mediated visual imagery in terms not only of sculpture, engravings and pictures of many sorts, but also photographs, television, films, laser-photography and computer-generated imagery. However, even lacking this mediated imagery, who is to say that an environment is not otherwise visually rich? It is not the kind of physical environment that is the key factor, but the child's relationship with that environment. As Athey (1980 personal communication has described, development is to do with what is available in the environment, matched (or mis-matched) with what is going on in the child. The child might on occasion derive a drawing from what might be termed a stereotype, but at no time does Wilson describe how this might be accomplished. The crucial questions about the process of drawing in his account remain unaddressed.

This present study will put forward strong evidence which suggests that the child is only able to reproduce forms from the drawings of others in so far as he/she is already generating these forms him/herself. Moreover, as was mentioned earlier, it is the child's own spontaneous generation of forms which in the first place alerts him/her to their presence in the environment (Matthews 1988).

The child's drawing will not flourish in a social or cultural vacuum, as perhaps Cizek and others believed, but nor is it reliant on dipping into a rich "image pool" (Wilson 1984,p.29) any more than

language acquisition is dependent on a " heap of words" (Willats 1983, p. 79).

This study will identify and describe part of this interrelationship between a child drawing and the environment. Willats (1985 personal communication) has said that, if the grammatical parts of speech cannot be identified and named, no discussion about language acquisition is possible. In such a situation one, quite literally, does not know what one is talking about. Likewise, the study of drawing requires descriptions which will enable us to identify the structural principles which organise its development. Doing this may reconcile the apparent contradictions between different accounts of children's drawing. It will be shown that the child's drawing is largely self-generated from within, but depends on, and is itself a part of an environment which is sensory, dynamic and also interpersonal. What it actually is that is actually being perceived and used in the environment, and how and why it is so used, will form the main content of this work.

Views

Underlying many dubious and restrictive attitudes about the nature and the teaching of drawing, one can glimpse an assumption which is far-reaching in its effects on our thinking about art and development. Yet this assumption - prejudice really - is rarely questioned by its holders. This is probably because it is derived from a dominant Western conception of graphic representation. This assumption has been pin-pointed by Willats (1985 personal communication and 1989a) and consists of the idea that drawing is of necessity about the copying of views.

Curiously, it seems to have occured to very few in the field of psychology that drawing could do anything else. Hagen (1985) for example is quite firmly of the opinion that all graphic or visual

representation depends on the draughtsperson selecting from a limited and fixed range of projective systems. Hagen argues that all forms of 2D visual representations, no matter how strange these may appear at first sight, do nevertheless show possible views. Hagen goes to some extremes (I am tempted to say some lengths) to defend this claim. For example, she accounts for variations of oblique and isometric projection systems (including those used by Oriental artists) by saying that these actually represent a view of the object obtainable at optical infinity. But as Costall (1988) has written, as an explanation of traditional yamato-e Japanese art this is just not good enough. These pictures show aspects of scenes and objects which cannot be seen simultaneously from a single station-point. As Costall says, one of the difficulties with Hagen's position (and there are many) is that she restricts her analysis to the projection of single, isolated surfaces. Her theory can neither account for the mapping of scenes or of objects.

As John Willats (1989, personal communication) has pointed out, it is rather difficult to provide incontrovertable evidence that very young children map holistic volumes as distinct from either sections or views. Nevertheless, both the experimental work of Willats (1981) and that of Vanessa Moore (1986) shows that children construct images which are not satisfactorily explained by a view-model of drawing.

Even if Hagen is arguing for the idea that some representations specify a muliplicity of views (she does not make this clear, and in any case there are reasons why the present author feels that this option is also unsatisfactory) Hagen has got nothing to tell us about the kinds of graphic structures around which the present account centres, which do not represent any possible view.

In their earliest drawings and mark-makings, very young children explore many possible expressive and representational responses. One example is the child's use of mark-making to explore and develop

feelings and ideas about events as well as objects.

The stage is set for this at birth. According to Bower (1974,1982) the young baby is interested, not only in the visual configuration of objects, but also their trajectories and positions. It is significant that the infant, in learning to identify the unity of a object places greater reliance (initially) on the character of a partly hidden object's trajectory than on its colour and form (Spelke 1985). If the infant is interested in both the appearance (frozen configuration) and the trajectory of entities, then one would expect to see these interests reflected in children's drawing. Indeed, we do.

This study has shown a multiplicity of representational concerns in very young children's drawing; some of these are configural, but others implicate mathematical and logical understanding; others are to be associated with linguistic development; and all of these are derived from the presentation and re-presentation of events.

In some early painting and drawing (around the end of year 2) the young infant is not using the medium to register perceived or conceptualised shapes from the surrounding visual world, but is employing the medium's "trace-making effects" (Michotte 1963, p. 289) to monitor or represent the flight-path or trajectory of an entity. These were called <u>action representations</u> (Matthews 1983,1984). This type of representation was also observed in work done independently and in parallel to the present author, by Wolf and Fucigna (1983) and by Athey (1980).

Some action representations trace simple flight paths from A to B, and some represent more complex actions. As Butterworth noted, when discussing this author's findings (1985 personal communication) these action representations are probably more than a simple transposition of movement for movement, but are used by the child to help him/her

understand the causal relations within events.

These representations in drawing run parallel to other investigations and symbolisation concerned with causal, spatial and temporal relations. All of these are presaged in the discoveries made about objects and events in the perceptual world of the new-born. This work suggests (along with some others, for example Athey 1980) that development constitutes a repeated re-working, at different levels of cognition, of investigations made at earlier times.

Later in this study it will be shown that the children were seen to alternate - sometimes in rapid succession - between quite different modes of represention. These were not the haphazard behaviours but, on the contrary, were experiments in structure and symbolisation characterised by intense systematicity. It should also be remembered that paintings are themselves unique events which young children are endeavouring to understand. This study suggests that even the very young use painting and drawing to reflect on the nature of the medium itself.

The implications of this are very different from those obtained from many other studies. For example in Kellogg's (1969) account, the path of drawing development is seen as a rather formal acquisition of a vocabulary of shapes which are eventually used for figurative purposes. In her influential study Kellogg, though she does recognise the value of "scribbling" at a level of sensorimotor practice, does not seem to consider early mark-making as having representational significance. To Kellogg, scribbling seems important only because of its later yield of shape values. She sees drawing development as the abstraction of formal elements accrued during early motor markings. She sees the infant as selecting, extrapolating and combining essentially abstract structures, which at some later date are synthesised to make figurative representations.

Now, there is a level of description at which something like this is happening, and it is an important aspect of the present thesis that young children explore 2D structure independent of meaning. However, failure to link this process with another programme of representational intent and struggle is to misunderstand completely infrastructural investigation. The child has to be allowed access to an area of graphic experience in which the components of action-programmes can be uncoupled from each other, and rearranged to generate new structure. Only in this way will the child discover a range of possible variations and their graphic/symbolic implications. Wolf (1984) has brilliantly described this process of alternation between ludic and adaptive orientations within the drawing process of the young child. Only if such a dual process is supported can the child gain any real fluency in a symbolic system - a symbolic system of which it can truly be said is the child's birthright. There are here some extremely important implications for the curriculum, for these ideas require nothing less that a revolution in our conception of representation within development.

In contrast with the present account, Kellogg does not attribute any representational significance to children's early pre-figural drawing. Golomb (forthcoming) describes clearly the contrast between Matthews' (1983) account and Kellogg's (1969) account.

Yet it would be strange, as Wolf and Fucigna (1983) have pointed out, if children's earliest mark-makings were devoid of symbolic significance. As Wolf (1983) writes: "Between the ages of one and three years, children exhibit a 'rampant' exploration of symbolisation. During these two years normal children construct the basic rules for both linguistic and gestural forms of reference. Moreover, they combine these forms into rather sophisticated representations of events in symbolic play" (Wolf 1983, p.1).

Fucigna (1983) in reviewing the psychological literature on children's drawing notes that many investigators mark the appearance of the "tadpole" figure (between 3 and 4 and a half years) as the child's first representation, yet: "By the age three the child is already quite proficient in the symbol systems of language...and symbolic play" (Fucigna 1983, p.1). Both Wolf and Fucigna argue that the child's early drawing symbolisations have gone unnoticed because researchers have viewed children's early drawings through a paradigm derived from Western art. This paradigm accredits representation mainly in terms of projective shape relationship between a drawing and a visual array. This model is one of pictures or views. Hagen's (1985) insistence on this has been noted earlier). Yet, to use Wolf's (1983, p.1) words, there is "...representation before picturing."

Fucigna (1983) points out that in early studies of language acquisition "...definitional problems originally masked the systematicity of early language use..." (Fucigna 1983, p. 1). Likewise, the early representational modes employed by children before the age of three, have been concealed by the imposition of adult definitions about what constitutes a representation.

The present study has found evidence that the group of marks and shapes produced by very young children has many possible and potential representational values for them, of which the use of shape to denote faces of objects is but one. It is not enlightening to measure these drawings against either Euclidean geometrical models, as Kellogg does with pre-figural drawing, or against projective geometrical systems as she seems to do with children's figural drawings, and as many other writers do with all children's drawing.

The Uses of Drawing

The use to which drawing is put by the very young child is not

solely or primarily concerned with either the abstracting of shape to assemble a formal graphic vocabulary, or the use of shape to depict viewed surfaces. This study then, will continue investigations into children's earliest mark-making and drawing to show how children themselves are giving meaning to drawing. It will be shown that the meaning and structure of children's drawing is unlike that to be found in adult cultural models, and must be evaluated in its own terms.

View-orientated accounts cannot explain the relationships between early mark-making, "scribbling", and configurative drawing, or how children move from one to another. Such studies do not account for the unusual 2D structures children use when they start to depict objects. Not only are these structures unlike adult artists' pictures of objects, they are often unlike the appearance of the objects themselves, either as seen from a single station-point, or, in many instances, unlike the appearance of the object as seen from any possible station-point.

Some researchers (e.g. Piaget and Inhelder 1956, Luquet 1927) have accounted for this by invoking the notion of incomplete or inaccurate interiorised mental models or descriptions within the child. Others (e.g. Freeman 1980, 1989) hold that the children really "know" what it is they want to display in their drawings (and this, Freeman seems to consider to be kind of configural verisimilitude) but are prevented from doing so by performance and production errors.

The production/performance interpretation of drawing is also shown by Arnheim (1954) to be inadequate. A modern version of this model has been proposed by Freeman (1980). Starting from the implicit ideal that drawing is about copying interiorised views, he proposes that children have difficulty producing the components of the view in a "correct" spatiotemporal sequence, and have additional performance problems in constructing the lines and shapes required to represent this viewed

array.

However, no amount of production or performance difficulties would result in some of the drawing structures children produce, and moreover, the present work suggests that children's early drawing performance is far more accurate than many would think. In fact, Freeman himself cites some instances where very young children display accurate mark-making; for example, in the placing of a pencil-point at a specified locale. The present author has also noted this ability. However, Freeman feels that this initial accuracy is usually masked by subsequent skiddings and careenings of the pencil or marker, a type of mark-making which he simply disregards as interference (Freeman 1980). So Freeman dismisses an entire class of drawing behaviours - the part of drawing classified by many as "scribbling". This little understood class of drawing will be revealed as being of equal importance as the accurate targetting of a pencil-point. As Arnhheim (1974) writes, "There can be no doubt that none of these drawings is an unskilful attempt at projective realism. They all clearly try to do something else" (Arnheim 1954, p. 156).

Possible Theoretical Frameworks

Athey (1980), Matthews (1983, 1984), Wolf (1983), Light (1985) and Willats (1983, 1984, 1985) have shown, in their different ways, that children use drawing to convey features of the world which cannot be encoded in single viewpoint depiction. Light (1985) shows that children use their drawings to convey information which they feel essential. The information may be of a quite different order to that considered essential by adults. Willats (1977, 1983, 1985) shows that some children's drawings are constructed from rule-bound systems. Whilst these systems recall quite legitimate drawing systems employed in the adult world of art, design, technology and engineering, the child's use of these cannot be accounted for by imitation from cultural examples.

Rather, the striking conclusion must be that the child's producton and use of these systems constitute genuine discoveries. Athey (1980), Matthews (1983), Wolf (1983) show that children's early drawn representations are part of a complex of approaches made by the child to symbolise events and objects, and this symbolisation is not constrained by adult definitions of cultural forms.

Whilst Piaget's work on sensorimotor schemes, and Bruner's on enactive representation remain powerful frameworks for the present writer' formulations, this study departs from the Piagetian concept of a hierarchical series of stages which are based on moves made in a general semiotic function. Also, while Piaget's division of spatial understandings into a sequence moving from the topological to the Euclidean, and finally to the projective, remains useful as landmarks, the present writer seriously questions this as an invariant sequence.

Rather than seeing stages of development successively replaced by more advanced ones, the present study suggests that many of the so-called higher level behaviours are exhibited near the beginning, but in embryonic form. How far it can be said that these are truly available to the child, is of course debatable. This writer's evidence does strongly indicate however, that several types of expressive and representational response are arrayed at the beginning of mark-making, but that many of these are masked or subsumed within the child's favoured mode; that is, the mode of greatest conceptual and symbolic salience to the child at a particular period of time. The reasons why one approach to representation tends to predominate at particular ages will be further discussed later. This family of modes has been barely studied yet this writer's research indicates that the child's use of this action quanta is essential for his/her construction of models or descriptions of reality.

Wolf (1983) also departs from the "...traditional descriptions of

early symbolic development in terms of revolutions in broad levels of semiotic skills or the growth of representation in individual domains" (Wolf 1983, p.1). Instead she proposes "...that three distinct waves of symbolisation occur between the ages of one and five. In each wave, children hit upon a distinctive approach to organising and encoding meaning. With each wave, children make an addition to their repertoire of approaches to encoding meaning. It is this repertoire which prefigures the range and specificity of expression open to adults who can represent experience according to the distinct grammars of language, drawing, or numerical symbol-use" (Wolf 1983, p.1-2).

The first "wave" she calls "event-structuring" (Wolf 1983, p.1). Using observational evidence similar to Athey (1980) and Matthews (1983) she also arrives at similar conclusions. The children during their second year of life carry over the symbolic scenarios from pretend play into the arena of drawing and painting. in these instances, drawing processes become spatiotemporal events which specify passages of movement and action-sequences external to the act of drawing itself, and similar to those represented in symbolic play. This is part of Wolf's "event-structuring" and corresponds to the term Action-Representation.

As Wolf says, "Because there are no competing forms for the representation of meaning, it appears that children of this age use their understanding about actions and actors as a template for formulating symbols in any number of settings" (Wolf 1983, p.2).

Evidence from the present writer's own longitudinal studies will describe in great detail how these representational concerns are carried over from one domain of symbolisation to another.

There are some differences between Wolf's account and that of the present writer. Behaviours she places within her second and third waves - topological mapping and digital mapping have been observed and recorded by the present writer before the age of two years , during

their event-structuring modes. These studies clearly show an alternation - sometimes in quick-fire succession - of a variety of representational and expressive possibilities. These include denotation of entire volume, surfaces and occluding edges (this latter implying viewpoint); location (Wolf's "digital mapping") and a variety of musical and mathematical concerns, plus a range of different types of action representations. It is in fact a key feature of the present writer's conception of these modes that, rather than appearing at particular ages of onset in a linear temporal sequence, they form an organised array of expressive options. The reasons why one or other mode appears to predominate at particular ages, and the details of their organisation within drawing behaviours will be discussed in other parts of this work.

The present writer has (like Wolf) also observed 3D representations both in symbolic play (really 4D representation involving time) and in play with blocks. That children occasionally employ a mimetic mode to explain these other forms is offered by Wolf as further evidence of a primarily dynamic level - or "wave" - of thinking. However, equally noticeable has been the instance of action representation implicating and eliciting other types of representation, or conversely, topological/locational modes have been seen to prompt dynamic modes. Where one sees action representation, one also sees, by implication, other modes of representation and expression.

It might conceivably be the case that there exist mini-waves within 3 main ones, subsumed inside the larger pattern to form a vertical-decollage. Here, behaviours would appear and apparently disappear over time, only to reappear, having been built upon, transformed and developed. A vertical-decollage description similar to that proposed by Athey (1980) has much to recommend it. Here, what has been investigated at one level is later re-investigated all over again, but transformed by developments in understanding. Whether this process

can be broken down into distinct waves, or whether other principles influence the organisation of children's symbol use is a question which, hopefully, this study will go some way to answering.

This study then, suggests that we may be seeing a family of representational and expressive responses, each in mutually reciprocal relationship with the others, perhaps, as Wolf says, not appearing "all at once" (Wolf 1983, p. 1) but nonetheless emerging during the second year, and grouped together at around 2 years of age.

They are present in the early days of drawing and develop as an interacting group throughout infancy. This writer, like Wolf (1983) maintains that early modes of representation are not "primitive" forms which ultimately give way to more "advanced" forms. This is implied in many models of drawing development, including the Piagetian model. On the contrary, these early modes are retained and play a part in later drawing, as will be shown.

For this and for other important reasons, the present study departs from the Piaget/Luquet framework. It may seem anachronistic these days to still refer to Piaget's ideas about drawing. Whilst, other aspects of Piaget's theory remain relevant to the present work, most people in drawing research at the present time attach little cognizance to Piaget's understanding - or rather, lack of understanding - of children's graphic representation (Golomb 1988, personal communication). However, it remains true that Luquet's (1927) ideas, subsumed into Piaget's general theory of development, have strongly influenced subsequent thinking about children's drawing. The ghost of this theory still haunts the teaching of art to children, and therefore needs an introduction here.

This theory, at its most simplified, maintains that children progress from scribbling to fortuitous realism - where the child recognises and verbally labels configurative likenesses in what were

initially sensorimotor markings. From this stage, the child is conceived of as progressing to a stage when he/she depicts, using a fairly rigid vocabulary of shapes, what he/she "knows". This is called the stage of intellectual realism . Only in later infancy (around 7 or 8) is the child thought to progress to visual realism where he/she draws what he/she "sees" rather than what he/she "knows".

Other authors made modifications to the theory. Karl Buhler (1930) suggested that the emergence of language alters the course of drawing for the child, and that it is language that is implicated in the intellectual realist stage. However, the present writer rejects the notion that the child's natural development is toward a "visual realism" (whatever this term means exactly) and that this development is somehow interrupted by language acquisition. In the following parts of this study, evidence will be offered to show that long before speech the child already possesses - in drawing - a symbolic system which is neither a deficient "visual realism" nor is it subservient to language. The present research shows that this remains true of later systems too.

While there is an element of truth to be salvaged from the classic Piaget/Luquet theory, there remain however some major difficulties with it. Some of these difficulties have been highlighted by Freeman and Cox et al (1985). These authors use recent and important experimental evidence to show that the relation between "seeing" and "knowing" is far more complex than the Intellectual v. Visual Realism model suggests. These authors show that the young child does sometimes produce drawings which convey aspects of objects which could not possibly be seen simultaneously from a single station-point. This occurs even when the child is specifically asked to draw objects exactly as they can be seen from his/her position. In such cases, the child seems to be attempting to specify the essential structure of the object irrespective of viewpoint. Such drawings would have been classified within the

Piaget/Luquet model as Intellectually Realistic.

At first glance then, it would appear that the predictions implicit in the Piaget/Luquet model are born out. However, the terms in which the theory is couched are altogether too vague, and do not do justice to what we actually see occuring in children's drawings. For one thing, close observations of children's early representational processes reveal that children, whilst encoding in their drawings information of a type which the Piaget/Luquet account would term intellectal realism, are simultaneously attending to and encoding features of a perceived visual array, which the same account would term visual realism. To use Pratt's (1983a) words "...even when making 'intellectually realistic' (drawings) children do a certain amount of scene-specific analysis"(Pratt 1983a,p.2).

Could it be the case then, that children switch from one mode to another, either within a single drawing, or in a series of drawings? Or is there another, more coherent explanation? The answer is suggested in Pratt's view - shared by the present writer - that drawings made at different ages in childhood all reflect different kinds of knowledge. Pratt has even turned the whole Intellectual v. Visual realism debate on its head by making the perfectly correct claim that a perspective drawing of a visual array is of course a highly intellectual system, precisely because no structural features of objects are preserved (Pratt 1987, personal communication). Again, the notion that perspectival depictions are more visually realistic issues from the erroneous belief that they are reproductions of optical arrays - almost as these could be peeled off the retina.

Though Pratt's (1983) study is concerned mainly with copying 2D models, he does show that "looking strategies" are guided by "knowledge" and that there is a "...dynamic relationship between the functional content of 'knowledge' and of visual input" (Pratt 1983, p.3).

Again, Piaget/Luquet based models tend to be hierarchically tiered, seeing early stages as deficient, and placing greater value on later representational approaches.Such models have had far-reaching effects on education.

The Piaget/Luquet model and its derivatives are inadequate,not merely wrong in detail but misleading as an entire concepts. They fail in major ways to correspond with what we see happening in the progress of children's drawing. The failings of Luquet's model are compounded by the fact (Willats 1985, personal communication) that Luquet, in describing each different stage of drawing, switches arbitrarily from one level of explanation to another.

Arnheim (1954, 1974) also provides a criticism of the "intellectualist theory" as he calls it (Arnheim 1956, 1974, p. 164). He shows the problems of describing children's early drawing in terms of intellectual abstractions. "According to the intellectualist theory, the child, in drawing the picture of a human head, relies on his knowledge of the words 'a head is round' and draws the roundness rather than the head. But even if the child possessed the intellectual concepts of roundness, the theory would fail to answer the question 'where did he derive the circular shape by which roundness can be adequately represented?" (Arnheim 1954, p.158).

The Intellectual realism theory leads moreover to an "absurd dichotomy" (Arnheim 1956, p.167) in which perception is severed from knowledge. As Arnheim says, there is no fundamental difference between "geometric styles" of representation and so-called visual realism (Arnheim 1954, p.159). The present writer believes that children are trying to capture in their drawings certain salient structures which they do indeed perceive and that this perception (involving kinaesthetic and haptic as well as visual sources of information) is, as Pratt (1987, personal communication) has said, guided by knowledge of varying types and of varying complexity. That these structures do not

replicate the retinal image does in no way necessitate the division of perception and knowledge. Such a split issues from naive realism. The structures the child employs are not retinal surrogates but, as Arnheim says, genuine inventions (Arnheim 1954, 1974).

In spite of the fact that Arnheim wrote these ideas over thirty years ago, this dichotomy still underlies the teaching of art in many British schools. Children's early drawing is still seen to be fundamentally different from later "visual realism", and teaching is generally considered the task of "correcting" children out of their early modes of representation so as to enable them to draw "properly"; that is, to produce, in 2D, view-specific arrays.

The "absurd dichotomy" between perception and knowledge is not only at the root of muddled ideas about children's drawing, it also underlies the misconceptions concerning the supposed differences - often felt to be fundamental - between culturally and historically separated groups. As Arnheim says "...the theory led to the contention there existed two artistic procedures that were different from each other in principle. Children, Neolithic painters, American Indians and African tribesmen worked from intellectual abstraction...(whereas)...Paleolithic cavedwellers, Pompeian muralists, and Europeans during and after the Renaissance represented what they saw with their eyes" (Arnheim 1974, p.167).

I would add to this certain current and ill thought-out ideas about differences supposed to exist between the drawings of different socio-economic class groups and between the drawings of girls and boys. Certainly there are in drawings, differences which arise from factors of race, class or gender, but these, it is argued, are not fundamental.

The way out of the intellectual and visual realism cul-de-sac is suggested by the work of recent writers including two whose theories, in certain respects. are very different from each other. I am refering to

the work of Marr (1982) and Gibson (1979).

Marr's research is important to the present work because of his account of how images are processed to form internal representations of shape and form. Marr's ideas about the rules and procedures which determine how internal representations are constructed have been useful in considering the systems which children employ in their external representations - their drawings.

Marr proposes 3 design features in representational systems; a coordinate system; the primitives or small units which compose the representation; and a way of organising the coordinate systems.

Marr says that the coordinate systems are of two types:

(1) An object-centred system which maps the main axes of the object itself, independent of any viewpoint

and

(2) A viewer-centred system which is based on an observer's viewpoint relative to the object. This kind of representation specifies the optical array as seen from a particular station-point, whilst simultaneously specifying the viewer's own relationship to the scene. (I am indebted to John Willats 1986 personal communication for this summary of Marr's position). Willats' use of Marr's terms (object-centred and viewer-centred) to describe children's drawings, has helped clarify and also retain some of the more valid aspects of the Intellectual and Visual Realism theory. (Pratt 1985; Light 1985; Chen 1985; Cox 1985; Davis 1985) use slightly different terms to describe similar distinctions between children's drawing strategies. Each author however, highlights subtly different aspects of children's sensitivity to problems of mapping scenes or objects onto a 2D surface.

For example, Chen contrasts content-directed with structure-directed; Cox describes object-centred versus array-centred; Light sees a drawing mode which conveys class-exemplars as distinct from one which

depicts specific-objects. As Freeman and Cox (1985) say, when overviewing this recent evidence, these distinct paired modes do not stack neatly into two clearly defined and separate piles. The question as to the exact nature of their overlap and interrelationship remains one of great importance to research on 2D representation. It will be returned to again and is also discussed in this author's review of Freeman and Cox et al (Matthews 1987).

Gibson's account of perception as an holistic ecological event has also offered a valuable framework for the present study.

His concept of invariants has been of help in providing a basis for the idea proposed by this author that children are actively seeking out invariant or deep structure beyond superficial surface appearance.

Invariants are "... patterns of stimulation over time and or space that are left unchanged by certain transformations" (Michaels and Carello 1981, p.20). There are two main types of invariant. Structural invariants tell us about the persistent properties, features and axes of objects, irrespective of both station-point of the viewer and the object's independent motion. These are structures which remain essentially unchanged despite transposition from one context to another. The second type of invariant is a transformational invariant. This is "...a style of change in a stimulus (which) can specify dynamic characteristics of an event" (Michaels and Carello 1981, p. 81).

These invariants can be discovered in the environment or within the process of drawing itself. Also, invariants perceived in the environment may be represented in drawing. According to Gibson, these invariants are not concepts; nor does the organism require concepts to perceive them. Our perceptual systems in themselves (and for Gibson the visual system occupies a privileged position here) are so constructed as to afford direct-perception of invariants.

Gibson also proposes the presence of a related capacity within

perceptual systems; that of the detection of affordances. Affordances are the potentialities of objects, or what objects are "good for" Castelfranchi and Miceli 1987, p.4). According to Gibson, perceptual systems are also designed to detect the affordances within objects and - presumably - within situations.

We shall also see the child in an active search within the environment for the potentialities or affordances of situations, objects and - of especial importance to the present study - graphic materials.

Although Gibson does not make clear exactly how direct-perception might work, and nor does he resolve some of the indeterminacies surrounding the related concept of affordances (for an interesting review of these problems see Castlefranchi and Miceli 1987) both remain valuable concepts for the present work. If it is possible for the child to perceive invariants directly in the "ambient" and "ambulatory" array, and those in his/her drawing, then this would dispose of the problem posed by Arnheim of how children could intellectually abstract general and constant shapes from visual transformations across space and time.

The evidence of the present study strongly suggests that children's early drawings, far from being either meaningless scribblings, or poor copies of surface layout, are the result of sensible strategies for exploring the invariant or - as the present writer prefers - deep structure of both events and objects.

The child also actively seeks out essentially the same deep structures across a range of contexts and media. Consequently, though it may sometimes appear that the child is moving haphazardly from one activity to another, this writer's studies support the idea that the child is seeking out structure which remains essentially unchanged despite transposition from one medium to another. Athey (1980) has also observed this process. The child, she has said, is not so much

"flitting" from one behaviour to another quite different one, but is, rather, "fitting" similar or even identical structures over or into each other (Athey 1980 personal communication).

It is this writer's view that the child's perception and use of these deep structures is driven by equivalent structures represented in the C.N.S. In both their internal and external forms they can be conceived of equivalent to schemes and schemas or, alternatively, to the concept of programmes of action. This may depart from Gibson's original intention, but it is in accord with this writer's observations.

Gibson has also made the interesting suggestion that it was only when humans started to draw that their perception became orientated to non-utilitarian aspects of form. Gibson speculated that it was the act of drawing itself that initiated the detection of 2D shape from within 3D form (Gibson 1966). In this sense, drawing clearly had a major role in the development of human-kind. At an individual level, the present writer's studies will show how drawing certainly guides perception of form in childhood.

While there are some differences in approach and emphasis between the two authors it should be apparent that there is some overlap between Gibson's theory of the detection of invariants and Marr's theory that object-centred descriptions can be obtained from viewer-centred information.

As Willats says (1985) personal communication) the accounts of Marr and Gibson are not necessarily incompatible. A different level of description is being employed in each.

Conclusion to Part 2

This part of the study has reviewed some of the literature, both old and new on children's drawing; has highlighted some of its shortcomings but also teased out from these studies those features or aspects which

retain verisimilitude to the process of drawing as revealed in this author's detailed, naturalistic data. Also in this part, an attempt has been made to show the relationship of the present work to other drawing research. This will be consolidated here before moving on to the empirical data itself.

The present work, whilst retaining Piaget's central concepts of thought being interiorised action; of schemes and schema; and of the concepts of assimilation and accommodation, nevertheless departs from the Piaget/Luquet model of drawing development, and also from Piaget's (and others') formulation of a hierarchical series of stages taken in a general semiotic ability. It is interesting that Piaget himself later modified his original theory to one in which development is conceptualised as a spiral rather than a series of steps (Turner 1984).

Dennie Wolf has clarified for me (1983 personal communication) how, if one looks at development in, as it were, section, the onset of different representational systems can be misconstrued as a series of hierarchically tiered steps, as in the Piaget model. In fact, appearances can be deceiving. This author suggests a model which differs from those which propose a process in which the child, as he or she grows, merely abandons "inferior" modes in favour of more "advanced" ones. In the present model the modes of representation are arrayed from the outset and each is developed by the child for its special potential and uses. They are organised within a complex of integrated programmes of action. None of the modes is actually abandoned but rather all play a role in later configuration.

The research does indeed shows the child moving through a series of distinctly different approaches to symbolisation. Each of these approaches is often marked, not only by gusto and enthusiasm, but also by a striking systematicity. The shifts in expressive and representational responses are due to changes in the type or character

of 'knowledge' that the child is developing. Initially the child's thinking is essentially 'embedded' (Donaldson, Grieve and Pratt 1983, p. 4) in actions. Soon, the child encodes not only the configuration of objects - and the relations within and between these - but also the configuration of events.

As the child grows, each successive approach to representation is a reflection of the priorities he or she attaches to certain orders or types of information over other types. This gives rise to the character of the forms and stuctures that are favoured at different times in childhood. At particular times certain structures acquire for the child powerful symbolic salience. From this, it is not to be thought that the child's adoption of a certain system merely signals an incapacity to produce other systems - systems perhaps judged superior by some adults. It is vital to realise that whilst some of the 2D and 3D structures may appear strange, they are in fact the product of a systematic search by the child for structure which has the capacity to encode information the child feels essential (Light 1985).

This being so, there are clearly some important implications for education and childcare which will await discussion at the end of the final part of this work.

Some neo-Piagetian research remains however, important. In Athey's (1980) account of early development she describes how schemes manifest themselves over a variety of situations and materials. Like the present author she reveals the child as engaged in an active search for underlying deep-structure which he/she discerns despite certain kinds of transformation and despite transposition from one medium to another.

As the present writer has described elsewhere (Matthews 1988) this investigation and representation of deep structure is not only carried out across contexts at particular points in the child's life, it also persists through time as the child grows; the same deep structures

appearing and reappearing, but transformed by developing understanding and changing emotional needs. This latter aspect is the vertical-decollage process mentioned above.

Here are two examples especially pertinent to the present work:

Like the present author, Athey enlists Bower's (1974, 1982) work on development in infancy to support the thesis that there is a route from early visual tracking behaviours in extreme infancy to later dynamic representation. Athey says that the baby's visual tracking of movement precedes identification of objects based on configural properties. This is verified by Spelke (1985) whose work on the neonate's interest in the trajectory of objects was mentioned above.

Such findings are extremly relevant to the present writer's ideas concerning the importance of the infant's dynamic representations. Very salient to the present account has been Athey's ideas about the child's progress from action to dynamic thought. She has shown that 3 and 4 year olds learn to symbolically represent changes of position (trajectories of objects) and also changes of state (Athey 1980 personal communication).

The other example, again used by both this writer and Athey, is the infant's acquisition of knowledge of inside-outside relations by investigations which start with hand and eye but later involve envelopment of the entire body. The child also begins to represent this relationship in various forms (Matthews 1984, 1986, 1988).

It is from such exploration and representaion of context-dependent structure that the child develops context-free concepts.

The present study shows that the earliest mark-making - even before so-called scribbling - has structure and meaning. These meanings are only really comprehended if early drawing behaviours are considered within the holistic framework of children's early symbolisation. The present work will do precisely this.

The present study considers drawing not as a copy of either cultural examples of picturing as some writers (for example Wilson 1984) appear to do, or as copies of ambient visual arrays. The whole notion of "viewpoint" is a complex one. What do we actually mean when we say we "understand another's point of view" or (significantly) when we talk of seeing things from a different "perspective"? Such questions are difficult to answer, partly because the infant's acquisition of knowledge of physical causality follows a different developmental history than that of their understanding of humans as independent agents (Wolf 1982; Wolf, Rygh and Altshuler 1984).

In Part 5 examples from the very young child's symbolic play reveal children often displaying striking non-egocentric understanding, in which they clearly project themselves into the position of another. In such contexts even 3 year olds seem to appreciate at least some aspects of what can be perceived from another's "viewpoint". But this perception almost certainly involves object-centred as well as view-centred information - just as it surely does when adults consider another's "point of view".

It is interesting how persistent is the notion that art can replicate a "retinal image" (whatever that may be). Golomb (1989 personal communication) has pointed out that Selfe (1977, 1985) accounts for the unusual drawings of Nadia in terms of abnormal psychopathology. Here, the notion is that the nature of the child's autism has in some way given Nadia a sort of artistic benefit in the sense that normal linguistic-symbolic processing is by-passed, allowing the child to somehow trace directly into 2D the optical array. Selfe seems to have made up her mind that all gifted draughtspersons are aided by deficits in other aspects of cognition and/or affect. I am in agreement with Golomb that this is a very naive account of the acquisition of drawing skills. As Golomb says (1989) personal communication) one really needs

to see the very earliest of Nadia's drawings - apparently her mother did not start to keep the drawings until they seemed "interesting". In all likelihood, Nadia developed her drawings in a series of mark-makings which no longer exist and which preceeded her now famous configurations. Golomb also quite rightly says that when one compares early with later drawings it is clear that, contrary to the opinion of many, there is some development in Nadia's drawing. (Golomb 1989 personal communication).

Apparently unconsciously, Selfe invokes the ghost of the Piaget/Luquet theory when she writes that it was the the advent of Nadia's therapy - the learning of language - which caused a marked deterioration in Nadia's drawing. The astonishing implication would seem to be that, with the intrusion of language and other symbolic modes, Nadia was robbed of an artistic gift derived from autism and so compelled to draw (and here I am being ironic) the ordinary and boring "stereotypes" of normal children. Golomb has made the point here that that the much-cited deterioration of Nadia's drawing is probably more an illusion on the part of researchers - perhaps a product of prejudice - than actual. During this period, much of Nadia's time and energy was going into the learning of reading and writing - she was simply not able to spend so much time on her drawing (Golomb, personal communication).

It is almost certainly not the case that Nadia and other very gifted child artists confound all theories of drawing development, it is simply that we do not yet know enough about the development of these skills and the kinds of conditions which foster their growth. What really needs to be considered here are the kinds and qualities of interaction between and support which might exist (and these might sometimes be fortuitous or accidental rather than planned) in this and other cases of so-called "extraordinary" drawing development. Whilst this writer disagrees with Wilson in many important ways, he is surely

right when he cites the availablity of images of various forms as being a kind of social interaction - and Selfe has written little about Nadia's picture books which served as a source for this young artist.

I have made this extended comment about Nadia to highlight the pervasiveness of certain assumptions about drawing development and how inadequate theoretical frameworks - really little more than prejudices - still underlie both research and education. The long-running myth would appear to be that the "normal" child is equipped with burdonsome strategies of representation which some kinds of extraordinary psychopathology, (or, some kind of magical attributes) will short-circuit, allowing "extraordinary" - that is to say projective - drawing to appear.

There is a naivity and insensitivity toward art on the part of some psychologists which has been a great hindrance to research and to educational provision. In some cases the naivity is transparent. For example, Selfe mistakenly and misleadingly terms Nadia's drawings "photographic realism" (Selfe 1985, p.142) the use of which term not only reveals her conception of drawing as a copying process but is also wholly inadequate in terms of perception. Lorna Selfe's notion that all artistic ability is concomitant with deficits in other aspects of development really only perpetuates one of the myths about artists which sees them as incomplete, quasi-magical sub-people.

Selfe is convinced that drawing had great meaning for Nadia - though quite how this quite tallies with the rest of Selfe's thesis - that Nadia's ability is the product of autism - is difficult to see.

It is, of course, incredibly difficult to characterise the nature and quality of the involvement the autistic child artist's has with his/her drawing. This writer's own observations of Stephen Wiltshire, the autistic boy artist, producing with apparent glee and excitement the most elegant drawings of buildings, raised again the perplexing

question of whether one was witnessing deep emotional and cognitive involvement, or merely its mimicry. There does seem to be development in his drawing. His drawing has been strongly supported by teachers and others, who delight in his work and who explicitly share with him their appreciation. His case again suggests that research should attend more closely to the salient features of the child's interpersonal environment.

In this respect Wilson is quite right to expect more than global statements about interrelations between nature and nurture. The trouble is here, that his own account exacerbates the problem because he already creates a false dichotomy between the formation of "universal graphemes" and later culturisation. Theoretically it could have been the case that the child assembles a formal vocabulary of shapes which at some time in later infancy are synthesised, subject to cultural influence. If this were true it could conceivably be perfectly legitimate to change the level of description as one shifts attention from the level of the universal grapheme to the congigurative level (Wilson like most other people has nothing to say about early so-called scribbling).

However, even at a theoretical level it seems unlikely that this could occur. It seems anomalous that Wilson whilst being insistent that children derive their drawing forms from surrounding cultural examples, is obliged to concede that there exists a stage prior to this in which forms are somehow developed independently of culture.

In any case, there are compelling reasons from the work of the present writer and of others, why we should abandon this model of development. The present work offers quite a different scenario.

In early infancy children are organising a complex or family of integrated modes which, though initiated from within are, by their very nature, immediately sensitive to the surrounding interpersonal

environment. One of the difficulties of Wilson's (and others') accounts is that drawing schemes amd schema are thought of as a collection of static elements rather than dynamic actions performed and ongoing. Confusion will always result if communication as an intent is compounded with communication as artifact. Children's graphic repertoire are not to be conceived as a box of objects either simply given by nature, or collected in the early years. The symbol systems of later years contitutes one end of an unbroken continuum which can be traced back to the first gestural interchanges between neonate and caregiver. It is within this relationship that the infant develops a 4D language - of which drawing forms a part - the elements of which are essentially boundless. Rather than copies of cultural models or of "retinal images", drawing is considered here as a structure in its own right. The child will be described as forming "structural equivalents" (Arnheim 1954, p.167; 1974) in marks, lines, shapes and colours. These equivalents are of many types. Some are linguistic, some mathematical, some musical, some configurative, some are dynamic. Drawing comes to represent or to generate mental reconstruction of objects and events. This entails seeing in drawing development two main complementary and interpenetrating aspects: (1) where the child investigates drawing independent of meaning as "self-sufficient structure not reliant on the linear derivatives of objects (Rawson 1982) and (2) as structures which specify objects and events external to the act of drawing (and note that these specifications need not be configural). These parallel processes become simultaneous, forming the "double-knowledge" (Furth 1969) intrinsic to any form of symbolic system. Representations are rule-bound structures in their own right yet simultaneously refer to objects/events outside themselves.

The example of recent accounts of language acquisition (Chomsky 1965, 1966; Bickerton 1981) will serve as analogies for the spontaneous,

rule-bound, self-generative process of drawing. Though in some obvious and important repects language is very different to drawing, these theories are helpful in that they bypass both the Romantic and Copyist muddles, and form a theoretical framework in which evidence can be presented to show how and why children perceive and employ the structural relationships between their drawings and the environment that they do.

In early speech the infant produces a plethora of sounds and begins to perceives relationships between the sounds he/she is making and the speech of others. Similarly, in drawing, the young child spontaneously generates a whole array of 2D structures and begins to perceive the relationship between these and structures in the environment.

The relationship between babbling and scribbling has been mentioned earlier and is an important one. There is recent evidence that 8 month old infants can differentiate between subtle differences in morphemes - differences which adults cannot discern! (Jane Werker 1988, cited in Blakemore 1988). This finding lends some weight to this author's idea that the very young are also making fine discriminations in their earliest mark-making.

From here it will be shown how children perceive not only the configural relationships between their drawings and the shape and volumes of objects, but also the dynamic relationships between the spatiotemporal process of drawing, and events or motion-sequences in the environment.

Evidence from studies on neonate perception (Bower 1974, 1981; Spelke 1985) can be cited to indicate that these representational concerns have a deep psychological background.

Drawing, symbolic play and language are mutually reciprocal in aiding the child sort out the causal relations within events , and the spatial relations between and within objects. As was indicated in Part

1, it is in symbolic play that the child learns to uncouple him/herself from the constraints of adaption to reality. It is within early symbolic play that the child is sorting out the relations between signifier and signified; constructing an arena of activity which will becomes an autonomous "analogue space" (Wolf 1983 personal communication) in which events and objects can be represented and in which new events are created. It is precisely because drawing and painting, and other constructive/expressive skills, become assimilated to the symbolic play arena, that they acquire their sensitivity and range. For this mini-world, though separate, is not a state of dissociation - that which some would term "madness" - it has a rich communications network with the real world. Events occuring outside the arena of painting and drawing intrude upon it and transform it, even as it unfolds. Painting and drawing materials themselves undergo the transfiguration enjoyed by other objects once they enter this psychological bubble. The consequences of this for drawing are fundamental and will be studied in detail.

Later, evidence will be offered to show that action representations developed in ludic phenomena with graphic media, are not merely abandoned but may form the basis of later configurative drawing. It will be shown that children detect, in their action representations configurative values. Also, it will be shown how the enaction of trajectories in 2D leads to the establishment of basic spatial relations, axes and coordinates, without which configuration is impossible. The present work will refer to Willats' research on the child's discovery and use of systems of transformaton and denotation (Willats 1981, 1983, 1985) and also to the work of Marr (1982) and Gibson (1979) since this research provides a possible theoretical framework for the present writer's acount of how children represent events and objects.

It may even be that it is the retention of dynamic modes, subsumed into configurative and other forms, which gives drawing some of the flair and vitality we see in the work of its more developed practitioners. Whether or not this is true (and it seems a possiblity in the case of some of our great adult artists) the present work will certainly reveal the link made in infancy between action and expression.

This author's descriptions of investigations made by the young child into structure and meaning should highlight the central role drawing can play in cognitive and affective development. The next part of this study will show in detail something of the development of symbolic systems, and the contribution drawing can make to the formation of internal descriptions of reality. It is further hoped that some of the principles of the interaction between our genetic endowment and the environment, which underlie the development of representation, will be identified, thus indicating the direction in which teaching provision and curricula design should move.

Expression, Representation and Drawing in Early Childhood

Part 3

How Meaning is Given to Drawing

In this part, the object is to trace the onset and development of a group of mark-making actions and to show how these come to acquire their representational and expressive values. The study will revolve around the question of how children give meaning to certain actions, to drawing actions, to marks, shapes and colours, and what sorts of meanings these might be. What are these actions used for? How do their uses arise? How are some uses developed, and why do some disappear?

Is action representation (as described in Matthews 1983, 1984, 1986, 1988 and in the present study) a form on its own - do children intentionally use it on its own? Or is it a part of a family of actions? Do action representations play an important part in later configurations, or is their use transitory? i.e.; is it a temporary use of graphic materials - a half-way stage to intentionality? If so, would this support the idea that it is part of an interface between action and symbolisation - something in the nature of Petitto's (1987) intermediary interaction system? In some children however, even at this level, the data would suggest that it something rather more.

It is intended to consider the possibility of such an interface between the kind of thinking locked into dynamic contexts, and the children's early symbol use. Are action representations then, part of a process wherein the child is learning to separate his/her actions from the resultant marks and so begin to see these latter as expressive vehicles in themselves? This would mean that action representations - in drawings, at least - are not something one would use intentionally as

one grows up.

Following on from this arises a further question about the nature of intentionality. It will be necessary to define intentionality; show and describe different levels of intention. It is necessary also to show clearly when some (or all) of these levels of intentionality are clearly not present in a child's actions (at a certain age? Or in specific contexts?) and when (later? Or in different contexts?) they clearly are present.

The present study is looking at structures which are so powerful to children that they recur across a range of situations regardless of differences in media. Because this is so, it is therefore necessary to show the place and importance (if it is important) of trace-making and drawing here. Whilst these structures are explored in 4D behaviours and play which often leave no record, trace-making - by definition - does leave a recording of otherwise invisible actions made by the child, and so a question arises as to whether such trace-making has an essential role to play in starting the child off on a route to 2nd Order Representation - to use Vygotsky's terms, including drawing, writing, mathematics.

These questions are complex, but all of them revolve around what appears to be a single cluster of drawing actions. Steve Harvey (1987 personal communication) has suggested that these may form a "new class of behaviours, or a new aspect of more familiar behaviours."

Such clusters of actions are used by many young children of 2-4 years of age and an investigation of such behaviours may turn out to be the study of "emergent creativity" as Harvey (1987 personal communication) has suggested.

These actions are present in a recorded observation this author made of Ben when he was painting at 2.1 years. During this painting episode Ben was already using the medium for expressive and representational

purposes. As has been shown (Athey 1980,; Wolf and Fucigna 1983; Matthews 1983, 1984) in the drawing of the very young child the medium is used to convey, not only the physical form of an object, but also its trajectory or flight-path. As has been suggested above, such dawning representational behaviours may have their antecedents in the neonate's and very young infant's attempts to coordinate configuration, location, and the movement of an entity (Bower 1982; Spelke 1985). Action-representations can also specify the unfolding of more complex events (examples can be found in Matthews 1983, 1984, 1986, 1988).

The following example is typical of many thousands of observations made by the present author, which show painting and drawing episodes as spatiotemporal events in their entirety. The point has been made earlier that some emergent representations - occuring throughout the so-called "scribbling-stage" - are impossible to discern within the end-product - the finished drawing. As mentioned above, for reasons both of methodology and those of a more conceptual nature, the vast majority of researchers have overlooked such early representational behaviours. Yet, careful analysis of behaviours hitherto regarded as trivial, reveals sequences of stunning complexity in terms of both structure and meaning.

Both the representation of shape and movement are present in this painting episode of Ben's at 2.1. The intention is to use this recorded observation as a starting point and, using my original longitudinal studies of Hannah, Joel and Ben, plus references to the studies of the 40 nursery children, to trace the origin and development of these marking actions from earlier in infancy. Using the same studies, the intention is to show how they are integrated and developed to become a unified cluster of expressive and representational responses used to describe the form of objects and events.

Now follows the example observation:

B. 2:1:0 (see colour-transparencies 2-9)

I have placed on a formica topped infants' school painting table, a sheet of white cartridge paper measuring 59cms by 52 cms approximately. To the left of this paper I have placed 2 pots of colour (mixed powder paint) blue and green. Each pot has a brush placed in it.

horizontal arc

First of all, Ben picks up the blue brush with his right hand and makes an arcing movement; the movement mainly issuing from his shoulders and hips as he fans the brush vigorously to and fro across the surface of the paper, creating a curving, elongated blue patch, like an arc of a large circle, which bows down to the left and right corners of the paper nearest to Ben.

push pull

Though this is the predominant movement, every now and then it is modified to a pushing and pulling movement so that the brush abruptly changes direction from a lateral to and fro movement to a longitudinal back and forth movement. This results in the blue, arcing patch acquiring an irregular contour.

He then picks up the green brush from its pot and, as he carries it across toward the central area of the painting, pigment drips from it, leaving a trail of green spots across the table near the green paint pot and across some of the blue painted area of the paper. Noting this, he immediately fans the brush back and forth above the paper's surface, making more green spots fall onto the white paper. Once, he allows the brush to touch the surface, making an angular, skidding line.

colour mixing

In the meantime, a further colour,

red, has been prepared for him, and placed, with a brush inside it, onto the table next to the other 2 pots. Picking up this red brush he makes further arcing movements over the blue patch. The red mixes with the blue to make a brownish colour. He momentarily stops painting to point with his left index finger at a contrasting edge of paintwork which has occurred at the perimeter of the arc further from him.

"There's a car there," he says.

Then the arcing movement is again varied by push-pulling movements which produce a range of oscillating zig-zags, lateral and longitudinal lines.

He looks up at me and smiles.

rotation

He turns back to his painting and suddenly makes, with the brush, a clockwise rotational movement, commencing from near the left corner nearest him, moving away from him over the edge of the blue patch, and onto the white paper, where it swiftly curves back into the blue patch.

Without stopping, and with the brush remaining in continuous contact with the paper surface, the rotational movement is made a second and a third time, in a continuous motion, with each succeeding rotation not quite coinciding with the previous one.

action representation

As he makes this continuous rotation he says:

"It's going round the corner...It's going round the corner...It's gone now."

He then dips the brush into the red paint pot again, and aims it into the roughly circular closed-shape he has made.

vertical arc

By repeatedly plonking the brush down with a quick, rhythmical stabbing motion, he makes red blobs appear in and around the centre of the closed-shape.

horizontal arc

He then vigorously smears these red blobs with the same brush, using that same horizontal arcing motion again. Very soon, the rotational shape and the small sector of white paper, which up to now remained within it, are obliterated under this dynamic, lateral arcing brushwork.

The above is a painting episode of a kind practised by 2-4 year olds (Matthews 1983, 1984, 1986, 1988).

As has been mentioned earlier, in Part 1 and 2, such behaviours have, until recently, been usually categorised as "scribbling" - haphazard sensorimotoric behaviours and, in terms of early symbolisation at least, little significance attached to them.

Yet, as has also been indicated earlier, it is precisely at this level that such painting episodes do have great significance and meaning.

Here, the child is using the medium of painting for concerns which he - and not an adult investigator - feels are important. In this observation, Ben makes a variety of actions which form the family of early symbolic modes. Each member of this family of actions has its own developmental history intwined with that of the others.

Using the empirical data from the longitudinal studies it is now proposed to trace each thread. Sometimes, for clarity, it will be necessary to isolate each one. However, the intention is to show that these dynamic stategies are mutually interactive and reciprocal.

However, before this is discussed in depth, a brief overview is needed of the above painting episode.

To begin with, what understandings does the child bring to these graphic materials? It is clear that he already knows a great deal about paint. In fact, Ben has used paint many times before. Some kinds of knowledge however, have been acquired in situations common to many children: investigating and playing with food and drink; studying the behaviour of water at bathtime. Ben knows a significant amount about contained liquids. He knows about paint-pots and brushes. He knows how to transport a paint-laden brush from the paint containers to the painting surface. He knows to re-load the brush at intervals. He seems to know already about the confines and use of the paper - he restricts, in the main, mark-making to this sheet. As the present author has stated elsewhere (Matthews 1983) orientating oneself toward a demarcated mark-receiving surface is the staging of a complex perceptual-motor act as basic as the use of the tools themselves.

Ben also has great command over a repertoire of actions which can be made with brush, paint and paper. These actions are organised and coordinated with his other knowledge of containers and contained pigment, and with the behaviour of this pigment.

horizontal arc

Ben's first mark-making gesture in this painting episode is one in which the brush is swung or fanned from left to right, almost - but not quite - at the extent of fullest reach, with much of the movement issuing from the shoulders and the hips. This gesture describes a self-referential arcing shape; a patch of blue pigment which records a natural swinging of the arm to and fro from the shoulder. It makes visible a normally invisible vector of body movement.

This mark-making gesture has emerged from even earlier infancy. I have called it the horizontal arc (Matthews 1983, 1984, 1988) and shortly its evolution will be described.

Ben produces other sorts of marking gestures too. He is able to vary this emphatic, dynamic fanning movement by inflexions from the elbow - he shortens the length of the arc occasionally, to fill in blank areas he has noticed. When he espies such an area requiring in-filling, his posture changes, becoming almost hunched; intently concentrated over these new targets.

He also re-locates the starting point of the arc; re-targetting the brush at this locale.

We are not witnessing a merely mechanical, reflexive, muscularly dominated movement. It is a complex, intentioned behaviour coordinated by looking strategies in which he visually selects areas for demarcation. He already knows something about 2 dimensional area and the brushwork required to fill it.

push-pull

His horizontal arcing to and fro of the brush is occasionally altered to a push-pulling action, creating an oscillating zig-zagging line. The present author has traced the origin of this push-pull gesture (Matthews 1983) and its emergence will be studied shortly. One effect of this push-pull is to disrupt the character of the boundary of the curved shape. It becomes a more jagged, irregular contour. This transformation has important consequences for painting, as such actions produce saliently textured and indented interfaces between pigment and ground, or between different colours. Such interfaces of skumbled paintwork generate configurations which are detected quickly by the infants. In the observation, the push pull action creates a patch of pigment which protrudes away from and in opposition to the general axis of the arc's boundary. Such a form may seem insignificant to some adult observers yet for Ben it has immediate symbolic salience. It specifies to him a contour derivative of a motor-car. It elicits from him the spoken

response - "There's a car there" - as he points at this patch with his left index finger at a particular section of paint, approximately 3-4 cms laterally, by 2-3 cms longitudinally,

Many other similar observations lend weight to the idea that such contrasting features created at the interface between pigment and surrounding ground can specify to the young child a contour derivative of an object. It is not possible to be certain about the exact sense of this representation (is, for example Ben referring to the occluding boundary of the "car" - its silhouette, if you will - or is he using the secton of pigment to convey, in a more amorphous, holistic way, the car's form and/or position?) and Ben himself may well have not fixed exact denotational values, to use John Willats' (1981,1985) terms. Nevertheless, a sample of a 2D array of scattered pigment is here used to specify a form or shape in the real world.

He is making the discovery about one of the propensities of painting: that of the depiction of shape.

This shape is the result of body action. The qualities and features of the shape are the direct consequences of the kinds of movement made.

Ben is attending to the consequences of his own actions.

What else does he do?

He spills paint from the brush. No constraints are placed on his behaviour by an adult. He immediately notes the phenomenon - fall of paint-drops - and extends it, by shaking the brush, so that droplets plop down onto the surface.

At this point it is important to be wary of the notion "accident". An "accident" implies that either something intended has failed to happen, or that something unintended has happened. We do not know Ben's intentions when he lifted the brush from the pot. It seems more accurate to describe the episode in terms of actions made and resultant effects; effects in terms of both physical and psychological phenomena - that is,

what occurs on the paper and what further behaviours this seems to elicit from Ben. Ben has probably no fixed plan but is completely at one with the moment of mark-making, sometimes allowing events to occur, as when paint spills, and sometimes adapting to these events; perceiving the causal relations and extending these by applying knowledge and skills, as when he purposely splatters paint onto the surface. Here, he uses knowledge of centrifugal and inertial forces and the effect these have on liquids and semi-liquids precariously held on a brush. In Piagetian terms, assimilation and accommodation are in a dynamic state of balance, alternating in quick succession; in Gibsonian terms, Ben is becoming attuned to the affordances (Gibson 1979) of these materials.

He already has acquired knowledge which he brings to this situation. From where has he acquired this knowledge? Shortly, a description abstracted from the longitudinal studies will show how Ben has built up 2 kinds of knowledge: the use of tools, and the behaviour of liquids. This knowledge includes an understanding of forces inertial and centrifugal, and the relationship between the spiller and the spilled; the marker and the marked.

continuous rotation

Aside from the push-pulls and horizontal arcs, Ben uses two additional mark-making gestures. He makes a continuous rotation of the brush which describes overlapping elipses.

This continuous rotation is an important discovery for the child, in terms of the action itself - and the dynamic representational possibilities this acquires - and the resultant configuration. The continuous rotation plays an important role in early representation. Its evolution will shortly be described.

action representation

The representation of action occurs whilst Ben causes the brush to describe its continuous rotating course. As it does so, Ben says, "It's going round the corner...It's going round the corner" and, "it's gone now," as either the encircling line is subsumed under succeeding lines, or else loses visual contrast against the blue patch.

As with Ben's spoken remark of a moment before - "There's a car there" - with this new statement - made in speech which accompanies the production of the elliptical line - it is impossible for an observer to define precisely the nature of the representation. However, in the light of many similar recorded observations it is possible to state that there is occurring here the alternation between two very important - but contrasting representational modes.

Whereas only a moment before, the chance emergence of a small, but clearly differentiated section of paintwork prompted a statement about a form, Ben now uses the moving brush and/or its trail of paint to specify the same form's movement. He accompanies the revolution of the brush with spoken narrative which also describes its movement.

The exact nature of the representational intent cannot be pin-pointed. Certainly (as will be discussed later) Ben's symbolic play of this time is implicated here; scenarios which involved elliptical circuits of hand-held toy vehicles, whose journeys were accompanied by spoken commentary.

It is also of great importance to note that cars are driven by human agencies. Physical causality is very different from causality in human action, and research shows infants developing a sensitivity to this distinction (see for example Wolf 1982; Wolf, Rygh and Altshuler 1984). The present study shows that infants use painting and drawing as a means of sorting out how and why both objects and humans move.

However, what are the "denotational values" of the lines? What do the lines stand for? Where is the representation to be located? Is it in the bristles of the brush alone? Or do such paint traces play an essential role here in supporting and consolidating the representation? Do such action representations help the child sort out the causal relations within events? Or are such paint traces the fortuitous by-product of what is essentially a much simpler transposition of movement for movement? If so, will such paint trails, from such beginnings, go on to acquire representational salience?

A return will be made to these important questions about emergent representation later in this study (but see also Matthews 1984). Suffice it to say at this point that very young childen display in their drawing an interest in both the configural and dynamic aspects of both events and objects, and that one can trace this interest back to the neonate (Bower 1982, Spelke 1985).

closed-shape

The rotational movement of the brush has resulted in a closed shape. Ben now re-loads the brush with red paint and impacts the brush at approximate right-angles to the paper's surface and within the boundary of the closed shape. This results in dots or blobs enclosed within this linear, elliptical, closed shape.

The discovery and use of the closed shape will also be described in the present study. It is a key structure in drawing development.

horizontal arc

Ben finally obliterates the closed shape and its red nuclei under an intensely vigorous arcing of the brush. This conclusion of a painting episode is typical of many, and there are many levels of explanation which can apply. The present account will develop the idea that such

painting episodes are complex spatiotemporal events organised by the infant's own "infrastructural motivation" (to use Bickerton's 1981, p.234 terms). These events are organised according to internal event representations which can be likened to scenarios or scripts which include entry and exit points. The completion of a painting by energetic arcing smears is one of a group of possible "curtain closing" acts. As with all the actions described so far, taken either singly as a group, these can be produced with different levels or kinds of expression and mood; or different degrees of amplitude of affect. Evidence will be offered to suggest that the infant can have much more control and even intellectual choice over the range of mood conveying effects. The origin of this sensitive use of actions as expressive vehicles issues, as will be seen, within an interpersonal context.

The intention now is to use the longitudinal studies to trace the emergence and development of the individual components of such expressive sequences from earlier in infancy, and then to study their use in later representation.

Early Interaction Between Infant and Environment: Visual and Motor Actions

If children's early representations are concerned with the nature of events and objects - including that special event-object, the human being - what is the background to this interest? In this part, it is necessary to consider the neonate's first encounter with people. It is within the first interactions between infant and caregiver that the complex action sequences like Ben's at 2:1 have their origin. Inside this interpersonal "bubble" (Stern 1977, p.29) actions first acquire meaning for the infant. It is within this psychological space that the infant's skills of looking and handling are developed.

It is now proposed to look at sample observations fom the

longitudinal study of Hannah, for whilst recordings of Ben and Joel yielded similar data, the study of Hannah contains the most detailed record of the earliest days of life.

Many of the following observations were filmed or videorecorded. Slow-motion techniques were also used to reveal the organisation of movement. Frequently, the method adopted was to record at normal speed (18 F.P.S for Super 8 film; 25 F.P.S for video) and to re-record certain sequences at extreme slow-motion - sometimes as slow as one quarter speed. Later, in this study, such techniques reveal the structure and organisation of "interactional synchrony" (Condon 1975, p.87) between the infant and caregiver, but for the purposes of this part of the study, the techniques have proved invaluable for micro-analysis of infant gestures in themselves. When these techniques were used in the making of observations, this is noted at the head of the observation.

In this part then, attention is focused on the onset and development of visuomotor actions out of which later skilled performances are built.

At the end of this part, some general points will be discussed. These will include important implications about the interaction and provision necessary for symbolisation to develop.

visual tracking behaviours

Perrott's (1988) study of the information-processing within the monkey temporal cortex suggests that the systems for the encoding, in the brain, of objects, are quite different from the systems for encoding actions. Bretherton's (1984) proposal that object representations are derived from internal event representations has been mentioned above in Part 1. Together with research findings (also cited earlier) suggestive of the significance attached by the neonate to the configuration of events, these studies form part of the background for this writer's study of the dawning representational systems.

As the present study will focus on early representation - some of which monitor the movement of entities and unfolding phenomena rather than frozen configuration - it is necessary to look at the background of these representational strategies. This includes consideration of early visual tracking behaviours.

Social Interaction

The neonate comes into the world equipped with a small repertoire of repeatable actions called schemes by Piaget (1951) which seem to be quickly linked to his/her perception of objects and people. These schemes can be thought of as the "soft-ware" - the initial progammes for living of life; perceptual-motor scripts represented in the C.N.S. In particular (as has been introduced in Part 1) the neonate seems to enter the world already equipped with innate propensities to engage in early social interaction (Trevarthen 1975, 1980; Richards 1980; Condon 1975). These recent findings are very important. Trevarthen's work suggests that the infant's ability to perform controlled actions is not the cause of the ability to engage in social interaction but rather a consequence of it (Trevarthen 1975). Furthermore, the child's expressive and representational use of actions and objects is likewise a product of the quality and type of caregiving and companionship offered by an adult to the very young child.

> H.0:0:0.
>
> A few seconds old, Hannah is lying face down on her mother's stomach. Her mother is talking to her. Hannah moves her head and corners her eyes toward the sound source.

As Bower (1982) has written, the neonate seeks out sound sources and behaves as if he/she expects something to be there. More than this, newborns respond specifically to the human voice (Condon 1975). Other

investigations have revealed that the neonate has a preference for his/her mother's voice (Mills and Melhuish 1974).

> H.0:0:3.
>
> Hannah is resting on her back on my thighs. She shows great excitement (moving her face, limbs and fingers) when I speak to her.
>
> Then I stop talking to her. The television is on, less than a metre away. Hannah seems to scan my unmoving face to locate the sound-source. She then corners her eyes toward the television monitor.

As Bower (1982) writes, the newborn not only displays auditory localisation and auditory visual coordination, but also behaves as if he/she expects voices to emanate from mouths.

The movement and location of objects - especially people - are interesting and important to babies.

> H.0:0:3.
>
> Hannah, supported against the front of her mother's body,and looking over her mother's shoulder, tries to visually track me as I move away. She raises her head and follows me with her eye gaze. Her movement is jerky and uncontrolled, and she seems to lose visual contact at over a metre's distance. Nevertheless, Hannah displays the (probably) innate tracking response to objects - especially humans.

It is likely that infants have special neural structure specifically for the representation of human movement.

An early task for the infant may be to coordinate both place and movement (Bower 1982). Much later on, at 2-3 years of age, such concerns are represented in various external forms.

The above example is what this writer terms an horizontal track. It

is also possible to see babies produce, during their first few days of life a visual track along a vertical axis, though this type of visual tracking may be more difficult for the infant to achieve. Spelke's (1989) experiments confirm that infants up to 2 years 6 months find tracking a horizontally moving object easier than tracking one moving vertically.

H.0:0:22

Hannah, sitting up, back supported, seems unable to track my hand moving slowly in vertical or oblique directions across her field of vision, though she can follow it horizontally.

Her ability to follow various directions of movement depends of course on her physical orientation.

Lateral movement of the head seems to be the easiest type of movement:

H.0:0:23

Hannah is lying on her back on my knees. When Joel who is by her side drops down to his knees, she tracks him quickly and easily by turning her head to the side, through 90 degrees.

She follows Joel's vertical motion by a lateral movement of her head - she is lying on her back. Nine days later however, she is able, from a supported sitting position, to follow Joel's changing positions through both vertical and horizontal axes as he plays.

Both horizontal and vertical visual tracking have an important bearing on early mark-making and this will be discussed in a later part.

Over a period of days and weeks, Hannah learns to visually track the movements of objects - especially people - through a variety of axes, including horizontal and vertical.

Hannah seems to find it easiest to track along a horizontal axis, harder to follow a vertical movement, and hardest of all to track along

an oblique axis:

oblique axes

Although Hannah finds it a little harder to visually track along an oblique axis, filmed observations made 3 days later shows Hannah visually following a cube moved horizontally, vertically and obliquely across her field of vision.

It may be that the order in which these 3 major tracking axes are mastered is later echoed in the sequence in which longitudinal, lateral and oblique marking actions are produced. Athey, using Bower's research, has suggested this vertical decollage model (Athey 1980 personal communication) and Freeman's (1980) studies would also seem to support this). However, more work need to be done here. This author's own observations would suggest that, at least in empty-handed motor actions, vertical arc precedes horizontal arc.

By 0:1:5 Hannah can visually track the movement of the cube along all 3 major axes.

Hannah is also around this time building up expectations about the location of persons:

> H.0:0:3
>
> When her mother leaves the room, Hannah makes a pleading sound and follows her with her eyesight as her mother exits through the doorway. Hannah continues looking at the empty doorway for some moments.

Hannah is building up knowledge of location and movement. She begins to make predictions about the future whereabouts of objects and people. She begins to interpolate trajectories:

> H.0:2:4
>
> If people are momentarily occluded as they move across her field of view,

> Hannah clearly anticipates and shifts her gaze to where they might reappear (see also Bower 1982).

The evidence strongly supports this writer's proposal that such understandings, as they are developed, about movements; about directions and axes; about location; about appearance and disappearance, are later explored all over again - from before 2 years of age - and represented in various forms.

So far, discussion has centred on Hannah's visual tracking of others. We have seen the establishment of 3 major tracking axes: the horizontal, vertical and oblique. What of the movements Hannah herself makes?

Body Actions

Her visual tracking of movements is part of active responses she makes to stimuli. Filmed observations made during her first weeks of life show an emphatic participation in events, involving movements of her own limbs and especially her fingers.

> H.0:0:3 (Filmed recording; slow-motion techniques).
>
> Whilst sucking at the breast, Hannah makes rhythmical arm movements. Her fingers curl in an exquisite wave motion.

> H.0:0:4 (Filmed recording; slow-motion techniques).
>
> Whilst lying on her back Hannah makes rhythmical arm and leg movements, almost circular, alternating from one arm to the other.Each movement is a little like a crawl swimming stroke.

This is a synergistic response, in which all the limbs and the fingers are moved in resonse to stimuli. A development of this synergism can be seen much later in early representation. Such behaviours, when

they occur in drawing, involve many actions of the body, in conjunction with the motor movements of the drawing hand and arm. Together, these actions all participate in the drawing episode. Such behaviours have been almost consistently misunderstood by those whose model of drawing is restricted to a narrow kind of objective drawing with its attendant task demands.

At one level of description the first drawings record the actions of the body in synchrony and define a body space. Many of these early drawing episodes will be characterised by rhythmical, cyclical qualities we see emerging in the first days of life.

First of all however, she has to become aware that she herself is the causal agent of certain movements, i.e. movements of her own body:

> H.0:0:14
>
> She catches sight of her own fist as it flies past her face. She tracks its trajectory as she would that of any other moving object. It may be that she has no notion that the fist is her own.

Eventually, from initially synergistic responses made to interesting stimuli in which all limbs are auto-reflexively activated together, the infant differentiates the 3 kinds of mark-making actions mentioned above: the vertical arc, the horizontal arc and the push pull. The developmental histories of each is complex. They each acquire a variety of associated but very different uses and potentialities. Whilst in certain respects each action creates and develops a different developmental route which can be described separately, it is important to conceive of these actions as members of a family which converge (for reasons yet to be described) in kinematic spatiotemporal sequences. Their development is a continuum which can be traced back to (and in a deep sense reflects) their origin as a cluster of actions we see forming deep in infancy and which are centred around objects and people.

The vertical arc is usually the first of these to emerge, and it is linked to the infant's perception of the object (or person) as a target in space.

Vertical Arc

> H.0:0:16 (Filmed recording; slow-motion techniques).
>
> I present a multi-coloured plastic cube within her visual field. She swipes at the cube with a downward, circular action.

Bower (1982) has shown that newborns, though lacking experience of objects will however, if supported so as to facilitate the movements required, quite accurately reach for objects. It seems they cannot resist reaching towards discriminable units. In this observation can be seen the origin of an aimed gesture that describes a vertical arc in space. Again, two days later:

> H.0:0:18 (Filmed recording; slow-motion techniques).
>
> She watches a mobile rotating. She reaches out toward it with an outward arcing swipe.

and again:

> H.0:0:22 (Filmed-recording; slow-motion techniques).
>
> She studies a yellow plastic cylinder held motionless within her visual field. She makes vertical arcing sweeps with both hands, one hand striking the object. She shows awareness of the contact.

The same movement is made toward people:

> H.0:0:23 (Filmed recording; slow-motion techniques).
>
> Hannah smiles excitedly when Joel approaches and plays with her.She

swipes her hand in vertical arcs towards him.

These two observations show the vertical arc's initial use, that of striking objects and surfaces; reaching out toward people, and also its early use as a social signal. The vertical arc, like other object contacting strategies develops many subtly different usages and connotational hues (see also Petitto 1987).

The vertical arc is for example developed to become an accurate reach:

H.0:0:28

Hannah is lying in bed next to me, looking at my face. Are her arm movements slightly different? She makes a reaching out, rather that an arc, to my mouth, ending with a grasping motion of the fingers.

As so much of what will follow in the next section is concerned with early tool use, the development of reaching and grasping will shortly be described. Before this however, it is necessary to show that, interlaced with the development of the vertical arc is that of the second basic mark-making gesture, the horizontal arc.

Horizontal Arc

Whereas in visual tracking behaviour (according to these studies) the very young infant is better able initially to produce more consistently the horizontal track, as regards the infant's arm actions the converse is true - the infant makes a downward vertical arm movement before an horizontal one. However, though it is not developed as quickly as the vertical arc, it too can be glimpsed when the baby is only days old:

H.0:0:26 (Filmed recording; slow-motion techniques).

I hold a multi-coloured cube from its

> chain within her visual field. She makes vaguely horizontal arcing sweeps at it. At one point she hits the object. She registers surprise at making contact with the object.

Again, even in the earliest days of life it is possible to see such actions already being adjusted to become reaching/grasping movements. Consider how the same observation of Hannah continues:

> H.0:0:26 (filmed recording; slow-motion techniques).
>
> She regards the object as I rotate it slowly. Eventually she tries more of those horizontally aligned sweeps, her hand below the level of the cube initially. Then, having regarded the object for some moments, she adjusts her arm and swings her hand slightly upward towards it. She is not, however, successful in striking the cube a second time.

The films made of Hannah at this time strongly suggest that she is reassessing the location of the object relative to her own position. In the above example one can see the process of accommodation actually taking place as she redefines the task and alters accordingly her reaching strategy. The horizontal arc follows a similar line of development as the vertical arc, though it does not seem to acquire quite the same versatility as a social signal.

While the vertical arc's potentials develop fairly rapidly over the first and second months - for swiping at objects; for outward reach and grasp; as auto-reflexive excitatory responses to people, the horizontal arc only really starts to develop when the infant can sit up and has within-reach access to horizontal surfaces. With Hannah this is at about 3 months. At this time, the horizontal arc comes into its own. It is then used as a fanning/wiping gesture, usually across a smooth horizontal surface and describing a semi-circular arc back and forth in front of the baby's chest across his/her midline. It is the prototype of the

movement Ben at 2:1 used - with a brush - to start his painting.

> H.0:3:1 (Filmed recording; slow-motion techniques)
>
> Sitting in her little chair, with her meal tray before her, she sweeps her hand across her tray toward a wooden rattle. Sometimes, using this action she knocks the rattle onto the floor.

She is beginning to build up knowledge about the relationship between objects and their supporting surfaces, together with a knowledge of the potentialities of her own actions. One interesting discovery is that objects can be slid and scattered along and off horizontal surfaces if the objects are resting somewhere around her midline on this horizontal surface. For this manouvre she learns to employ the horizontal arc.

Different locations will prompt different strategies. The observation continues:

> H.0:3:1
>
> When I hold the rattle above her tray however, she brings her hand above the edge of the tray in an upward arc designed to reach the rattle.

A position around the centre and along the midline of the baby's chest is a very salient location for the young infant. If the adult dangles an object in this position it proves particularly effective in eliciting an object-contacting strategy from the infant. So powerful is the effect that Gray has called it the "hot-spot" (Gray 1978, p.168).

> H.0:3:4
>
> Lying on her back, she moves her arms simultaneously toward a central "hot-spot" in response to an object dangled there.

Basic arcing strategies are already undergoing modification as the

infant re-assesses the location of objects relative to both local landmarks and self-referential cues.

Nineteen days later, both horizontal and vertical arcs are used as object-contacting, object-gathering or object-scattering strategies. In particular at this time Hannah has developed an all-purpose downward striking action which she applies with gusto to a range of objects and surfaces. Again, certain positions of object will cause Hannah to inhibit production of her ubiquitous vertical arc. At 0:3:20 for example, when she is sitting in her chair with her meal tray before her, a small toy is placed on the tray at around her midline. One can see her making intense efforts to inhibit horizontal but especially the strong vertical arc tendency and painstakingly bring her hands together at a controlled meeting point at the midline where they clasp each other and (sometimes) the object.

It is as if different strategies and different sets of cues, both kinaesthetic and visual, vie with each other as what were initially self-referential, muscularly-dominated gestures give way to careful midline searches executed with excruciating concentration.

Later in this study it will be shown how the coordination of external local orientation cues and self-referential cues plays an important part in early graphic representation.

Push Pull

The push pull, the last of the trio of mark-making gestures does not really make an appearance until the fourth month, as this action requires the child to grasp an object. Therefore, before continuing the description of these gestures it is necessary to make a detour in order to consider how the infant develops reaching and grasping skills.

Intentional Reach and Grasp

H.0:4:21

Hannah is picking up the wooden rattle. She is sitting in the little chair with her tray before her. The rattle is offered to her by my holding it within her visual field around the "hot-spot" but slightly more toward her face. It it presented in such a position that she can move her hand toward it.

The rattle in form is a wooden rod or dowel 18cms long by 6mm in diameter along which freely turns a wooden sphere about 18mm in diameter which is penetrated at its centre by the rod. This sphere is encapsulated by a further, hollow wooden egg form, penetrated by the rod at its two ends. This egg form has been divided into two sections so that when the rattle is shaken or moved these two halves separate and slide along the rod, revealing the wooden sphere inside. This conjunction of moving parts also causes the interesting rattling sound.

Each end of the rattle terminates in a fixed wooden sphere, again about 18mm in diameter. It is one of these spheres that I hold, in a pincer grip,the rattle and present it to Hannah. In this way she has the longest possible target to consider and to grasp.

When the rattle is handed to her in this way she visually scans along its length to its free end where her eyes focus on the wooden sphere. She then moves her hand accurately in an upward arc towards it, carefully clenching her fingers around it. She then adjusts her hand and head position, so that even though she is manouvring a rod 18mm long, she can place - usually with first-time success - the end furthest from her hand into her mouth.

She croons excitedly as she makes these actions.

It is interesting to note that in one instance when I hand her the rattle, she clearly has to consciously resist moving her hand toward my hand. In this one instance she shows a tendency which

> recently she has repeatedly shown; that is, she initially moves her hand toward my own hand in which I hold the object for her. At the last moment however, with her hand fast closing in on mine, she re-directs the path of her hand to the opposite end of the rod.

This is what Bower terms an "in-flight" correction of a reach (Bower 1982, p.175) and is characteristic of the older infant. Below 20 weeks infants seem unable to make such in-flight corrections but rather correct a mis-reach by making a further, modified reach.

The position in which I hold the rattle - that is, its orientation within her visual field - effects her guiding and placement of her hand, as well as the form of her hand in mid-flight. This would suggest that she has an internal representation of the object and is refining generalised, high-order action programmes with additional and more detailed, low-order specifications (see also Kelso and Clark 1982) More will be written about representation of objects and events in Part 5.

The arcing, object-contacting gestures are refined to an intentional reach and grasp by about 3 months in Hannah. It is important for this study to trace the development of the components of this reach and grasp. These components include the scanning along the boundaries of a form; the coordination of looking and reaching schemes; the accommodation of the muscular-skeletal form of the hand according to the child's perception of the form of the object - the gradual fine adjustments made to action programmes. As Kevin Connolly (1974) has said:

"...skilled motor behaviour is concerned with the patterning of movements in time and space, movements which make up a programme of action specifying and objective to be attained. The means-end relationship is a control feature of a skilled performance and it is the ability to make adaptions in the means of attaining desired ends that character-

ises the skilled person. Flexibility in adjusting the means of achieving a given end to the changing characteristics and demands of the situation is one of the hallmarks of skill" (Connolly 1974,p.138).

Initially, reaching and grasping are all-of-a-piece (Bower 1982, Von Hofsten 1983, Trevarthen 1984).

> H.0:0:29 (Filmed recording; slow motion techniques).
>
> Hannah uses an upward arc of her arm, again in a clear attempt to collide her and with the cube dangling before her. She hits it twice and in one of these collisions succeeds in grasping it.

It will be several weeks before this scheme is separated into two distinct actions which can be connected or disconnected at will. As natural arcing movements of the arms are refined and adjusted to become accurate reach-grasp, so their functions change:

> H.0:1:3
>
> Hannah is lying on her back on my knees as I sit on a chair. When I hold my index finger within her visual field she focuses upon it, reaches out toward it with her right hand and is sometimes successful in grasping it in a power grip.
>
> Sometimes I hold my finger within her visual field and then I slowly move it away from her. She carefully visually tracks it and suddenly swings her right hand out at it in a wild, over-arm arc, almost managing to clutch my hand, whilst at the same moment arching her neck and head upward and right away from my knees as if in an attempt to follow my receding finger.
>
> Surely she is trying to stop my finger from escaping?

Gradually, Hannah will disembed and separate each of the units from within the larger action programme and repeat and use these over and over again.

Bower (1982) asks why it is that the infant should differentiate reaching and grasping as it grows older, since before 26 weeks reach and grasp are unified. This differentiation, he argues, allows the infant to grasp and then reach - a variation which is of utmost importance for tool use. "As long as reaching and grasping are coalesced into a single act, tool use is not possible " (Bower 1982, p.175). Such differentiation and recombining of reach and grasp allows for greater accuracy. As was mentioned earlier, the infant below 20 weeks of age is unable to make in-flight corrections of reach, having to correct between reaches. By separating the individual components of what is initially a united act, the infant is able to make fine adjustments that are visually guided within the act of reaching. (For a full discussion, see Bower 1982, p.175).

Kevin Connolly writes:

"An approximately successful outcome is in itself rewarding and will lead to the refinement and adjustment of the sub-units and of the programme in which they are embedded" (Connolly 1975, p.140).

H.0:2:9

Hannah is lying quietly in bed on her back. In the absence of any object she makes repeated reaching and grasping movements whilst intently watching her hand. She holds her closed fist close to her face for a moment, studying it. The elbow is bent in this position. Then she moves her fist away from her, using an over-arm arc. At the end of its trajectory the arm is oustretched whilst the fingers gracefully fan out.

She does this dozens of times, watching with a rapt expression of concentration.

Hannah is repeating the components of a reaching and grasping movement independent of any object. Play is implicated here. In play, the infant can separate means from ends and investigate the elements of

kinematic chains of action as structures intrinsically interesting in themselves. This infrastructural investigation, made possible by the infant having access to an arena of activity in which actions can be performed with a totally different orientation, is of vast importance to the present study. We will return to this several times in this work.

> H.0:2:9 (observation continued)
>
> She holds her hand in front of her face, gently rotating the hand back and forth on an axis. She studies it intently.

It is no longer a question of her catching sight of her fist as it fortuitously zips across her field of vision. She is now able to hold her hand steady before her in order to move it and observe it.

Sometimes during this period, she would strike a surface with a palm, and then hold this hand up before her face and gaze at it with interest. (See Bower 1982 and White, Castle and Held 1964 for full discussion of hand-regard).

The next observation shows Hannah practising the counterpart of an outward reach:

> H.0:2:10
>
> She seems to be purposely moving her hand from just outside her field of vision in an upward arc toward her mouth, at which moment the trajectory decays somewhat - perhaps because she again loses sight of her hand at this point.
>
> She brings her hand up to her eye-level and studies it intently.

It is interesting to note that there seems to be a period prior to this stage when the infant's reach is actually disrupted by his/her catching sight of his/her own hand. See Bower (1982) for full discussion.

There is an interaction here between proprioceptive, kinaesthetic and visual information in this observation which shows Hannah making visually initiated movements and building up knowledge of trajectories which pass in and out of sight.

The observation continues:

> H.0:2:10
>
> With her hand in an outstretched position, she arches her head upward at the same moment as she brings her hand (which is at this moment out of sight) on its upward flight towards her.

Though she cannot see it, does she in some sense "know" her hand is out there, just out of sight?

Whilst hand-watching, she seems to be in a peaceful state, gently moving her hands whilst all other movements cease.

She further explores the consequences of her actions upon objects:

> H.0:2:10
>
> She is sitting in her chair. She makes clenching movements of her hand and raises it upward and towards her face, in an arcing sweep.
>
> Sometimes, by accident, her clenching hand grasps her blanket and it is carried up to within her visual field by upward moving arcs. She does this several times. Sometimes, at the end-point of the trajectory, when hand and blanket are near her face, she looks closely at them both.

So strong is her interest in studying objects, trajectories of objects, and particularly the actions of her own arms and hands, that it overshadows and temporarily replaces her normally great desire to communicate.

H.0:2:14

Contents herself for 20 minutes by looking at her hands. She can now smoothly bring a fist to her mouth.

H.0:2:15

Studies her hands and moves them slowly, tracking the subtle movement.

I show her the multi-coloured cube, holding it from its little chain at about 20 cms from her face and slowly rotating the cube.

She studies this whilst remaining utterly motionless.

I then contact the cube against her hand and within her visual field.

(Filmed recording, slow-motion techniques)

She then repeatedly strikes the cube with an over-arm arc. She shows great interest in this and even appears to be slightly startled by the effects of her actions.

This startled response develops to become by 6 months a backward flinging of the arms whilst the spine is arched backward. Reaching strategies are modified by the infant's perception of external orientation cues. Frame-by-frame analysis of filmed and video-recorded sequences of the infant's travelling hand closing in on its target, shows the skeletal/muscular form of the hand accommodating in mid-flight to the form of the target object. In this it can be seen that the representation of objects and the representation of actions are mutually reciprocal in their development.

Horizontal Arc

Whilst intentional reach and grasp are becoming perfected so it is that the earlier, natural movements - the vertical and horizontal arcs - acquire different purposes, becoming mastered and used in intentional

acts.

By 5 months, so useful has the horizontal arc become as an object gathering strategy along a smooth, horizontal plane around her midline, that Hannah at this age will still resort to it as a search strategy if all else fails:

> H.0:5:22
>
> Hannah is trying to find a piece of orange that has become lodged in her left sleeve. She knows that it is around somewhere in her immediate proximity. Perhaps she can smell it. She tries various strategies to retain it. She raises her left fist and sucks her fingers - no use - it's not there.
>
> Then, with two hands she makes synchronised horizontal arcing wipes vigorously across the surface of the tray, hands coming together at the midline as the gestures describe two symmetrical arcs along the formica surface.
>
> Is it by chance that the orange is dislodged from her sleeve and the orange falls onto the tray where she sees it and recovers it by reaching it and grasping it?

This multi-purpose horizontal arc is one of a variety of learnt search strategies she employs when she has been unsuccessful with retrieval actions which are in fact more sophisticated. The question remains as to whether Hannah intentionally uses the action to dislodge the orange. Leading up to this time she has certainly acquired a great deal of knowledge about the whereabouts of objects. However, at 5 months I have noticed that she will often revert to one or more of a series of more basic retrieval actions which she will use in spite of there being no information about object-location, or even when there is conflicting information.

The horizontal arc has, in the past, been such a successful way of locating an object. Eventually, the hand or arm must (she learns) make

contact with the object if it rests within the frontal hemisphere of her body-space.

In this way, Hannah is acquiring knowledge about the potentialities and limits of her body actions, and about her own flexible capsule of personal space. Because more sophisticated search strategies will replace natural arcs as the predominant means of retrieving objects, so the use of the movements will become released, as it were, for ludic purposes.

A similar developmental history applies to the vertical arc.

Vertical Arc

On the same day that the above observation is made, after dropping the rattle and failing to find it, Hannah makes a series of vigorous vertical arcs which crash against the surface of her tray. As with many of these observations there exist possible alternative - but not mutually exclusive - interpretations which should be considered, since they help suggest the range and richness of these actions. Here, for example,it is possible that the vertical arc is here used for communicative, or mood conveying, expressive purposes. Again, the development of its use to convey - and contain emotion (see Petitto 1987) - is of significance in the later description of gestural representation.

The vertical arc is used by the infant in conjunction with all manner of surfaces and all manner of objects. The same action used across different situations offers up very different information. Setting aside for the moment the enormous psychological effects one can set up in another person by an action of a limb, the range of physical effects created by one type of gesture is very large. Depending on whether one uses the same action to strike the surface of a table-top or a surface of water; the keys of a piano or a coloured pigment, the effects are very different in each case. Vertical arcs, like other

early, natural movements, yield valuable information about affordances (Gibson 1979) of personal action and materials, and information about personal action with materials. The infant soon appreciates the potential of the vertical arc as a major tactic for retrieving information about surfaces, objects, and the consequences of actions:

> H.0:3:19
>
> Hannah is sitting in her chair with her tray before her. On the tray is a tower composed of individual, circular, plastic containers which are stacked vertically according to size; the largest as the base, decreasing in size to the smallest one at the top.
>
> Hannah strikes the tower using an over-arm arc, causing the tower to fall apart, the separate containers clattering over her tray and some rolling onto the floor.
>
> She watches this phenomenon with great interest.

She is learning that some objects fall, roll, clatter, or even disintegrate when they are struck. The vertical arc is used quite purposively as a hitting movement - as the infant detects such interesting affordances of entropy.

An identical striking action can result in quite different effects however:

> H 0:3:20
>
> Hannah is sitting in her chair with a Jack-in-a-box before her. She strikes its head with a vertical downward arc, causing it to squeal.
>
> She seems a little frightened of the Jack, but nevertheless strikes it again about 8 more times, causing it to squeal and squeak.

Hannah soon becomes used to the Jack and purposely hits it in order to obtain its plaintive cry. It is interesting to note however, that

about 3 months later she again becomes frightened of it and of the effects of her actions upon it. The possible reasons for this re-occurence of fear may revolve around a developed appreciation of imagery and expression.

In the meantime however, sounds are produced by the vertical arc movement in many, and most, contexts. For example, consider the following observation of its use in conjunction with a reaching/grasping movement.

> H.0:3:20
>
> She practises picking up the rattle from her tray before her. Sometimes she uses the general purpose striking motion against the rattle and/or tray; sometimes turning this strike into a grasp; sometimes not.

It seems as if Hannah is in the process of learning to differentiate between the various effects that each unit and sub-unit of the action-programme has upon the object.

> H.0:3:24
>
> Hannah makes a vigorous upward-downward arcing movement repeatedly, with her right hand (and in space - not against a surface) when she is excited and wants me to repeat a little game I am playing with her.

She uses this movement specifically as a signal to elicit a behaviour from me.

All these movements acquire an instrumentality (see Petitto 1987 and discussed above) and come to be used rhythmically and expressively. These developments will be eventually considered when this family of gestures will be described as an interface between action and symbol.

In the meantime, Hannah is developing increased awareness of who and

what is causing the various effects:

> H.0:5:11
>
> Hannah repeats an up and down slapping with her right hand on the tray of her chair in which she sits.
>
> She then studies this hand, rotating it at the wrist and gently touching its fingers with the fingers of her other hand.

And on the following day:

> H.0:5:12
>
> Hannah bangs on the table with her hand and then looks with curiosity at this hand.

It is almost as if she is asking of herself: "Was it my hand that did that?" She is gradually acquiring knowledge that she herself is the causal agent of certain effects. She is learning that she is able to produce and reproduce effects when she chooses:

> H.0:6:2
>
> Hannah is sitting at the piano. She applies with enthusiasm, the vertical arc to the keyboard, clearly in order to produce the sounds.

The selection and use of one or other action-programme is essentially an intellectual behaviour.

By this time she is quite adept at picking up objects in a power grip, so she develops other uses of both horizontal and vertical arcs, some of which form the basis of early graphic representation, and some of which continue to gather up information about different kinds of surface and the effects upon these of the actions:

> H.0:10:2
>
> Hannah is sitting in the bath. The

> water level is up to her middle. She strikes vertical arcs against the side of the bath, causing a wet, clonking sound and slightly splattering droplets of water.
>
> She then slaps the surface of the water causing splashes. Water drenches her face and goes into her eyes. She looks distressed by this and I wonder if she is about to cry.
>
> It seems however, that she is unable to resist trying it again.
>
> She impacts the vertical arc once more against the water, causing more splashes into her eyes.
>
> She winces and stops the action.

Other types of targets which are tested by these natural movements are those which consist of substances and liquids which stain or leave marks on surfaces. Description of the effects of the same actions upon these will be postponed however until one final, important natural gesture is described - the push pull.

Push Pull

The push pull is also made in the example observation of Ben at 2:1 when he is painting (see Part 3).

It is now proposed to trace the origin and development of this push pull action, intertwined as it is with the other actions described earlier.

Like the horizontal arc the push pull requires the child to make a hand/arm action along a flat - usually horizontal - plane; that is, the child has to accommodate his/her actions to a physical surface. It is, however, a more specialised movement, since it requires more complex muscle coordination (involving the elbow). Also, whereas empty-handed arcing, waving gestures can be seen in the neonate and are not necessarily directed at an external target, the push pull is usually

made with a hand-held object in conjunction with a surface. This signifies the start of the use of combinations of objects. The push pull is therefore a more advanced action conceptually. It appears on the scene when the horizontal and vertical arc are already being modified for handling objects, and joins the family of movements then at the beginning of tool use.

It is not glimpsed in Hannah until about 3 months, when she is learning to push and pull objects around on a flat, smooth, horizontal surfaces:

> H.0:3:4
>
> Hannah holds a bowl by the section of the rim nearest her, using both hands; fingers closing over the top of the rim.
>
> She pushes the bowl to and from herself along the surface of the table, in staccato bursts of action.

The push pull action is one of a cluster of actions used in conjunction with the gripped object on a flat plane. The same observation continues:

> H.0:3:4 (observation continues)
>
> It is as a consequence of her particular handgrip on the rim that the bowl is set spinning on the table. She watches this event with great interest and manages to purposely repeat this, i.e; she moves her hands to the bowl; grips rim; moves bowl.

The push pull action, once used, is repeated and developed over the next few days and weeks. She learns to differentiate "push" from "pull" action and finds important uses for each:

> H.0:3:17
>
> Hannah pulls plate toward her on table surface. She makes an aimed reach, followed by a firm grasp over the rim

and finally she pulls the plate towards her.

Over the next days and weeks, she develops this action as she discovers its potential. She adapts the action according to the requirements of different contexts. In the next observation Hannah is lying on her stomach on the carpet. Next to her is a wheeled toy vehicle lying on its side:

H.0:5:13

She makes a clawing, pulling movement to towards her on the carpet, next to the toy which is to the right of this arm.

Then, she uses a pulling movement to actually right the overturned toy.She puts her hand over the edge of its body, and pulls towards her, pulling the vehicle upright onto its wheels.

It is interesting that Hannah appears to practise the movement independent of the object, before applying it to the object. This example illustrates some of the features of the development of skilled motor performance mentioned earlier. Apparently Hannah is able to isolate components and sub-routines from larger action-programmes before re-combining them to serve the task.

The push pull has a powerful effect when it is used with wheeled toys which remain upright:

H.0:5:28

Hannah repeatedly pushes and pulls a toy telephone which has wheels. When moved on its wheels, the toy emits a squeaking sound.

It is at about 6 months of age that this motion is applied to a mark-making medium:

H.0:6:11

Hannah is lying on her stomach on the shiny tiles of the kitchen floor. She regurgitates a little milk onto the floor before her face. She reaches her right hand into the fluid and makes a pull motion from the small pool, towards her,. She stops. She averts her eyes to another position on the floor and then looks back at the small pool of regurgitated milk. She looks at it intently and then reaches into it again, again making a pulling movement along the floor towards her. This results in a long mark which runs from the initial target to a position near her right shoulder. It is unclear whether or not she looks especially at this long mark.

Such early mark-making events accompany Hannah's beginning to crawl. Very similar early mark-making episodes were observed in Joel at 6 months, just before he too learnt to crawl.

J.0:6:3 (colour-transparency 10)

Joel is lying on his stomach on a purple carpet. He regurgitates some milk in front of him, presenting a discriminable unit of great contrast. He reaches his fingers into this irresistable visual target and makes a scratching movement. He receives both visual and auditory feedback - he hears his fingers scratching into the carpet - he watches with interest the effects of his own actions in terms of the transformation taking place within his visual field.

A return will be made to this, the origin of mark-making and drawing, but firstly it is necessary to continue tracing the development of the push pull action itself, for an understanding of this helps appreciation of the expressive potentials of early body actions. For these gestures are not to be considered as emotionally neutral but rather as rich in affective nuance. The actions have acquired their affective values as a direct consequence of the process through which

they have acquired their various instrumentalities. It is significant that the discriminable targets and the mark-making pigment which forms them, actually come out of the infants' bodies. It is significant that the push pull action is used by the child to capture (accept-incorporate) or reject.

The use of these actions to accept or reject food - as illustrated in the following observations - is a particularly powerful example of the emotionally laden character of these actions. That the actions have such deep roots within affective interpersonal relations means that when they are eventually used for expressing or representing spatial extension or direction, they are already laden with emotional tone and are associated with moods and the meanings of words.

There follow some further examples of the development of the use of the push pull:

> H.0:6:11
>
> Making sure that she is watching, I hide a piece of bread behind a wooden screen which is placed vertically between her and the bread. As long as she sees the bread in the process of slowly disappearing behind the screen, she will reach out to either edge of the screen, hook her hand around it and pull it - the screen - toward her, revealing the bread, which she then retrieves.

However, Hannah is not able, using this pulling strategy, to retrieve the bread in certain spatial relations to other objects:

> H.0:6:11
>
> I place the bread slowly into a cup, ensuring that she is watching. She pulls the cup towards her, looks inside, and sees the bread. She is not able however to retrieve the bread. She cannot put her hand inside the cup, nor can she upturn the cup.

Inside - Outside

The discovery and use of the inside relationship is one of profound importance both cognitively and affectively, and one to which Hannah's attention is increasingly turned. Inside-outside relations will be later represented in various ways. In the example observation of Ben at 2:1 he created, with the brush, a closed-shape, into which he placed dots or blobs.

Inside-outside relations, and their representation, will be discussed later. In the meantime, consider how Hannah learns about the pull movement and its capacities.

At 6 months of age she uses the action to uncover and reveal objects. A little later she becomes quite adept at exploiting push and pull, together or separate, to reject what she does not want and to gather or retrieve what she does want:

> H.0:7:22
>
> Hannah pushes away from her a glass of water she does not want. She pulls towards herself a plate of bread she does want.
>
> When she pushes and pulls the plate she accompanies this action with an almost donkey -like, in-out, in-out, bray of satisfaction.

The child's synchronisation of vocals to limb - action, and other cross-modal associations he or she makes, will be discussed later, for these signal an important achievement in early representation. For the moment, consider the rejection value of the push movement. It is around this time that Hannah is beginning to use a sideways shake of the head as a "no" gesture. The "no" gesture shake has evolved from a sideways turning, aversion movement. This she has now minimalised to a signal. In an observation made on the same day she uses just such a signal of refusal. She uses only the slightest motion to communicate her wishes.

She is beginning to abbreviate, as it were, body actions and to use them to supplement and emphasise vocalisation as communication. Petitto (1987) has described just such a process as being integral to the learning of American Sign Language. It is part of the process of turning actions into symbols.

Sure enough, at this time also, I record that she uses a slight forward inclination of the head as a "yes" signal.

Meanwhile, the vertical arcing movement is also acquiring communicative power; a pounding on a table signalling displeasure, or demanding attention:

> H.0:10:13
>
> Hannah stands by a wooden cupboard in the kitchen, and when I enter the room, she bangs on the cupboard, smiling delightedly. Surely she uses the vertical arc to pound out a greeting?

She also uses this gesture to signal that she would like to start a game.

So as well as noticing the effects these actions have on the physical environment, the infant also notices the effect they have on the interpersonal environment. The actions create changes in the behaviour of others. the infant begins to purposely use the actions to exert some influence over others with the aim of satisfying his or her own desires.

The child develops the communicative and expressive power of these actions. A pushing away gesture comes to signify dislike, rejection; a pulling toward gesture comes to acquire the emotional values surrounding acceptance, incorporation to the Self.

The emotional hues and meanings of gestures are not of course developed in social isolation, but are part of a complex of meanings developed between infant and caregiver within an interpersonal space. The caregiver's role is crucial. According to Petitto (1987) the

caregiver starts to behave as if the infant is signalling. As Petitto has said a single gesture made by the infant is interpreted by parents in very different ways. Each gesture develops variable meanings according to context.

By 9 months, Hannah is using the push component in a very accomplished way as a discarding, rejecting action:

> H.0:9:20
>
> Hannah, when offered a piece of toast, can push it away with the palm of her hand.

It is interesting to note my interpretation, written at the time, of this oservation:

> H.0:9:20
>
> Is the discarding of the toast really a frustrated discarding of my incorrect attentions? Is this action more than just a physical discarding of the toast? Is she using it to express or "stand-for", in some sense, her mood?

It is important to keep in mind that the other gestures are also being developed at this time. From one of the sideways, arcing gestures of the arms and hands a proto-throw is emerging. This is becoming more accomplished by 11 months:

> H.0:11:7
>
> She has developed a wild discarding arc of the arms and hands. Sitting on the floor and rotating her hips, she flails her outstretched arms in line with her rotating shoulders, releasing an object from her hand, often at the point of furthest arc, and causing it to fly off, by virtue of the centrifugal effect, or angular momentum.

In filmed observations made of Joel at 1:1, we see him bringing this knowledge of angular momentum and inertial forces - acquired in similar circumstances to Hannah's - to tools and materials he has encountered for the very first time. These are paints and brushes.

> J.1:1:25 (colour-transparencies 11-12)
>
> We see him crouching on his haunches, swinging the brush in a controlled arc in space, causing droplets to fly off by virtue of angular momentum. Joel is attending carefully to what is happening, his eye-gaze locked on the trail of yellow spots of paint, as they appear on the floor. describing an arc.
>
> However, perhaps he feels a little unsteady in this position, for he stands up and, without actually touching any surface with the brush - using inertial force alone - he now adopts an emphatic, vigorous, vertical arcing gesture causing more droplets of paint to splatter to the floor.
>
> He clearly makes the first arcing gesture and now this stabbing gesture in order that the paint should fall to the floor, and he attends very carefully to their moment of impact.

This observation has been taken from a stunning sequence in which Joel encounters brushes and pigments for the first time and as it were re-invents their uses. (Read also Matthews 1983, 1984, 1988).

As with other gestures, Hannah learns that the push pull has a range of different effects, depending on circumstances:

> H.0:8:13
>
> Hannah pulls a mobile toward her and this causes it to bob and jangle. She repeats this action and the effects are repeated.
>
> H.0:10:13
>
> Whilst being held by me, she reaches out to a nearby wall and makes a clawing action along its surface. She

> attends carefully to this action. She can feel and hear the vibration of her slightly moist palm against the surface.

The point has now been reached in the discussion where it is necessary to consider, not just the actions of the arms and hands in themselves, but the infant's conceptions of the targets towards which these actions are directed.

The Infant's Investigation of Events and Objects

There is a mounting body of work on neonate cognition which suggests the newborn is already equipped with necessary perceptual mapping for the formation of conceptions of objects (Bower 1982, Spelke 1985, Von Hofsten 1983). Even though lacking experience of objects, the newborn infant behaves towards them as if he or she expects them to be tangible solids. The infant also shows some comprehension of their direction of movement. The purpose of this part of the study is to sketch part of the process whereby infants build up knowledge about the differences between 3D bounded volumes and those other salient visual targets which are bounded in a rather different sense. These latter are 2D images and other 2D discriminable units.

Such a sketch is important for this present work, as it completes the essential background against which the child's first use of graphic media must be described.

Bower's experiments have shown that even the neonate is able to discriminate between objects and surrounding space. He has shown that if the infant is physically supported enabling him or her to use arms and hands, the infant will reach out toward - and sometimes grasp - an object dangled within reach. (For full discussion of the infant's response to objects both within reach and out-of-reach, see Bower 1982).

Newborns also reach towards a "virtual" object - that is; an

illusion, created before the infant, of an object. In such cases, the infant is usually dismayed to see his or her hands apparently passing through the "object". This would suggest that the infant expects the object to be a tangile, handleable form, and is disturbed when this expectation is not fulfilled.

Infants in the first week of extrauterine life can also "identify the direction of movement of objects relative to themselves" (Bower 1982, p.62).

Bower's work demonstrated that the infant will take avoidance actions (eye-widening, head retraction and interposition of hands), if an object is made to slowly approach him or her on a collision course (Bower 1982). Ball and Tronick (1971) have shown that (on the other hand) babies do not respond defensively to objects approaching along a miss-path.

Such findings suggest the existence of built-in capacities for the perception of 3 dimensions and of the perception of the direction of movement of objects through these dimensions. The relevance to the present study of these findings, should now be apparent. Later representation would seem to be mapped onto a development of these early capacities for the detection of form, location and movement.

Bower has made the important point that it is not a foregone conclusion that the newborn should be so predisposed to attend to objects. It could conceivably have been the case that, lacking experience of objects, the infant would not attend to them as if they were bounded volumes, but would attend equally to the spaces which surround objects. The fact is that this is not the case. Infants regard objects as discriminable entities to be avoided or reached toward. They also respond to many other kinds of salient visual target - rather than to the spaces between them.

Such findings have important implications for our understanding of

early representation. For such behaviours point to the special roles played by boundaries and edges; both those which exist in the 3D world - as the interfaces between the object and the surrounding medium - or in the world of 2 dimensional imagery - as abrupt changes in colour, or changes of tonal or textual intensity, or, again, as linear boundaries.

This writer's own research has shown the infant testing out, in a systematic way, all manner of objects. From soon after birth and throughout their first year, the longitudinal data shows the three children, Ben, Joel and Hannah, learning to differentiate between many classes of objects, and between these and other kinds of bounded visual target. This entails a rather large task for the infant; the phenomena to be investigated ranging from the more obviously three dimensional, volumetric solids, whose solidity is confirmed in various ways - perhaps they roll, clatter or fall - to very flat objects on flat planes; hairs, specks of dirt, small piesces of paper resting on smoth surfaces; and also 2D images and pictures of various kinds.

H.0:1:18

Hannah is scratching at the boundaries of a 2D image of flowers printed on formica table mat,as if initially attempting to peel up the edges of the image from the surface of the mat.

The figure-ground relationship in this image is of high-contrast, black on white.

Interestingly, Bower (1982) has claimed that babies do not attempt to grasp images as if they are objects, but immediately seek out the true physical edges of the supporting surface. He quite rightly says that 2D images do not offer up the depth cues derived from the parallax information received when we scan or move around 3D objects.

There are two important points to be made here. First of all, the babies studied by Bower may have had experience of images prior to the

experiments. Secondly, Bower talks only loosely about pictures. He does not distinguish between 2D images of various kinds. Some depictions specify (by projective systems; linear or aerial perspective; or by texture gradients) form and depth back through the picture-plane. Probably, these do not fool even the most inexperienced observer into believing "real" volumes are being perceived. Slight movements of the perceiver's head reveal the true flatness of these depictions - no parallax information is forthcoming.

However, this is altogether a too naive understanding of the nature of 2D imagery and of the human interaction with this imagery. There are many forms of representation which do not utilise tonal or textual gradients, or projective systems. The flowers on the formica table-mat in the above observation were uniformly black silhouettes, with no tonal gradation or perspectival cues. I believe it is the very nature of the depicted boundary which is being investigated here. The fact that no discernable tactual change can be sensed when one's fingers pass between figure and ground seems to be of great interest to babies. Babies soon discover all manner of flat objects on flat planes and investigate these. I believe that, in this example, Hannah is learning something of the distinction between 3D objects on a plane, and 2D figures which, though having boundaries, nevertheless remain integral with a flat ground.

The interest babies show in 2D images and pictures is probably due to the paradoxical nature of such imagery. 2D images specify three dimensional forms or arrays; they are composed of structural derivatives of external objects or scenes; have some of the invariants (Gibson 1979) of such arrays - yet they remain flat. It seems clear to this writer that it is the very nature of this medium - its possibilities and its limits - which so provokes the interest shown by the human infant, and this is why, once again, it is vital to understand both our perception

and our construction of images, and the role these play in development.

So whilst not challenging Bower's assertion that the young infant can differentiate between "pictures" and "real objects", due to the difference in parallax information, his explanation is altogether too simple, and needs - in this writer's view - to be re-cast. It is not simply a question of whether or not infants are fooled by pictures - the question should be; for what reasons do they continue to handle forms specified in 2D, long after their first encounter with these? Yes, babies may not attempt to grasp 2D images - in the sense of attempting to pick them up - but they do finger them, and what drives these actions is of great interest. Part of the answer might be that it is the 2D structure itself and its relation to external phenomena which so interests the child.

Consider the following observations:

> H.0:2:16
>
> Hannah studies with great interest the contrasting print on a cover of a book.
>
> H.0:3:14
>
> She seems to enjoy looking at patterned surfaces, like my checked shirt, or the lettering on the covers of books.
>
> H.0:3:15
>
> Hannah looks with great interest and attention at 2D images of contrasting colours or tones in books - not just pictures but any stiking figure and ground relationship.
>
> She gives a startled response to some pictures; first of all looking at the image itself, and then looking across the paper to visually locate the true edges.

After initial visual (and sometimes haptic) inspection of the image itself, the infants would then go on to apparently check - by locating the true edges of the supporting surface - that the image is indeed integral to a flat surface.

Consider the next observation:

> H.0:4:1
>
> Hannah stares intently at pictures in a book. These are illustrations in a book of nursery rhymes. The images are in pen and colour-wash, with tonal gradation, including cast shadows, and in perspective. Figure/ground separation is augmented by outline. When I move the book she persists in visually tracking the picture and surveying it. She typically reaches for the image and closes her hand over it.

Such examples suggest that the picture/reality distinction is a simplistic dichotomy. It could be the case that the infant, noting the lack of depth cues derived by head movement, is then obliged to subject the image to further tests, as if to ascertain in what sense then does the boundary exist?

Experiences of 2D images may be quite overwhelming for the young infant. The above observation continues:

> H.0:4:1
>
> When shown a new picture, she flings her arms back in surprise. She averts her eyes from the picture, and sucks the corner of the book.

The backward flinging of the arms is a typical surprise response which persists into later infancy. Later in this study, observations will be used which show the same child at 2:6 producing a developed version of this action in response to a drawing she is making.

Sometimes, on first seeing a picture or a striking image, she grasps her hands together at the midline of her chest, mouth open, eye-gaze

locked on target.

The next observation was made on the following day:

> H.0:4:2
>
> Hannah looks at the front cover of a children's comic book. The figure/ground separation ("Korky the Cat") against a flat, bright red ground) is maintained partially by out-line but mainly by high tonal and colour contrast. In this particular comic style there is no tonal gradation.
>
> Hannah flings her arms backward in a surprise response to the picture, almost throwing her body backward, and with her mouth open.
>
> She eventually seeks (visually, and with her hands) the true edges of the surface, and when she has located them, pulls the book towards her and sucks this part of the edge of the thick cardboard cover.

Whether stronger tendencies to handle the image are elicited by the image-boundaries specified by abrupt changes in the intensity of tone, or colour, rather than by drawings in which figure/ground separation is conveyed by line alone, is open to question. Unfortunately, this writer's data has not captured sufficient information regarding differences in responses to different kinds of representation; whether these be representations in which form is described in colour and/or tone and/or in perspective or some other projective system; whether they are photographic; whether they are line drawings, "naturalistic", characature, or comic style.

Nor does the data capture information about whether interests in different visual languages change over time, that is to say; are there preferences for certain types of visual image which change according to the age or cognitive maturity of the child? The answers to these questions would be very helpful, for they may support the general

framework being offered of the factors which influence the direction of early representation. What is more certain is that the infant's interest in the image is not dependent on the image's degree of verisimilitude to nature - it is not dependent on the power of the illusion. What we are seeing in the infant's inspecton of image is the child building up knowledge about visual representational systems.

Progressive Pictures

Other observations made by this writer show infant's as young as 6 months to be responsive to moving pictures or "progressive pictures" - to use Gibson's more accurate term (Gibson 1979, p.293). Given clear photography, and direction which preserves physical and psychological transitions within sequences, this writer's observations would suggest that some of the meaning of filmed or video-recorded events is accessible to even the very young infant. The invariants of events are revealed in progressive pictures, as some invariants are revealed in static pictures. Observations which show Joel and Hannah at about 6 months totally engrossed in certain T.V. sequences would suggest that even young infants are able to detect such invariants. It is significant that (according to this writer's observations) the films to which the infants are most responsive are those which show events involving humans.

To return to the static image, it has been shown (Carpenter 1975, Perrot 1988, Stern 1977, Trevarthen 1975, Bower 1982) that no visual image provokes such powerful responses from the infant than the image of the human face:

> H.0:7:17
>
> Hannah looks at a photograph of a girl in a magazine. She touches the girl's wide smiling mouth. Hannah herself smiles widely at this photograph.

At 8 months, Hannah is pointing at pictures of people in books and

"talking" about them. "Bla bla bla bla!" She would say.

She also carefully compares 2D representations against the entities they represent:

H.0:8:10

I have lined up a photograph of Joel, smiling, with Joel's real face - who obligingly smiles. Hannah looks with great interest at the photograph, and then at Joel's real face. She looks carefully at one and then the other, with great seriousness.

Conclusion to Part 3

There are other important questions raised by these descriptions of the infant's investigation of images. These questions revolve around the interrelations between our genetic programmes of perceptual search, and culturally mediated phenomena like pictures. Careful consideration of this issue sheds light on some of the vexing controversy regarding nature and nurture. The present work offers a way out of the cul-de-sacs created by simplistic attitudes on both sides - those who overemphasise so-called "universality" and conversely, those who equally simplistically stress something they call "cultural variation". However, discussion of these issues will be postponed until the conclusion of this work.

The findings concerning infants' perception of pictures and the information concerning shape, size and depth that they derive from pictures, remain inconclusive (Olson, Yonas and Cooper, 1980). Clearly, more research is needed about the infant's understanding of 2D static and moving pictures in order to illuminate the mechanisms of interaction between cultural input of images (photographic, electronic, holographic) and programmes generated from within the human organism for the representation of configurative and dynamic aspects of events and objects.

Expression, Representation and Drawing in Early Childhood

Part 4

Action and Marks

There are complex variations in the child's interaction with graphic materials. Some of these variations are caused by the effects that each different medium has upon unfolding programmes within the child. These programmes are patterns of action set in motion by internal mechanisms within the Central Nervous System (Young 1978) and which have complex relations with the environment. Changes occur in these action programmes as they are shifted to different conceptual levels as the child matures. At any one level of development however, the child appears engaged in an investigation of certain dynamic structures; action-programmes which, despite transposition from one medium to another, tend to persist.

At the same time however, these programmes (or deep structures, or schemes) are subject to subtle changes caused by the impact of unique properties of each medium upon them. There is then an interplay between the persistence of these structures and the variations created in them by different materials and contexts. The observations suggest that the child attends carefully to these effects; builds up knowledge about that which remains the same and that which changes. The action-programmes may be so designed as to drive the child toward the discovery of principles underlying variance and invariance in structure. Such programme design would seem essential if the child is to be in any position to organise and synthesise structure.

The internal mechanisms which drive this development seem to be constructed to initiate programmes of activity even in the absence of aequate support from an interpersonal environment (Bickerton 1981, Treverthen 1988). Whether these propensities can - in such situations -

be fully realised and developed however, is doubtful. The research of this writer and that of others in diverse fields strongly suggests that the child's self-initiated programmes of symbolisation requires assistance and nurturing if the child is to achieve mastery of these unfolding expressive options. That many of these modes are made available in the experiences offered by mark-making, painting and drawing, should become clear in the following pages.

In this and the next part of the study it is intended to look at this interface between patterns of action initiated by the child and different media, and to consider the developments that occur in these strategies.

From about 1 year of age onward a dual process is occuring in which actions and marks are being both differentiated from each other, yet synthesised in new ways together. In order to use the marks as entities in themselves the infant has to differentiate these from his or her own actions. The infant has to perceive that an action results in a mark. The infant goes on to perceive that the character of the mark is determined by the character of the action. Changes made by the child to action-programmes are guided by information offered by the residual traces of pigment accruing on the mark-receiving surface. It is this intense feed-back - unique to painting and drawing - which aids the child in synthesising actions (and consequently shape) in new ways. First of all, single action-traces (Matthews 1983, Smith 1983) are made, the infants beginning to perceive a relationship between their body-actions and resultant traces in pigment (Smith 1972; Matthews 1983, 1984, 1986, 1988).

As has been described above, there comes a time when the infant (at about 8 months in Ben, Joel and Hannah) notices an interesting effect caused by dashing certain kinds of objects against surfaces. These objects are mark-making instruments of various kinds.

They leave marks and traces in their wake as they travel along surfaces - the "trace-making effects" described by Michotte (1963, p.289).

The infant looks carefully at the points of these instruments. He or she soon ascertains which orientation and movements of the marker relative to the mark-receiving surface are required if the effect is to take place. The child experiments with various actions and relationships of marker to surface, noting when the marks appear, and when they fail to appear.

Observers have tended to stress the infant's lack of control at this level. This is to overlook the more important fact that till recently no such behaviour has been possible at all. If we call the condition at which no mark-making is possible, Level 1, then at Level 2, the intention is to make a mark with the marker - that is all. Following on from this level, the child perceives one of the most basic principles of drawing as a vehicle for expression, that is: different actions result in different effects.

The child has started on that long process described by John Willats as the "interaction between production and perception" (Willats 1984, p.111). Whilst the marks are the product (even the "by-product", in some instances) of body actions which are often wild, nevertheless the child begins to perceive the consequences of these actions - begins to form the conceptual link between the visual forms and the forms of actions necessary to produce them. Shortly, one sees the child attempting to repeat them. So, right from the outset of mark-making, the child is forming representations of a complex class of actions.

Even though early drawing does reflect body dynamism, this is not to say that it is at any time completely muscularly dominated. We will see again and again that even the very young infant is already guided by propensities within him or herself and uses the potentials he or she detects in external media to release - and realise - these propensities.

In some contexts, the child finds and adopts external targets which act as guides to actions. This requires of the child that he or she modifies his or her actions. This writer's own studies show the children investigating the potential of paint in unrestricted siituations and adopting some unlikely targets "...his or her own body, a wall, a window, the cat" (Matthews 1988, p.167). Paint, at this time is a medium to be slapped, smeared, stamped and sat in. Ben, sitting on the floor at 1:4 paints - on the floor - all around his own body (Matthews 1983).

However, the observations also suggest that "even in these unusually free situations... he or she will spontaneously move toward the most sensitive mark-receiving surface his or her culture provides, in search of maximum contrast or effect" (Matthews 1988, p.167).

These mark-receiving surfaces (in many societies, rectangular pieces of paper) offer to the child external orientation cues - external landmarks to which the child must accommodate. What were originally actions "in the round" - in 3 dimensions - now meet 2D planar surfaces and have to be adapted accordingly.

Arranging one's orientation to a mark-receiving surface is as basic as is the use of the mark-making tool, yet this act is accomplished by some children at the end of their first year (Matthews 1983).

Observations made of Ben at 1:9 show him using the paper's edges - especially the edge nearest him - as guides against which he aligns blots of paint.

Accidents and Intentions

This writer's evidence suggest that the apparent "accidental" nature of children's early painting and drawing may, in many accounts, have been rather over-emphasised and certainly oversimplified. There is, for example, nothing accidental about Joel's horizontal arc in the milk at 1:1:

horizontal arc

J.1:1:15 (colour-transparencies 13-15)

Joel,at this time, has just learnt to toddle. He also likes to carry his cup of milk around with him. However, coordinating these two new skills is not easy and he frequently spills milk. On this occasion, the milk falls on a smooth,shiny concrete floor. Joel,his jaw dropping, watches with great interest the spreading white shape. Then, he reaches his right hand into the milk and starts to smear it using the horizontal arcing motion. He quickly brings his other hand into play, so that both hands are fanning to and fro in synchrony, meeting at the midline - until they become out of phase. He thus describes in the spilt milk two sectors of a circle.

Here then is one of those early mark-making gestures, whose origin has been described above, making contact with the 2D surface and being modified so that its graphic and dynamic potentials may be exploited. Joel has mastered this action - he chooses to employ it. Nor is there anything at all accidental when three weeks later, he develops the potential of this action by making a horizontal arcing trace on my studio floor, in orange paint, with a brush - so extending peripheral exterosensory activity by tool-use. (See colour transparency 16).

Between 13 and 14 months, Joel is repeating this action, enrapt, across a range of different situations and media. At this time one can be fairly certain that when he reaches into the milk, or applies brush to the floor, he does so with the intention of making that action. Remember that he does in fact have other options open to him. Joel's first use of the brush to make horizontal arcs was a discovery made during the painting episode mentioned in the last part of this work, where he was described waving and stabbing the brush - in mid-air in both cases - purposively propelling paint across space and onto nearby surfaces by inertial force. The complex of orchestrated features

revealed within these detailed recorded observations together convey that Joel is selecting an expressive action from a range of different ones available to him. The action he uses is in no sense haphazard. He knows when to use it; how to use it; and what it is good for.

However, every instance is different. While there are principles which describe the development of controlled movement (Trevarthen 1984), the present author has only just begun to develop a form of conceptualisation which captures the range of interactions possible between infant and graphic media. These differ in kind and complexity due to the nature of the particular medium available, and the age and experience of the child.

In Ben's adventure with brush and pigment at 1:6 he sets in motion a fast moving object which deposits and smears a glutinous coloured substance in its wake. At this age he can detect some of the affordances in advance; he knows something about the relationship between container and contained; he knows that the paint can be scooped out of the little pots with the brush and transported to the paper; he knows from his experience with other messy substances, something of their mark-making potential.

Some affordances and effects are however unpredictable and are only revealed through the ongoing process of painting itself. How the infant adapts ongoing visuo-motor programmes in response to these events tells us a great deal about the development of controlled movement (see Trevarthen 1984). Drawing and painting can play an important role in helping the child develop and organise quite comples visuo-motor orchestrations.

At this juncture it is necessary to consider the very different types of control demanded by different media. Which kind of control best reveals the potentialities of a particular medium? Each type of material varies enormously in its effects and in its demands upon the user,

despite the fact that each makes marks. This, of course, is no big news to artists, but in the context of this study it is very important to look closely at these differences. Consider the differences between the marking experiences offered by pencils, felt-tips, crayons, brushes and paint. Felt-tips and crayons have their colours in-built. An empty brush leaves no trace. Brushes come in different sizes, different widths, lengths and weights. These properties alone make for vastly different effects even if similar actions are exerted on the markers. Brushes have to be loaded with pigment which is then to be transported to a surface. Pigments in the form of paint have different colours and can be deposited in various and sometimes surprising ways. Colour changes occur when different pigments are merged together. The colour change occuring between paints is of a different type to that which occurs say between crayons or felt-tips. A fundamental difference between pencil/pen type marker and brush is that whilst the former makes a line, the same action with latter can cause a wider area to be covered with pigment.

With all kinds of markers, the infant might be obliged to select. What influences this selection? Range of choice has constraints imposed upon it by the caregiver, who (especially in the case of painting) has - for the very young child - to arrange and set up the situation. What factors influence this provision? This is an important question since its implications for childcare and education are vast. Such matters will be addressed in the final part of this work.

Very important also, and further modifying any simplistic account of motor-involvement in drawing and painting is that there are different kinds of accident.

Accidents with pigment are unfolding events to which the very young child attends - often very carefully indeed. Such events are very different in say, paint than in felt-tip or crayons. Crayons and pencils leave a trail of dry pigment adhering to the surface. Paint creates some

of the richest accidents; it is wet and messy. It does not dry quickly like felt-tips. Right from the earliest days of children's painting one sees an interplay between accommodation and assimilation, in which the child is seeking a fine-attunement with such fluid, forming and transforming phenomena.

So, whilst it is possible to see on occasions the very young infant getting into terrible messes from which he or she has to be extricated,, it is equally possible to witness an infant, equipped with only rudimentary techniques, completely at one with the moment of mark-making; in a state of total participation with the unfolding events.

As simple techniques become mastered, so they can be used playfully. Whether or not the child has "control" as such, in a tight-reined sense, is perhaps not the best question to ask. Between the child and the caregiver a potential space is being constructed in which actions and objects are disengaged from their usual associations and functions. The programmes which develop are flexible, open-ended, highly adaptable. "Accidents" are unforeseen events fluidly assimilated into everchanging scenarios. The child does not always intend to "control" these events at all.

Certainly, there is in the earliest mark-making (from about 8 months to 1 year of age) a fair amount of skidding around the paper, a surface which sometimes appears to serve only as a general target at which actions can be aimed. Sometimes, the child does not even look in the direction of his or her own drawing actions.

Certainly, the shapes that occur in drawings made by Ben, Hannah and Joel at around 1:1 are not intended - at least not in the usual sense of the term. Nancy Smith (1983) says that at the earliest level, "shape" - strictly speaking - is not a feature of the infant's drawing - meaning that the infant makes a series of single and discreet marking actions on a surface which acts only as a support for these actions. To give an

example from the present writer's own studies: to an adult's eye, some of the paintings produced by the 3 children at 1:1 show 3 sided or curvilinear open shapes - the product of lateral skiddings occuring between push and pull actions.

At other times skidding lines cross over each other forming closed-shapes. In all these cases, the lines act as boundaries, either partially or completely enclosing other marks, dots or blobs.

Such effects are almost certainly not intended by the child but are the product of a fortuitous superimposition - different actions occuring at the same locale.

However, it is not sufficient explanation to say that such very early paintings or drawings are nothing but the product of a lack of control. It is within the very skiddings and flailings of the marker itself that the child is detecting the essential affordances and potentials of the graphic media.

Dynamic patterns of movement emerge which the child learns to control, repeat and use. These become simple techniques which form the currency of early playful routines with graphic media. These will be described shortly.

The evidence suggests that the child is far more an originator of an early 2D system than has been generally acknowledged.

From about 1 year onward to 2 years of age, one sees basic mark-making gestures resulting in a variety of formations, partly due - it must be conceded - to the accidental careerings of the pen, pencil or brush, but also increasingly guided by the child's perception of the consequences of his or her own actions, and (it is argued) driven by an internal programme of expression.

The consequences of marking actions are gradually perceived in terms of form, shape and dynamic events. Certain forms acquire perceptual salience in so far as they reflect the structure and organisation of the

nervous system. By this it is meant that "What we see and hear is largely the result of our own programs of search, some of them following habitual rhythms" (Young 1978, p.69).

The observation reveals a tendency for the child to try to repeat such structures, and develop variations of them, whilst other structures are - for the time being - neglected.

As we will see, the child moves through a series of distinct approaches to structure and representation. Such differences in the types of drawing produced at different times through infancy are not to be described in terms of the consequence of deficits in visuo-motor coordination or cognition - a point that I hope is now becoming clear. The changes in construction are in part determined by shifts in the significance the child attaches to certain forms and relations over others. The child moves through a series of changing priorities concerning the type of information felt necessary by him or her to be encoded. The differences we see then, in the drawings of children as they grow older, reflect differences in the type of "knowledge" developing in the child.

Early 2D Structure

The infant, from 1 year, is already separating out push from pull strokes and sometimes these form single lines on the paper. It is tempting to refer to some of these as "verticals", but in the earliest mark-making, it may be wildly inappropriate to classify lines produced by the infant in terms of a coordinate system. I say may be, because this is not certain. The neural structure in the visual system does seem to have a structural predisposition for the detection of horizontal and vertical, but because these axial coordinates are represented in the C.N.S does not necessarilly justify us in speaking of the infant as perceiving "horizontal" or "vertical" in the adult sense of the terms.

It may be that these deep structures register maximum contrast of polar coordinates and, as with other aspects of development, such structures may need re-working at higher levels before it can be truly said that very young children are producing X and Y coordinates. (There are also controversial questions about how far such predispositions are genetically determined and how far they are influenced by cultural context).

However, it does seem to be the case that the very young child does not at first seem to appreciate subtle departures from local verticals and horizontals or, to put this more accurately, these are at this time lacking in symbolic salience and are therefore not "useful" - in the deepest sense of that term - to the child. Pratt (1983) has shown in experimental work that even adults (with the exception of artists) have difficuly in gauging the degree of obliquity of lines.

It may be that it is the character of the junctions or vertices between lines which is the key feature here, for the child at this time may well respond to - and learn to create - other, more dramatic contrasts of direction - especially acute angles and lines which disect, or sometimes bisect, other lines at approximate right-angles. Or again, the infant may respond to and cause to occur, other dramatic contrasts, for example, lines against dots or blobs.

These 2D formations, it should be noted, are the natural outcome of the basic axes and vectors of the drawing arm and hand - the horizontal arc, the push pull and the vertical arc.

The children seem to be increasingly attracted to angular, and sometimes cruciform structures, which emerge as early as 1 year, and are very clear in paintings and drawings produced at 18 months of age by Ben and Joel (for example B. 1:6:0 and J. 1:8:0; colour-transparencies 17-18). In paintings by the children at this time, horizontal arcs are deflected by abrupt direction changes of the painting arm as it pulls

the brush back toward the Self. This creates acutely angular structures.

In other paintings or drawings contrast is achieved by impacting the brush at selected lines or at other marks, causing clusters of dots or spots which create a different kind of contrast. ((for example H. 1:3:16; B. 1:9:16, colour-transparencies 19-20)

Hannah, from about 1:3 seems to contrast together, separately applied arcs, one imposed at a right-angle onto a preceding one. Contrasting direction changes result from a continuous contact line which (by energetic inflexions of wrist or arm) runs at a right angle across a preceding trace.

This is also a structure which Hannah uses repeatedly from about 1:3 to 2:0 (for example H. 1:11:25, colour -transparency 21). This particular action results in little, asterisk-like, or star-burst forms. The observations suggest a tendency for the children to repeat these and other contrasting combinations and to create variations of them. This tendency is probably driven by the children's exploitation of the maximum differentiation or contrast of form afforded by these shapes which run as they do along the 2 opposing axial coordinates described by the basic arm movements.

Connectivity

From around 2 years of age, the children have started to make approximate perpendicular attachments between lines which will later be used to describe distinct forms which are connected to each other. (For example H. 2:0:26, colour-transparency 22).

It may be that it is the discovery of this relation within drawing which alerts the child to its presence in the rest of the environment. It is a formal and visual contrast to which the child will increasingly attend, both in the visible, ambient 3D array and also in 2D forms. For example, later on (between 3 and 4 years in Ben, Joel and Hannah) the

child will assimilate to his or her right-angular connective schemes, letter forms he or she perceives in the environment. (The relation of emergent writing to drawing is an important issue which has been mentioned in Part 1 of this study). Gibson's (1966) idea that the act of drawing itself initiates and guides a special type of form detection, has also been mentioned above in this context. He made the interesting suggestion that when humans started to draw, this triggered quite a new mode of perception of configuration which was freed from its usual ecological/functional constraints (Gibson 1966).

Before their second birthday then, the children have already learnt that the contrasting forms of action result in contrasting forms of shape. Ben, for example, at 1:9 is intentionally exploiting contrasting actions to create maximum formal contrast. Using existing marks or lines as targets for further marking, he frequently disects or near bisects these, using arcs or push pulls which run near to the perpendicular across them (B.1:9:16, colour-transparency 20).

Or else he clusters dots or blobs at the beginnings or ends of lines (again see colour-transparency 20); termini which also act as salient locales. Hannah at this level is also clustering marks at the beginnings and ends of lines, or else grouping these around acute angles formed by arcing or push-pulling movements (H. 2:0:0, H.2:1:1; colour-transparencies 23-24).

Colour-Use

Such emergent structures also appear in Joel's drawing and painting at about the same age (J. 2:3:20, colour-transparency 25). As well as using distinctly different actions or contrasting directional changes to create maximum visual effect or differentiation, the children also use changes of colour which serve to distinguish not only one <u>shape</u> from another, but also to demarcate one <u>action</u> from another. It is as though each action is colour-coded according to the rules of a spatiotemporal

game: one colour corresponds to one action (and sometimes to one sound as well, or to another action). Such permutations will be described later.

Ben, at 1:11 is already using a combination of such strategies, involving graded variations of actions within controlled sequences; colour-coding of action and mark, plus local, spatial orientation cues to guide drawing.

B.1:11:5 (colour-transparencies 26-27)

He has wax crayons and has found a piece of A4 size paper which has been folded (by an adult) into 4, and then unfolded, so that the creases still show, dividing the paper into 4 rectangles. He selects each rectangle as a demarcated area in itself, and whilst he does on occasion traverse the boundaries (creases) between sections, he restricts, in the main, his crayoning to each of the 4 rectangles.

Also, he marks each rectangle with a different formation or "character". He does this on both sides of the paper, developing the strategy more strongly by the time he gets to this second side.

On the first side, in the bottom right-hand section, he superimposes, with small and intense arcings of the crayon, black; over green; over orange; each layer bisecting the previous layer at a contrasting angle.

This seeking out of a formal differentiation is an emergent principle of 2D construction. Out of such sequences are constructed quite elaborate graphic-dynamic orchestrations.

There are other aspects to consider here. In using one's existing marks as targets for further mark-making, the child is also noticing the effects of superimposition. The child screens or covers one layer with another. Such an exploration can be the forerunner of a late projective dimension through the picture-plane.

These targetted markings result in superimpositions of different colours layered one upon another at selected locales (at the ends of lines, for example, in a felt-tip drawing by Hannah at 2:1:8). So, in covering, the infant is starting to effect and see colour changes taking place - he or she is learning to mix colours.

It is important to note that in observations of the type just mentioned, superimpositions of shape and colour are not simply the accidental result of the infant carelessly aiming his or her hand down toward the position of last impact - not bothering to alter alignment of hand to paper. On the contrary, it is quite clear that, if the child chooses, he or she is quite capable of aiming the marker with great accuracy at very small locales. This is true of the 3 children at around 8 months of age. As was mentioned earlier, even if the pencil goes on to skid around, the initial aim - even at small points - is very accurate. (Freeman 1980, has found this is true of older "scribblers").

Alternatively, an empty space can be selected as a target for mark-making. Joel, at 1:6:2 (colour-transparency 28) produces a lateral series of pull lines, nearly every one carefully separated a little from its neighbour by an intervening gap, as he marks each successive stroke a little further to his right. It is as though the child is giving each mark its own space or place. In addition to this, part of the same routine entails Joel separating each marking action by replacing and removing each pen cap between each stroke!

Again, in a small drawing book at this time he starts a new page for each mark. This sorting of marks is of significance not only for later configuration, but also in terms of early writing and mathematical logic. Such observations show again that early mark-making is far less haphazard than has been generally thought. The young child is very selective about the placing of marks and this careful targetting reflects his or her logic and spatial understanding of this time. The

child is building up a model of space which includes objects as unified, bound volumes, each of which occupies its own space and which cannot occupy the space of another object - unless it is inside that object. (See also Bower 1982 and Athey 1980).

Points in Space

Such spatial concerns underlie the child's use of the vertical arc to create dots or blobs. Sometimes the child will superimpose these marks; sometimes they are clustered in tight groups; at other times they are dispersed or scattered across a wide area. At still other times they are carefully restricted to a locale specified or delimited by previous mark-making (for example H.1:1:15, B.1:9:16, H.2:2:28, J.2:3:20, B.2:4:3; colour-transparencies 1, 20, 29, 25, 30).

Continuous Rotation

By 1:11, push-pulls and arcs are becoming far more controlled and can be opened-up as it were, by inflexions of the wrist, elbow and shoulder (H. 1:11:25, colour-transparency 21) to become continuous rotations (for example, B. 2:2:0, B. 2:4:0, H. 2:6:10, H 2:7:0; colour-transparencies 31, 32, 33, 34). (See also Matthews 1983, 1984, 1988).

There are probably many factors one should cite as influencing the child's tendency to open up these push pull and arcs so that they become more expansive. I would like to mention two of these. One is that the child has discovered the capacity of this axis for the sustaining of movement. The child (as will be described more fully in the next part) is exploring certain deep structures across a range of situations. One of these is the continuous rotation which, along with other other forms of dynamic action, is performed through 4D spacetime. He or she learns that movement can be prolonged if an elliptical course is mastered. This is not usually the case - in many environments - with straight line

courses (though there are some exceptions to this - for example, running along a beach). Continuous rotation allows for acceleration and decceleration; for changes of tempo; changes of intensity and amplitude, and - equally important - the duplication of sensation. It is these potentialities of the rotational, dynamic structure that are behind Nancy Smith's (1972, p. 70) term "circular repetition".

A second factor behind the emergence of the rotational movement is the child's desire to "cover" an area. Now, with a heavily loaded brush, this is actually facilitated by the width of the brush itself, and by the nature of the pigment. In this case the rotational (and other) movements in themselves are sufficient to cause surfaces to be physically covered with pigment.

What is even more interesting, from the point of view of the child's conceptual level, is how - lacking paint, and armed only with a pencil or a felt-tip pen - the intention still seems to be to cover an area - but of necessity in a notional way only.

If this reasoning is correct, then children before 2 years of age are developing a sophisticated and abstract drawing convention - a "sketching" technique really - in which a linear boundary "stands for" as it were, an area that paint would have actually, physically infilled. (See for example B. 2:2:0, colour-transparency 31).

In a sense, it could be argued that already <u>line</u> demarcates a <u>region</u>.

Crediting the very young infant with such a conceptual achievement is not far-fetched, and further examples will be later supplied in which discoveries made at sensorimotor level about the behaviour of pigment are shifted to higher cognitive levels.

<u>Closed Shape</u>

It may be that it is from such rotational movements that the

discovery is made by the child of the closed shape - a structure which plays an extremely important role in drawing development. Amongst its powerful propensities is that of encoding inside-outside relations. (H. 2:1:2, B. 2:1:0, J. 2:5:7; colour-transparencies 35, 36, 37).

How far it can be claimed that the child's discovery and use of the closed shape is dependent on a forerunning experience of rotational marking, or other rotational experiences, is controversial (Golomb 1988, personal communication).

Certainly, the emergence of the closed shape signals an important shift, not only in motor control but also in conceptual development. Important cross-cultural research (Court 1989) has produced powerful evidence that the structures at present being described are represented in the Central Nervous System. Elsbeth Court's work will be discussed later on, as will the questions which arise about the role of experience in development.

Along with other important structural and conceptual achievements, the closed shape will be more fully discussed in the next part of this work.

Separation-Classification

If the development of a concept of connectivity leads the child to combine forms, then the converse of this relation - separation - is also of cognitive and emotional significance to the infant. A thread of development entwined then with the processes already described is one in which the child separates out and isolates individual elements. So it is that the child separates out from the continuous-contact lines components which he or she then begins to sort into groups - to classify.

Longitudinal Parallel

For example, pull lines are differentiated and separated from push

lines. It is possible to see the start of this before the child is even 18 months of age. Hannah at 1:4:17 for example, (colour-transparency 38) pulls lines over the nearer edge of a piece of paper, making a roughly parallel series.

By 2 years of age these are being arranged in notionally parallel, longitudinal series, and colour-coded according to various systems. They become the forerunners of a vertical axis and they acquire a wide range of denotational values. (H. 2:2:28, H. 2:6:10, J. 2:9:9; colour-transparencies 29, 39, 40).

At around 2, a line is used by the children to link or connect two spatially distinct and separate patches.

At 2:0:19, Hannah is in sufficient control of a continuously rotating line, that she is able to embrace or enclose dots or other marks at will.

These achievements signal new moves made in spatial awareness. Developing ideas and feelings about location, connectivity, distal and proximal relations, continuity and discreetness - relations which, as we will see, form the substrate of play - guide early drawing.

As has been noted earlier, as a corollary form, the child also learns how to separate out individual components. At around 2 years of age in the 3 children studied, a range of different marks and shapes can already be executed skilfully, either combined together or individually, at will. Lines and marks are generally grouped according to class (the example of colour-coded longitudinal lines has already been mentioned).

Such behaviours embody the beginnings of mathematical logic.

With increasing differentiation and motor control, variations are made of the basic mark-making repertoire.

Early Synthesis

From 1:11:0 to 2:2:0 for example, translation of a push pull action

makes possible the creation of the travelling loop and the travelling zig-zag or wave (H. 1:11:29, H. 2:1:17, B. 2:2:12, B. 2:2:14; colour-transparencies 41-44).

To produce these, the child has learnt to move his or her hand and arm along laterally whilst making (for the former) a push pull which crosses back over itself between pull and push; and (for the latter) a push pull that is not allowed to cross itself between push and pull. Prior to this, "e" shapes of various kinds, waves and little spirals have been discovered. The difference now is that their production is sufficiently represented in action programmes so that continuous, rhythmical repetitions can be formed.

In Hannah at 2:1, the rotation is quite accomplished; she can inhibit or curtail the movement to create near single-line enclosures - often encircling the other marks; or else she can choose to spiral inwards or outwards according to whim.

Joel and Ben were able to produce similar graphic structures at around the same age.

Conclusion to Part 4

The creation of these structures can be described as being deeply rooted in human relations. The infant's detection and production of these forms may well be pre-figured in the neonate's earliest detection of structure, a search which involves the close attention to his/her mother's face. Whilst current research in this area remains at present controversial, it seems possible that the major formal structural features upon which the infant is later to build expressive modes are to be located in the earliest visuomotor engagements with another person. The infant attends to dynamic trajectories, in the form of meaningful movements, as well as to highly salient configurations which may be detected in a programme of search of the mother's face. These include a

range of variation in intensity of luminence, abrupt texture gradients, high degrees of reflectance and contrast between shapes; contrasting angles or vertices of edges and boundaries. It is inadequate to describe the acquisition of structural elements in terms of perceptual motor skills development alone or even in terms of cognitive development alone. All the forms which we see employed by the child are suffused with emotional significance from the outset, precisely because they make up progammes of action which are orchestrated by states of mind.

As this writer has described elsewhere, the shapes that children create from 6 months onward are the natural outcome of body dynamism. "Drawing occupies a special place here because of the particularly intense order of visual and kinaesthetic information it offers up. Normally invisible trajectories of the body and limbs become visible; records are left of their passage; the ephemeral, transient abstracts of spatio-temporal events" (Matthews 1988, p. 169).

From about 1 year onward, all 3 childen are using the markers with the intention of making marks. Regarding current discussions of whether we are justified in crediting the child with intentionality, it has been important to show that there are many levels of intentionality. At Level 1, no marking is possible; at Level 2 the child simply uses the marker to make a mark. At Level 3 - which follows quickly - the child is already anticipating the events which follow when the marker is moved in a particular fashion or direction (Smith 1983 and personal communication).

By 2:6, Ben, Joel and Hannah are well on the way to producing at will, and in a controlled manner, a variety of lines and shapes including continuous rotation; grouped lines; travelling loops, zig-zags or waves; clustered or seriated dots or points; and syntheses of these, including right-angular connections of various kinds (For

example, J. 2:3:20, B. 2:4:3, H. 2:6:11, H. 2:6:18; colour-transparencies 25, 30, 45, 46.)

At about this time, the child may well be able to produce two other very important graphic structures: the closed shape, and the core and radial (Athey 1980). (See H. 2:6:10, colour-transparency 47.)

It should be clear by now how and why this study differs from accounts in which drawing development is conceived of as an emotionally neutral acquisition of a formal vocabulary of graphemes which are only later to be used for expressive and representational purposes. In the present work, in synchrony with the child's discovery and construction of shape is the generation of powerful expressive possibilities. Drawing production soon becomes part of spatio-temporal games in which sound, gesture and image enjoy one-to-one correspondences - are mapped over each other. A congruence, or equivalence - to use Arnheim's (1954, 1974) term, is found between events occuring in different sensory modalities. More will be written about this process in the next part.

The present research shows that at every level of development, children are attributing to and investing meaning in, marks, shapes and colours. This again is quite different from accounts which describe drawing acquisition as a hierarchically tiered series of steps starting from meaningless actions and only gradually conforming - by imitaton - to the pre-established end-point of a culture-conventional system.

Rather that viewing development as a stage-hierarchy, it is suggested that an entire family of interrrelated modes are arrayed and available in early infancy. At different times in infancy, certain modes tend to dominate. It is easy to see how - if one adopts a stage-hierarchical model which sectionalises a continuum - such a situaton could be misinterpreted; the onset of a particular graphic schema mis-perceived as occuring for the first time at a particular date. For this insight I owe something to Dennie Wolf (1983 personal communication).

What actually causes the shifts in the child's thinking - what causes the child to give certain forms symbolic salience - has been touched on above, but requires further discussion in following parts of the present work. As Claire Golomb has pointed out (1988 personal communication) a blow-by-blow micro-analysis will not in itself reveal these changes in thinking. However, the present writer's research has shown again and again that neither can one afford to ignore the revealing details of such longitudinal studies. It is such studies, after all, that have alerted us to inconsistencies and contradictions in other and traditional theories. In particular, it is the microanalytical approach of the present writer that has revealed the existence of this family of symbolic modes.

This author's view of drawing development is compatable with the findings of recent research on language acquisition. Early speech has a structure and syntax long before the first true words are uttered (de Villiers and de Villiers 1979, Garvey 1984). Those first phonemes and morphemes are immediately employed within a 4 Dimensional language involving actions of the body.

It seems certain to this writer that the equivalent is true of the onset and development of 2D graphic symbolisation. Humans do not wait around until they have acquired a culture-conventional symbol system before they express their thoughts and feelings. Within them is a programme designed to cause exterosensors to actively seek out those forms of stimuli which will allow inner propensities to be revealed and fulfilled (Young 1978, Trevarthen 1984).

Bickerton (1981) has written that language acquisition is not totally reliant on having available within the interpersonal environment an adequate language model. Even Trevarthen (1988) has said that the internal programme for representation can at least be initiated even lacking the availability of social interaction with a caregiver.

However, Trevarthen makes it clear that this is a capacity for temporary autonomy in adverse conditions (Trevarthen 1988). Research from diverse fields shows conclusively that development is quickly stunted without support, and in fact interaction with another is one of the very stimuli which we - as neonates - are programmed to seek out. Bickerton's evidence that language development occurs even in an interpersonal environment lacking a mother-tongue, is not only a superb confirmation of the existence of such programmes of symbolisation, but is also a testament to the power of interpersonal relations with the caregiver that such relationships are able to generate development. Evidently such relations between caregiver and infant have semantic structure at a level deeper than words. The kind and quality of such interaction is a principle aspect of the present work. Little data is available at present concerning how general - or rare - is support from adult care-givers for early drawing efforts. (It may be that we will be surprised to find that many children's early drawing activities are encouraged by their parents. This would seem to be a valuable area for further research). Certainly it is true that only a few children have access to artists' studios. Nevertheless, the principles operating within these 3 children's activities have, at a deep level of description, a universality. This writer would predict that most childen can follow similar courses. One is looking at a naturally unfolding development, which though curtailed in many children is nevertheless a potential path of development for all (Matthews 1988). This writer's additional longitudinal studies of 40 nursery children support this claim as do studies of other researchers. The work by Bickerton cited above and in Part 1 is compelling evidence for the existence of deep bioprogrammes which are not culturally acquired and which allow humans to create - whilst they are still babies - new languages. This and other writer's studies on drawing show that infants are generating forms

which are not imitated from cultural models and, moreover, that children persist in producing these forms despite pressures upon them, from some adults, to desist.

Important cross-cultural work has also convinced this writer of the generality of certain structural and representational principles. In isolated homesteads in Kenya, infants of 2 - 4 years, who had never drawn before, when presented with crayons and paper produced energetic horizontal and vertical arcs, push pulls. Others produced elegant continuous rotations, closed shapes, targetted markings and seriated and clustered points (colour-transparencies 48-49). An 18 year old woman, who had never drawn before, produced closed shapes plus nuclei, core and radial, notionally parallel, notional vertical paired lines, grids and u-shapes on baselines - the 2D schematic repertoire of a London nursery child (Court 1989). (See colour transparencies 50-51.)

This is all compelling evidence for the idea that these structures are represented in the Central Nervous System.

Of course, much of the above is extremely controversial. This study can and will elaborate further, in the conclusion of this work, the interrelationship between nature and nurture. It is hoped by then that the deep and essentially a'cultural character of expressive and representional modes will be explicated. For clearly, there would seem to be some vast implications for childcare and education, together with some alarming realisations about the abuse which children (and adults) suffer in the names of religion, politics and so-called education "reforms".

The present work, from its outset, has mentioned some of the innappropriate paradigms (adopted consciously or unconsiously by researchers) which have tended to obscure from us the principles operating in early mark-making and drawing, and have masked the child's real intentions. Many problems have arisen in drawing research by

persistently considering drawing as an apprenticeship toward some future goal, rather that attending to the uses to which children put drawing at each and every level of development, no matter how humble their techniques might appear to be. The notion that drawing is necessarily a "problem solving" exercise with a fixed set of attendant "task-demands" and requiring a rather tight-reined motor-control, has to be challenged. The question has to be asked whether the child always intends control, and if the answer is yes, then in what sense?

The young infant's painting and drawing is certainly an excellent illustration of a stunning process; that of the development of articulated movement and tool-use (Connolly 1975, 1987; Trevarthen 1984). Via subcortical structures which initiate chains of action, incoming proprioceptive, kinaesthetic and visual information about events at the interface between drawing hand and pigment-receiving plane finally reach graphic-motor structures in the child's brain. Here, responses are organised and guided by vision to enable appropriate actions to be executed. One can see a fine-tuning being developed to sensory feedback about impending events along the drawing surface. Unfolding visual and kinaesthetic data constitutes a dynamic, ever-changing reference-frame against which new trajectories of marker are rapidly plotted and executed.

This reference frame provides the child with information about areas of resistance and clear passages; sometimes about protuberences and indentations, smudges, blots, blotches, skid-marks; hazards to be avoided by the oncoming brush or, conversely, which act as targets into which the brush is to be slashed or impacted. These features act as cues for initiating changes in the action programmes and for guiding anticipatory actions.

Such emergent features form the terrain of a 2D micro environment which, as we will later see, becomes an analogue space for the macro-

environment. It is a mini-world of events and objects; a world whose creation is moreover, initiated and sustained by the child him or herself. The child has no extrinsic goal in doing this, but drives the generation and regeneration of this 2D world by responding to events in the greater interpersonal environment, and to those micro-events occuring in the painting or drawing itself. So it is that one set of events can form equivalences for others. The features of the 2D landscape become loci around which are developed the child's thoughts and feelings about the configuration of objects and the configuration of events.

This surely spotlights the unique position occupied by painting and drawing. Only in painting and drawing is it possible to experience such fluid and intense interchange between unfolding internal programmes and extracorporeal events.

The models that the child is constructing should not be thought of as static structures. "Understanding" involves action. The process is essentially and technically creative. It is ongoing. It is made in relation to others. Within the construction of such models, the child is generating ideas about ways of living.

Whilst pointing out the complexity of the variations in interaction between infant and graphic media, this part of the study has also pointed out some of the underlying structures, dynamic and configurative, which remain in essence identical throughout their occurence across a range of very different contexts. These are the deep structures or invariants (Gibson 1979) referred to earlier.

This writer's observations points to the clear role that drawing plays for the young child in the detection of invariant or deep structure.

The 2D forms described above are one manifestation of such structures the child discovers elsewhere in the environment.

These invariant relations form some of the substructure of symbolic play and graphic representation. It is to the discovery and manifestation of these invariant relations that we now turn.

Expression, Representation and Drawing in Early Childhood

Part 5

Deep Structure

Sometimes very young children are thought to be wandering rather aimlessly and endlessly from one activity to another. However, on closer inspection it often emerges that they are in fact engaged in an active investigation of structures which at certain points in their development they find extremely salient. The children's detection of these structures persists despite certain transformations these may undergo due to changes of context or media.

The kinds of structure which interest the child change with age. As was described in Part 4, this is because the child is moving through phases of sensitivity to certain kinds of information. These changes are partly due to shifts in the configuration of existing neural mechanisms. Earlier programmes are put to new use or combined with others to form new programmes. Also, changes occuring in the architecture of the CNS make possible the creation and use of new programmes.

So powerful is the child's attention to these deep stuctures that his/her perception and use of these persists, despite differences in the media in which they occur.

The intention in this part is to illuminate how the child systematically seeks out, within different events and objects, those relations and structures which remain invariant despite changes in context; or changes in position, or certain transformations in state.

These invariant or deep structures include static verticals and horizontals; ascending and descending verticals; dynamic horizontal vectors; locomotor rotational movements; (along horizontal or vertical axes) and curving or arcing flights (through horizontal or vertical

axes).

Deep structures of this type delineate spatiotemporal vectors.

Other deep structures demarcate position and location. These are: points in space, and include clustered or scattered points; seriated points and vectorial termini (or beginnings and ends of lines or vectors).

The closed shape can also be considered a deep structure of a special class which can denote or convey a range of spatial or dynamic specifications, including position and location, volume or aspect, and inside/outside relations.

Hundreds of observations testify that children discern and represent these structures in various forms including drawing.

Straight line courses are experienced with the whole body and through any environment having sufficient space to allow unimpeded movement. These are also produced in drawing. Ascending and descending verticals are practised in play, for example; with the whole body jumping up and down, or from place to place, sometimes with synchronised, onomatopoeic vocals underscoring moment-of-impact. The equivalent form recurs in drawing and painting in arcing, inverted u shapes, and again this is frequently amplified by a one-to-one correspondence between drawing - action and speech, or with action from another exterosensory system. Alternatively, dynamic verticals can be experienced with separate dropped and thrown objects.

Static horizontals and verticals can be experienced in a number of ways, amongst the most powerful being lying down and standing up. The apparent simplicity of these actions (and I use the term "action" carefully) is deceptive, as will be seen when child's representation of a vertical axis is described.

Rotational movements are also performed, sometimes through vertical

axes, but especially along horizontal planes. As with curving or arcing flights, these can be practised either with the whole body or with body parts, or with wheeled or hand-held object or toy. Again, continous rotation occurs within the mini-world of drawing.

Changes of position are investigated by the children using their whole bodies in space; termini of trajectories are dynamically demarcated by the use of jumping, stamping, beating, counting.

The clustering of points in space is demonstrated in various ways; jumping on or around the same spot; or with the use of demarcating toys or materials. The scattering of points is practised by variation of above.

The demarcation of seriated points involves the child in stepping or hopping games perhaps along a straight line course, or with the grouping of objects along a various types of courses or paths. Vectorial termini is a special case of the position demarcation; here, the child punctuates beginnings and/or ends of a linear trajectory through space/time, perhaps with an emphatic jump, sometimes synchronised with a vocalisation.

Another way vectorial termini are described is with the use of little collections or heaps of toys or objects at the beginnings and/or ends of linear trajectories paced out by the child from A to B. Before one and a half years Hannah would wander through the house depositing orange peelings, or shoes, or toys at the beginnings and ends of linear journeys she made from one fairly clearly defined or landmarked locale to another (for example see observation of Hannah 1:5:8 in Matthews 1983).

All the kinds of bangings, stampings, beatings, countings etc. mentioned above, find their equivalent in the dottings and stabbings that occur in drawing and painting.

Likewise, all kinds of arcing, waving, swaying, rocking movements

are echoed and re-echoed between 4D body actions, and the 2D space of drawing.

Closed shapes in all their various manifestation are noted by the child at a particular time in their development, including those whose boundary is 2 dimensional; to those whose boundary is not significantly extended into the third dimension (for example, hoops); to those whose boundaries enclose volume and afford actual physical containment.

In a multi-channelled process, drawing plays a special role in alerting the child to the presence of these structures in the environment. It is from such invariants that the child is able to construct a coherent description of reality from disparate phenomena. It is because of this programme of search and production of deep structure that the child is able to form, out of the bewildering variation of their manifestation, concepts.

Such is the robustness of this progamme that it operates across differences in manifestation which can range from the subtle (the correspondence across contexts being virtually isomorphic) to the very dramatic (the addition or subtraction of a spatial dimension or of the temporal dimension; or change of speed of the temporal flow. The same deep structures are perceived within rigid physical form and within fluid, dynamic events. More dramatic still, is the child's perception of these throughout the change from one sensory modality to another. An example of this tranference has been cited above and includes the synchrony between onomatopoeic vocalisations and the various jumpings, beatings and hoppings; or the squealings, screechings, or melodic wails, moans and monotonous songs which accompany other continuous movements of body or body part.

The synchronised association of events or actions occuring in distinct sensory domains is of especial significance in the present work, and a return will be made to this later. Suffice it to stress at

this point that what is under discussion here is not unrelated phenomena. On the contrary this writer's evidence, which will be offered in this and the concluding parts of this work, shows clearly that the child is forming equivalences in structure. He or she perceives that the essential form of one sensorimotor action echoes or analogues the form of a quite different action. The child has made a discovery that will have vast implications for the development of symbolic systems, that of the potential of association of equivalent expressive forms across the range of communication systems. In most cases, the exploration of structures entails their parallel symbolic use. The symbolic scenarios which surround these structures, dynamic or static; configurative or physical, are developed as the child matures and undergo some transformation. Nevertheless, at their centre, one can discern the same deep structures. So, not only do these structures persist in the child's activities during a particular period, they are also retained and transported to higher cognitive levels as the child grows. As the present author has written elsewhere (Matthews 1988) "This process works in many ways. The same structures or 'invariants'...are found in different settings or media. Structures spatial, volumetric, temporal, once specified in the act of drawing, are noted within the environment, and vice versa. Not only is the same structure investigated through a range of forms at a particular time in the child's life, this investigation is also repeatedly shifted to new levels as the child grows older" (Matthews 1988, p. 168).

It is now proposed to tease out from the longitudinal data one strand of the child's investigation into the complex of deep structures. The following is from my 1983 paper:

Rotations

"Whilst roughly straight line course are both presented and represented ...an interweaving development, that of rotational courses involving the whole body in 3D space, is emerging:

> H.1:1:8
>
> Hannah manages to rotate on one spot, sometimes pivoting on one leg. She smiles with pleasure and delight to me.
>
> H.1:1:10
>
> She runs naked in a circle around the room, waving at the same time her plastic pants in an anticlockwise rotation of her right hand.
>
> H.1:1:15
>
> Rotates again on the spot, frequently on one leg. Laughs.

Eventually, the same kind of rotation is used symbolically to represent the movements of another object:

> H.1:1:23
>
> Outside the house with me at night, Hannah sees a car go by, lights blazing. She looks at it, following it around with her head and body. She then rotates on the spot, holding out her arm and her pointing index finger so that it describes a semi-circle, with her hips as the axis. As she does this she makes a "prrrrrrrrr" sound with her mouth, in clear imitation of the car's sound.

She is symbolising with sound and movement of her own, the movement and sound of the car. Very possibly, the moving finger itself represents the moving car. Athey (1980 personal communication) has also noted the use of the index finger in tracing dynamic representations in space.

The synchronisation of sound to smaller rotations made by arm and

hand occur later, sometimes with a held object:

> H.1:7:20
>
> Hannah at breakfast makes for the first time a continuous clockwise rotational movement with a held object, a piece of bread, against the surface of her baby chair tray. To each rotational sweep she synchronises a vocalised sound; 'eee-eee-eee'. "

(From Matthews 1983).

There are several significant features here. The fact that Hannah constrains her actions so as to create smaller rotations, is in itself important. She is in the process of constructing an "analogue" space (Wolf 1983, personal communication). The constraining of her rotational arm movement is indicative of a move she is making toward symbolic use of actions. This recalls the progress deaf children make towards minimalising or, if you will, "notionalising" natural and instrumental actions of the body so that they become signs (Petitto 1987). In this particular example, Hannah is guided by external constraints to which she has to accommodate: the area of her baby chair tray whose limits are demarcated by raised edges.

She is also extending this rotational scheme by the use of a tool.

She also synchronises the movements she makes with vocalisation.

The above observation is of one of the forerunning experiences to the beginnings of dynamic graphic repesentation exemplified in my original observation of Ben at 2:1, when, with a paintbrush, he described the course of a car. It is at this moment in development when such actions begin to be shifted to new levels of dynamic representation, as the child brings these understandings to media of various kinds. With regard to early drawing, this is usually referred to by the misnomer, "scribbling".

There now follows some extracts from videotape transcripts. These

were derived from videorecordings made of Hannah's developing expressive and representational use of the continuous rotation:

> H.1:9:8 (videorecording)
>
> In a large room Hannah rotates, clockwise, on the spot, whilst holding up in both hands a tape measure from forehead height and allowing a major part of its length to trail beneath her to the floor. The tape almost fans out by centrifugal force, or angular momentum, as she spins.
>
> As she spins, she synchronises a rising and falling "oooo-oooo-oooo-oooo" vocalisation.
> She rotates 7 times and stops, swaying slightly, almost stumbling with dizziness.

Ben, Joel and I, who are watching (it is Joel, 9:1:25, who is videorecording) imitate her vocalisation, and request an encore. "Go on Hannah - go round."

She rotates again, anticlockwise this time, flailing out tape measure, excitedly synchronising vocals, completing only one and a half circuits before allowing herself to stumble to the floor onto her stomach - actually in a parody of her earlier dizzy stumbling.

She is re-enacting - representing - the experience she had of a moment before. It is an interesting question as to whether she is representing, in addition to a physical action, a state of mind (for a good discussion of the representation of internal psycholgical states in symbolic play see Wolf, Rygh and Altshuler 1984).

The falling down at the end of rotation is significant for another reason also. She is combining rotational axis and abrupt descent to form a new expressive programme. The sudden collapse to the floor serves as a full-stop to the sequence, clearly demarcating its end. The child is developing expressive routines which have syntactical, punctuated infrastructure including well - formed entrance and exit points.

Shortly we will see how this is carried over into drawing.

The sudden descent is also part of the child's investigation of another deep-structure, that of the descending vertical. We will return to this in just a moment. In the meantime, Hannah is sitting on the floor and waving the tape measure from one of its ends, almost succeeding in passing a wave motion through it.

Travelling waves form a part of mark-making in a few weeks time.

Then she coils the tape measure, looking carefully at this.

It is important to note that here, she has broken out of play and is accommodating to the affordances of the tape measure. This alternation between ludic and non-ludic modes is fundamental to the child's development and we will see it over and over again.

Having detected a further structural possibility, that it can be coiled and uncoiled, she then returns to the play mode:

She stands and, holding on to one end of the tape-measure, allows it to uncoil to the floor, whilst at the same time synchronising a vocalisation which descends through a musical scale.

The decending (and ascending) vertical are discerned and synthesised cross-modally. Equivalent rising and falling dynamic structure is discerned across distinctly different sensory domains. This is an important achievement in the detection of deep structure and we will see it developed over the weeks in the observations made.

In 4 months time, Hannah will begin to encode in 2 Dimensions, this vertical axis.

It is important to point out at that this writer's evidence suggests that the success and popularity of certain cultural forms is due to the existence and creation of progammes from deep within the child's CNS. This is a very important point and one suggestive of a relationship between development and culture-conventional forms which is the very opposite of that habitually conceived - or perhaps ill-conceived - by many people. There are vast implications here for the

childcare and educational provision but a discussion of these must await the end of this work.

The mapping into 2D of the rotational axis follows on fairly quickly from its production in 4D. At just over 2 years of age, from experiences of rotation which pass through many changes, Hannah is abstracting a concept which does not change, that of roundness:

> H.2:0:3 (videorecording)
>
> At a table, Hannah draws, with a felt-tip pen, an anticlockwise rotation. At the conclusion of this dynamic series of overlapping ellipses, she lifts up the pen and says:
>
> "Round!"

She quickly assimilates all manner of encapsulated volumes and faces of objects to this closed shape.

> H.2:2:28 (videorecording)
>
> She makes a closed shape on the paper with a felt-tip pen. She looks down at it suddenly, and points to it, saying excitedly:
>
> "There's Daddy's watch!"
>
> She then superimposes over this closed shape, push pull markings.
>
> Then, she draws a closed shape on her hand.

There were similar episodes at this time, involving the drawing of "watches" on paper, and then onto her hand or wrist. One interpretation would be that she is in the process of lessening the gap between signifier and signified. This explanation tends to see the process as being one from embedded thinking to more abstract symbol use. The difficulty with this interpretation is that it tends to create a layered hierarchy, valuing abstractness over concrete. Whilst there is a general

move in this direction, this writer considers that on its own, such an interpretation does not do justice to Hannah's understanding and behaviour. Hannah is being essentially inventive within a medium whose parameters she decides herself. She is not constrained by adult conceptions of the use of drawing media. Here, Hannah has, in play, learnt sufficient combinations of action programmes which allow her to develop a new play scenario incorporating not only a complex of motor skills and speech but also the creation of shape. "This is Daddy's watch" is followed immediately by the realisation that the watch can be transferred from the paper to the wrist (hand) and that and she has sufficient mastery and understanding of the media to be able to achieve this to transfer without disrupting the chain of thought.

In an observation made of Hannah during the same day she also made a further, larger closed shape. This started with an emphatic, targetted push pull which demarcated the beginning of a line which soared away from her to return and terminate at this patch, affording the closure.

Closed Shape

This form is a profound discovery for the child. Its symbolic potentialies are far-reaching. With Ben, Joel and Hannah, it emerges at 2 years, but its onset in other children can be at about 3 years of age. This was true of some of the nursery childen I studied for this work (see videotape). From near the onset of its production it is used to specify a spatial relation which children find extremely powerful. This is the inside-outside relationship. Piaget has described this as part of the child's conception of space which at this level he characterised as being topological in class (Piaget 1956).

Light (1985 personal communication) has said that whilst projective relations might dramatically change, either because of observer movement, or movement of the objects observed (for example, this is true of

in front of/behind relations) the inside-outside relation remains stable despite any movements. Object "A" remains inside object "B" no matter what movements the child makes around "B" - a container of some kind - and this relation continues to persist throughout certain movements of "B" - until emptying strategies are employed.

The acquisition of knowledge about how one gets objects into and out of vessels of various types forms a strand of development which is very important to the present work. (For a very good description of this development see Bower 1982). The represention of this and other relations forms part of the scripts and substructure of drawing from about 2 years onward. This development is not to be considered in cognitive terms alone, for the child's discovery and use of these relations has a deeply symbolic and emotional aspect.

However, it should not be thought that the child is at this time somehow locked into a wholly topological understanding of space. (Nor, for that matter is the child at other times trapped within other systems of spatial understanding). The present research has revealed that the child has a range of spatial strategies and understandings, which interpenetrate. This author has, for example, seen infants encoding projective relations before their 3rd birthday. As has been indicated earlier, it is the symbolic potentialities of certain forms at certain ages, which accounts for their dominant roles at these times.

Inside Outside

From about 2 years then, Ben, Joel and Hannah do attach great significance to inside and outside relations. From their earliest weeks of life the infants formed a representation of an object which constituted a bound, unitary form which could not occupy the position of another object. From about 6 months they begin to form the profound realisation that an object can in fact occupy the volume of another

object - if it is inside that object (Bower 1982). By about 1 year of age we see the infants exploiting this potential for the containment of objects one inside another across all manner of situations - and frequently the most unlikely and inconvenient contexts; the infant drops his/her father's watch into the lavatory bowl; mother's shoe or bag is filled with orange peelings or apple cores. Exasperating as this kind of behaviour can be to parents, it is really the child's investigation of the deep-structure of inside-outside relations. The child is acquiring the knowledge that this relation persists despite certain changes in context.

It is the child's interest in this relationship which is behind the success of certain "posting" type toys. Again one can see that there are important implications here for childcare and education.

At 13 months we see Joel applying his knowledge of this relationship to brushes and pots of paint. In one filmed observation Joel tried repeatedly to put a 12.5 cm brush into a 8.5 cm pot. The inside outside relation is here undergoing a size modification (colour-transparency 52).

In the same episode, we see Joel building up understandings of fullness and emptiness too, in his investigation of contained or poured liquid pigment (colour-transparencies 53, 54, 55 and Matthews 1986).

Given then the deep developmental history of this relationship, it is not surprising that later we see it being represented in various forms. From about 2:5 Joel seems to have extrapolated the closed shape from the continuous rotation. From this time we begin to see him carefully placing nuclei inside these closed shapes.

The knowledge that he acquired about 17 months before in the placing of 3 dimensional solids (and also liquids) inside 3 dimensional containers is now in the process of translation in 2D.

Sometimes he further differentiates these nuclei by making them in

a colour distinct from the one used to produce the closed shape (colour-transparency 37).

At 2:5:20 he is sorting out different kinds of marks and grouping them according to class in different locations within a closed shape; pull lines on one side of the closure, rotational marks on another (colour-transparency 56). This is an example of early mathematical logic - the infant is developing set theory. At this time Joel also sorted into groups according to kind, his toy figures and cars. Such behaviours were observed in Ben and especially in Hannah.

The closed shape plus nucleus soon acquires very powerful symbolic potential indeed. For example, at 2:5:22 Joel makes a closed shape into which he marks a little squiggled nucleus, saying as he does so:

"There's a baby in 'ere...there's a baby in the water." (Colour-transparency 57).

It is interesting to wonder then about the denotational values he is ascribing to the lines. It would seem reasonable to state that the enclosing line is now beginning to represent, even if only at a notional level, an edge or boundary. (See Matthews 1984, 1988).

These two terms are not synonimous, and interestingly enough, the infant's use of the closed shape shows this. The evidence of this writer suggests that the infant can use the closed shape to represent the whole volume of an object, in which case the denotational value of the line is suggestive of boundary, or else the closed shape is used to represent the face of an object, in which case the line denotational value is suggestive of edge,(See also Willats 1985, 1989, 1989a).

The possible mechanisms which drive this development will be described later. Suffice it to say at this point that such discoveries made by the infant of the representational affordances of line are of profound consequence. The child is attributing transformational and denotational meanings to marks which were, only a short time before, the

tracings of sensorimotor actions. Without copying this from other drawings, the infant is in the process of constructing, in a manner which parallels language acquisition, a graphic symbol system.

Core and Radial

Eventually the child achieves a synthesis of two distinct graphic schemas. This usually involves a right-angular attachment; a connective principle to which the child's attention is turning in the environment (Matthews 1988). The germinal beginnings of the principles of association, connectivity and synthesis were heralded in the graphic explorations made before the children's 2nd birthday and described in Part 4. These discoveries are now being re-worked at higher levels of meta-cognition. One early synthesis is the core and radial (Athey 1980) the discovery of which greatly interests the infant.

What follows is part of a transcript of a videorecording. In order that a complicated story be made marginally simpler, observation and evaluation have been somewhat blended together:

> H.2:6:10 (video-recording; colour-transparency 33)
>
> Hannah is drawing with a green felt tip pens on an A4 pad whilst standing at a low table. She makes an energetic clockwise rotation which she immediately says is "a hat". She resumes rotational drawing whilst synchronising a vocalisation - "oooooooooo" - along an ascending musical scale. She follows this by making a series of impacts with little vertical stabs of the pen, accompanying the production of these dots with a one-to-one correspondence of the vocalisation, "dit-dit-dit-dit", and creating a course of dots anticlockwise around the perimeter of the rotational shape. Maintaining this direction of movement she changes the dotting line to a continuous contact line which she terminates at the base of the rotation (the section nearest her midline). Apparently unconsciously, as she turns

> toward me she pulls the pen towards her body forming a line which moves out from the perimeter line at an approximate right angle. Then she makes another line of dots but reverses the direction to a clockwise course.
>
> Then, whilst intently looking over the appearing image directly below her down-turned face, she makes a further rotational course over the central portion of the rotation thus far achieved.
>
> She appears to thoughtfully look down at this.
>
> "Made a hat!" She exclaims.

Around this time Hannah is assimilating a variety of content in the form of faces of objects or volumes to the rotational mark, including hats, watches and living bodies of various kinds.

> She then makes 2 dots in quick succession.
>
> "Two eyes!" She exclaims, and then counts - "Two - three..." whilst making a one-to-one correspondence between these words and two sharp, quick, pointing motions of the handheld pen in the air above each dot.
>
> Then, half turning to me, but continuing to attend to the drawing beneath her face, she says to me:
>
> "I made eyes - I made his body. I - I made his hat round and round."
>
> She reinforces her description "round and round" by mapping a rotating finger mimetically 15cms directly over the rotational mark.

This can be interpreted in several ways. The following explanation is offered: She can describe, in slightly different terms, a drawn shape executed only a moment before. The rotating finger mimes the rotational course directly over the the green rotation, i.e.; her miming finger maps onto the drawing isomorphically. It seems therefore

that she has, over repeated, rotational drawing experiences, built up both the sufficient mastery of actions required, and also the powers of interiorisation which enables her to reflect upon what she has done. She can consolidate the representational accomplishment by separating out one component action which she uses as a tool to isolate, consider and describe back to herself (and to me) the salient aspect of the representation. She is therefore somewhere along a route which has at one end, complete fusion of signifier and signified and, at the other end, their separation. On the other hand, she has not completed this disembedding. For instance, it is doubtful if she would mime the graphic rotation temporally or spatially distant from it. It is also interesting to ask whether she would at this time be able to mime the rotation in any other orientation other than the horizontally aligned isomorphic relation she adopts. There are many other aspects which one could consider which derive from these few seconds of videotape. However, there is not the space here to do so, and a return must be made to the observation:

> (videorecording)
>
> She then makes a series dots which run in an anticlockwise direction around the perimeter of the rotational shape.
>
> Some of the vertical arcs she employs to make this last series of dots are more like slashes of the pen which result in little lines ranging in length from 1 cm to 2 cms which disect the perimeter line of the closed shape now formed.
>
> I ask her if she would like me to turn the page of the pad for her, she agrees, and I do so.
>
> She chooses a new colour - blue - and on the new sheet she makes a clockwise rotation.
>
> "Made his hat," she says.
>
> Then she appears to pause for a moment,

looking down at the drawing, as if in thought.

Then she makes three dots at the base of the rotation. These seem to be spaced with some care and precision.

Then she makes a series of pull lines through a section of the perimeter line nearest to her. These lines appear in a series from left to right, and each veers off from the perimeter line at approximate right-angles until her pen approaches the section of the perimeter line where it increasingly curves away from her.

(see also colour-transparency 47)

She has made a new structure - the core and radial unit (Athey 1980). This synthesis of two schemes may have been prompted by her recognition of the chance disection of the perimeter line by slashes of the pen, or, perhaps the idea was formed when - in the previous drawing - she made that pull line at the base of the rotation.

As she makes the last of the lines to be attached to the perimeter line, she appears to make a deliberate effort to preserve its perpendicular attachment to this baseline before she moves further to her right, leaving the core and radial structure she has created and continuing to produce roughly parallel longitudinal lines in a series to her right.

Microanalysis of this video seems to suggest that it is at this point that one of two options emerge. She can continue to attach her radial lines to the perimeter line at approximate right angles. This would mean that she adopt the rotational mark in itself as the dominant landmark for the targetting and orientation of the lines. This would require of her a continuously monitored adjustment of her drawing hand and wrist so that the radial lines continue to depart from the core at right angles forming a star or compass array.

Or, she can continue to use her own self as the orientation cue,

drawing the pen toward her own body whilst fanning it smoothly to her right to produce longitudinal lines in a roughly parallel series across the paper to her right. She does indeed take this, the easier course.

Perhaps the lateral movement of her drawing arm and hand is irresistable. Perhaps also she does not at the moment possess the set of configurative and event representations that the production of the compass radials would require. An emergent structural principle might run something as follows: Disect perimeter line with radial lines along a vector which affords maximum contrast (that is, at right angles) or, attach lines to baseline by making these radial lines depart directly away from baseline (that is, at right angles). Coupled with the Self-referential origin of mark-making, this would make a powerful strategy.

Variations of this early structural principle might be sufficiently useful in themselves without the further complexity of adding lines in a graded sequence of obliquity. It is misleading to account for this right-angular attachment solely in terms of a "perpendicular error" as it is sometimes called (Bremner 1985, p.314). As the present author has stated elsewhere (Matthews 1988, p.175) "The decisions and influences involved in this 'perpendicular bias' - visual, motor and intellectual - are complex (Bremner,1985) but I agree with Willats (1986 personal communication) that a factor contributing to this tendency might be the child seeking the maximum visual contrast of forms that this linear junction offers. Later, other structural-symbolic options might be available but, for the present, this so-called bias might be an important early rule in an internal programmes designed to move the child toward increasing differentiation of form."

In fact, the star or compass array is a later development which appears when the child starts to attach a new significance to oblique lines, and is able to master their moment of turn from external (and later, internal) reference frames. At this time, the child has a range

of options open to him/her. From the same text as quoted from above (Matthews 1988, p. 175): "Lines are attached to the closed shape, and again the child's targetting of lines oscillates between different sets of cues, so that this core and radial form ... may have its rays drawn between perimeter line and self, or its rays may be aligned with nearby longitudinal an lateral lines - the edges of the sheet of paper perhaps - or else all cues other than the closed shape itself are ignored, and lines arranged at different points of the compass, departing from the perimeter line at around 90 degrees."

We will return to the development of these structural principles later, but in the meantime, consider the conclusion of this video-recorded observation:

> (videorecording; colour-transparency 47)
>
> Hannah then makes a push line longitudinally away from her whilst accompanying this "ascending" line with an ascending musical vocalisation - "oooooooooo". "Made a tail - made - "

(She is not quite sure how to describe this).

> Then she starts to count:
>
> "Two ones.."
>
> Then she starts to count push lines as she produces them:
>
> "One, two, fourteen..."

Whilst this is not a conventional numeron sequence, Hannah is obeying some of the principles of counting; she employs a one-one correspondence between action, appearing mark and arbitrary tag (See Gelman and Gallistel 1983). The forerunnner to this early counting is the one-to-one correspondences the infant makes between vocalisations and actions, and between these and appearing image. Such a behaviour was

mentioned above in this observation but it was common to many of the children studied. In their chapter on the counting abilities of the very young, Gelman and Gallistel make the point (of great pertinence to the present work) that "...tags need not even be verbal..." to qualify as counting (Gelman and Gallistel 1983, p.192).

Hannah then disects this line near its end furthest from her, making a near cruciform, points at this conjunction and says:

"Sitting on a lock."

She is making some comment on the relationship between these two lines.

Again, she is struggling for words with which to describe the relationships between lines and what these recall in the real world. Here is her next statement about this right-angular cross-over:

"One two - one on sop."

Then she makes a pull line towards her, synchronising the production of this "descending" line with a descending musical scale - "ooooooooooo."

She finishes the drawing by making a little more rotational marking over the centre of the blue rotation.

The rotation is very important, both for its configurative and dynamic possiblities, and most of the children studied would alternate between the representational and expressive potentialities of locomotor-rotational drawing - sometimes within a single drawing. Sometimes, the configurative form of the image has a functionally dependent relationship to the dynamic representation out of which it arose. For example, at 2:9:22 Ben enacted with swirling blue and black crayons, the circular motion of "The Big Wheel" (he had just visited the fair). It seemed to me that in this and other representations, the infant was beginning to perceive these funtionally dependent relations between action and form.

U Shape on Baseline

The synthesis of what were initially discreetly different structures leads to a whole generation of hybrid forms with an attendant proliferation of structural-symbolic possibilities. A synthesis quite complex both in conceptual terms and in terms of motor-coordination, is the U shape-on-baseline. This is a right-angular departure from a baseline which then makes an arcing flight to return to the baseline.

The structural and representational possibilities of this form are truly vast. With it, the child can encode all manner of volumetric forms, and specify something of their relationship to supporting surfaces. U shapes can serve as baselines for other U shapes. In this way, complex structures can be made of cell-like units accreted one to another.

As well as the creation of closed shapes to represent faces (and sometimes volumes) of objects, Hannah is also demarcating the beginnings and ends of lines, another deep structure which was seen being represented in other forms of play at around this time.

Descent Through 2 and 3 Dimensions

In a videorecorded observation made of Hannah when she was 2:2:28, she is drawing at the table on A 1 size paper with felt-tip pens (videorecording). She pulls the pen along the surface of the paper toward her and toward the nearer edge of the paper. As she does so, she synchronises a melodic vocalisation which descends through a musical scale.

Immediately the pen reaches the edge of the paper, she lifts up the head-set of the V.T. equipment (which I have left on the table) and drops it over the edge of the table, her lips compressing in anticipation of its moment of impact. When it hits the floor, she releases the sound - "Bop!"

It is noteworthy that Hannah first of all represents a descending vertical trajectory in 2 dimensions before secondly demonstrating it in 4D spacetime. Here is an example of the role drawing plays in aiding the child's perception of these structures in the real world.

The synchrony between ascents or descents through musical scales, and actions and lines which travel away from or toward the Self have been mentioned above. They form part of the child's establishment of a vertical axis and higher/lower relations, in descriptions which are external (such as drawings) and in internal descriptions, or mental models. The above example is particularly striking in that the child is considering the invariant descending and ascending vertical in real space time and comparing this to its representation in 2 dimensions, where a longitudinal line is starting to assume the tranformational value of vertical axis.

Higher and Lower Relations

The observations show Hannah, Joel and Ben, from around 18 months discovering and investigating the vertical axis across a large number of situations. All three infants at this age began to mimetically represent up/down flight, clearly considering and monitoring higher and lower relations. By 2 years of age they were mapping or encoding higher and lower relations onto the drawing surface. In the above observation one can see Hannah at the beginning of this process. At about 2:6 she will (like Ben and Joel) produce longitudinal lines or other configurations which seem to move along a notionally vertical axis. Consider the following observations:

> H. 3:2:7
>
> "...she creates a series of continuous ellipses which spiral away from her toward the farther edge of the paper. She says 'The bubbles are going up to the surface.'

(Colour-transparency 58.)

H.3:5:9

...she makes a drawing in which the pen point travels away from her as she says 'A cat...his head's growing', and then, as the pen line moves back towards her, 'It's going down again!' Immediately after this she makes another drawing in which, once more, a line is moved away from her toward the farther edge of the paper, as she remarks 'The baby grow'd.' (Matthews 1989, p.130).

(Colour-transparency 59.)

The first observation is of a continuous rotation translated along a longitudinal axis. The next two drawings are a development of the basic push pull longitudinal. Taken together, this type of sequence surely makes explicit the progress the infant is making in the transformation of Self-referential movements made along a longitudinal path into a true vertical axis.

Curving and Flying Arcs

At around this time the infant sometimes utilises graceful arcing lines, made in the air. These are often accompanied by synchronised vocalisations which enact dynamic events occuring through a vertical axis. Very often flight games incorporated graceful slow motion displays of weightless moment of apogee, simulated by the controlled movement of a hand-held toy. Such behaviours reveal the child building up knowledge of the behaviour of objects within a gravity field, and the various consequences of being a living, feeling organism existing in this condition.

A wide range of different content is assimilated to these dynamic vertical flights, from people jumping and flying, to the fall of aeroplanes.

A rising and falling arc is sometimes produced by infants in their drawings at this time, and is frequently used to represent the flight-path or trajectory of a flying object or person. The following observation of a very early occurence of the flying arc is taken from Matthews 1984:

> J.2:5:20 (colour-transparency 60)
>
> A felt tip pen is used by Joel to describe a graceful arch. As the line lengthens, "rising" toward the "top" of the paper, and soaring along this edge, Joel says to me,
>
> "It's a man flying...it's a man running away..." (Matthews 1984, p.13).

In the same paper (Matthews 1984) this author compares such drawing episodes with Joel's miniature world play at this time, in which hand-held figures describe up and down flights through 3 dimensions.

Whilst one must remain tentative about ascribing too positively precise transformational values to the lines within a single such drawing, given a series of drawings the steps through which the child gradually maps into 2D flying trajectories through a vertical axis are strikingly clear. This point will be strengthened shortly.

In drawing, at around 2 years of age, the children would frequently alternate between action and configurative modes within a single drawing. For example, at 2:4 Ben says he is painting what he says is "a smashed aeroplane." He uses colour-coded criss-crossed laterals and longitudinals to represent the form of the wreckage. A moment later however, he traces a longitudinal line toward the edge of the paper nearer to him, demarcating its terminus with a splodge of paint whilst synchronising this moment of impact with an onomatapoeic vocalisation. This is a development Ben has employed painting to represent both the configuration of the aeroplane (the form of its tangled wreckage) and also its trajectory through space (colour- transparency 61).

A clear feature of development revealed by this study has been that earlier programmes of action are re-worked at different levels as the child matures. The strategies that Ben employs in this episode are developments of the pull line and the vertical arc described earlier. He is also developing the expressive potential of the synchrony between sound, action and emergent image.

Vectorial Termini

Another structure developed by the children is the demarcation of vectorial termini. The children discovered that linear journeys can end in all sorts of ways, happily or sadly. Some endings are catastrophic - in this observation Ben describes the end-of-the-line for the aeroplane.

This writer's evidence supports clearly the idea that children use painting and drawing to explore 3 basic elements of phenomena: location, form and movement. The children are asking questions about ultimate realities concerning appearance and structure of objects. They also ask the questions, where do they come from? Where do they go? They use painting and drawing to coordinate different understandings. These media can convey not only the integrity and unity of form, but also its ultimate entropy.

Vertical Axis

Initially it is unclear as to whether the child is in fact encoding a vertical axis. In Ben's smashed aeroplane drawing for example, one cannot say with certainty whether he intends the edge of the paper nearest to him to denote the lowest part of the scene - the ground against which the aeroplane impacts. It could equally be the case that this edge merely served as a convenient local landmark against which the brush's trajectory could be terminated. In this case, the line would specify no particular orientation in the real world.

However, as has been indicated above, given a continuous, unbroken

chain of drawings, accompanied by observations of parallel representational investigations made by the child, the suitably informed and sensitive observer can detect a special type of transformational invariant which specifies a fluid sequence of structural development.

By 2 years 8 months Joel seems to be mapping onto drawing surface higher-lower relations. For example at 2:8:13 he marks on an envelope, a "nose" and a "foot", saying these words as he makes a tiny tick for the nose, and a tiny rotation for the foot. The foot is placed on the part of the envelope nearest to him, on a torn open flap which perhaps cues for him the configurative profile of a foot. Further from him, somewhere at the mid part of the envelope, he places the nose. He seems in effect to be stating that "noses", generally speaking, are higher up than "feet", and that positions along the longitudinal axis of the drawing surface can denote higher and lower positions in the real world (colour-transparency 62). (See Matthews 1984).

In pictures we have come to expect that the highest part of the scene is mapped onto the "highest" part of the drawing surface, and that the lowest part of the scene is mapped onto the "lowest" part of the drawing surface. This, of course, is a particular drawing convention, and one not obeyed by certain drawing systems. (It is also important to know that the use of such systems is not confined to children.)

The mapping of higher and lower is not an arbitrary convention however. It corresponds to representations in our visual system which are themselves formed out of the coordination of different sets of information; that which specifies local vertical and horizontals, and information from vestibular and proprioceptive mechanisms about the pull of gravity and our relationship to supporting surfaces. Much of this information is derived from a standing posture. As Trevarthen has written, "...from the onset of standing the motor system is responsive

to information from the surrounding visual framework about surfaces and edges..." (Trevarthen 1984, p.232). As was mentioned at the beginning of this part, standing still is a complex act.

Again, the kinematic progression of drawings made by Joel over the next few days confirms the idea that he is indeed encoding the vertical axis. At 2:9:20 he makes longitidinal parallel lines which he says are "Mummy, Daddy, Joel and Ben" - the family group (colour-transparency 63). (see Matthews 1983, 1984).

He, like all the other children studied by this writer, is looking beyond surface appearance to the deep structures which remain.

At 3:2 Ben is drawing an arching line rather like a developed version of the curving or arcing flight produced by Joel and mentioned above. About the configuration Ben attaches to the "upper" side of this line he says: "The train is going over the railway bridge". A few moments later, he produces a second drawing, again showing an inverted "U" shape which represents the "bridge" but this time he draws a convoluted configuration "below" the arcing line, about which he says: "The train has crashed under the railway bridge" (colour-transparencies 64-65). (See Matthews 1989). This is not the point at which to describe how Ben has arrived at the structures he uses to depict the railway train in its two different states. The inverted "U" shape is however a structure which is very salient to the discussion at this point. It is a relative of the U shape on baseline described above and is a development of the curving or arcing flights made in 4D spacetime. Now it is encoded in drawing. There is a universality about this form. Many of the nursery children also produced it, both in movements of their bodies or limbs in the air, or on paper (see videotape). Hannah also produced these. Here is one more example: "Hannah at 3:8:20 also produces a drawing in which an inverted U shape represents a bridge. 'A train', she says, 'goes over a bridge, and water is under the

bridge.' She too has followed a similar route in mapping the relationships on to the drawing surface." (Matthews 1989, p.130). (Colour-transparency 66.)

So the child is moving on to make further stipulations about the relations within and between objects, and between these and events which can be made to occur on the drawing surface. This writer's evidence suggests moreover, that the infant's use of the drawing surface for the encoding into 2D of relations and axes is not dependent on imitation of the imagery of others but constitutes a genuine discovery made by the infant about the representional affordances of drawing surfaces. This is, of course, controversial.

Rotational and Vertical Axis Coordinated

In the miniaturised spacetime of symbolic play, observations revealed all the children exploring and coordinating both the rotational axis and the vertical axis. Again from this writer's 1984 paper is an example which typifies many play behaviours recorded in children from about 2 years and a half:

> J.2:9:14.
>
> J. studies a milk-bottle top which has been depressed by an adult thumb to such an extent that when placed upside down on a flat surface, it presents a dome-like appearance. Joel remarks on the folds which run down this hemisphere:
>
> "It goes down, down, down..." as he runs his fingers down the folds.
>
> Then he enacts a circular movement around the circumference of the milk bottle top:
>
> "...a car goes round and round " (Matthews 1984, p.26).

If one watches attentively it may be possible to witness the

encoding and coordination of both the rotational and vertical axis into 2D. In a startling drawing made at 2:11:16, Joel encodes and coordinates both the rotational and vertical axes of a "mountain" (colour-transparency 67).

On a holiday in the Lake District of Britain, I go for a walk with Joel up the rocky fells. When we return to the caravan in which we are staying, Joel plays outside, making handheld toy figures go around and around, and also climb up, over and down large stones and outcrops of rock. Later that day, Joel places a pencil eraser (dimensions 4x3x2 cms) over a hole he has rubbed in a sheet of A4 paper. (This hole, and how he uses it, is in itself significant as we shall see). He draws with a fine, black felt tip pen, a rotational mark around this rubber; action and object serving as cues and supports for a play scenario which decribes climbers (he says) "going around" a mountain.

So far, a quite familiar scenario.

What he does next though, astounds me.

He moves further to the right of the paper's surface and enacts, with a carefully modulated and controlled push pull movement which results in an open triangle, its apex furthest from him, the climbers' route up to the summit and down the other side.

Is it the case (as I have described elsewhere (Matthews 1983, 1984, 1989) that almost as a by-product of an action representation he arrives at a shape which serves as the configurative profile of the mountain? There is another possible interpretation. It could be that different types of perception are elicited by different situations. With objects that one can handle or walk around, the perceiver is able to detect structural invariants that remain constant despite certain kinds of transformation caused by viewer's own station-point relative to the movement, or apparent movement, of the object. It may be that from such perceptions that object-centred drawings are produced, which do

not specify views of objects so much as their invariant structure. What happens though with objects which one cannot handle, and around which one cannot move - at least not so readily and quickly?

It may be that in the perception of such objects - and mountains are an excellent example - a different mode of perception is induced, in which something of the object's frozen optical aspect is revealed. Even Gibson (1978) was obliged to concede this (in a letter written 3 Jan 1978 in response to a note by David Topper 1977 and quoted in Gombrich 1989. Also see Topper 1983). This mode of perception, in which the configurative aspect of an object is revealed, may in turn might prompt in drawing a viewer-centred representation. (I am grateful to Alan Costall (1987 personal communication) for the useful discussions we have had about this).

Such an explanation would not of course exclude the dynamic modes of representation that the child also employs to build up knowledge of such objects. It could well be that one is actually witnessing the child in the process of coordinating different kinds of information from different sources.

In any case,so powerful is this configurative profile that Joel is immediately prompted to add to this a "rope", as he calls it, which follows a course roughly parallel to the side of the mountain, is attached to the peak, and descends the other side. To this "rope" he attaches two "climbers" on the left slope of the mountain, who are thus linked together. One of the climbers has discernible limbs and body. Again from my 1984 paper:

" 'there's his body, there's his head, there's his knees' he whispers, as he connects the climber to the rope...shapes near the foot of the mountain or 'rock' are family and friends; 'Daddy, Linda, Dominic and Ben, and cars waiting at the bottom' " (Matthews 1984, p.29).

However one accounts for this type of representation, it is quite

clear that Joel has depicted higher and lower relations. In addition, he has "... drawn a profile of a mountain. On its profile he has drawn people. He has shown size relationship between figures and mountain" (Matthews 1984, p. 29).

Joel, like other children studied in this work, produced head body and limb units in human figure depiction before he ever drew the so-called tadpole figure. Yet again, the classical model of invariant universal stages is contradicted. Is it because the tadpole figure has been too readily assigned by researchers as primarily a human representation that has contributed to the slightly distorted emphasis in drawing research?

The tadpole figure is best understood as a special use of core and radial. Studying the literature on children's drawing seems to suggest that psychologists have zeroed-in on this form to the exclusion of equally important forms. Their apparent urgency to tie this form in with a model of general moves made by the child in cognitive develoment has effectively concealed the many graphic representational options available to a child even before 3 years of age.

Projective Relations: Before/Behind and Under

It could conceivably be the case that Joel is also considering projective relations. Is Joel considering that family and friends are occluded from the two climbers by the mountain itself? Projective relations are being explored and represented at this time, albeit at a very notional, germinal level. For example, on the very next day Joel makes this painting:

> "J.2:11:17.
>
> Joel plonks a blob of white paint onto the paper. He then covers this with a blob of green paint. He says to me:
>
> 'The white is hiding' " (Matthews 1984,

p.20).

Such representations can be traced back to the peek-a-boo games played between caregiver and infant, but more recently have been facilitated by the covering, screening potential of various materials - pigment being an excellent example. Various covering or screening activities were observed in the drawings and paintings of Ben, Joel and Hannah from about 1 year 9 months, and became very pronounced by about 2 years (Matthews 1984). In such episodes, occlusion is concretely, physically taking place, but very shortly such embrionic representations with their implications of viewpoint, were shifted to more conceptual levels. For example, only 6 days after Joel "hid" the white behind or beneath or under the green, Joel demonstrates new procedures for the encoding of occlusion. Again, from my 1984 paper:

> "J.2:11:23
>
> Joel draws an angular closed shape, inside which he places a smaller, angular closed shape. He says:
> 'There's a duck under him... I think it's a - a baby under that doggy...It's an egg.'

Here Joel uses the line of the larger closed shape to stand for the edge of an opaque object ('doggy') which conceals, by covering, the baby or egg - the smaller closed shape. The significance of this drawing is that whereas days earlier he concretely and in reality covered a mark by physically burying it under a layer of paint, here the act of concealment is sustained solely by Joel's imagination. He has to deny his own visual perception of the smaller shape and pretend that it is concealed; covered by the larger shape" (Matthews 1984, p.21).

I make the point in this paper that it is wholly inaccurate to describe such drawings "X Ray" drawings, as some psychologists do, if this term is intended to imply errors in graphic production. On the

contrary, these drawings are momentous conceptual achievements.

Two Axes or Two Views of an Object?

To return to Joel's mountain drawing, consider its remarkable completion:

He completes the drawing by placing the pencil - eraser over the profile of the mountain and making a rotational course with the pen around it. It seems as if he is recapitulating his understanding of the mountain's other, rotational axis. He uses a different colour pen as if to maintain the distinction between this and the profile. The rotational axis accurately circumscribes the open push pull, its innermost line precisely touching, at a tangent, the peak of the mountain.

In effect he has drawn a plan and elevation of the mountain. As John Willats (1987 personal communication) has pointed out, an engineer would recognise this drawing as an orthographic projection. Joel has seen no such representation in the surrounding pictorial environment. He has arrived at this as an original solution (as far as he is concerned) of an age-old transformational problem. Perhaps partly as a residue of action representations formed in symbolic play, where the tracing of the pen-point emulates the movement of climbers, Joel has caused to show in a drawing, two aspects of a scene simultaneously.

This writer believes that we are justified in considering these aspects as literally that - two views of the object. Initially it may not have been Joel's intention to represent opposing views of the mountain - he may have had no well-established programme for this. However, during the process of desribing with a pen line those movements one can perform along two major vectors around and on this large object, the child has perceived visual consequences of these drawing actions in terms of shapes which specify views of the object. Again one sees that development here is due to an ongoing dialogue between the child and his

own drawing production. Through this process of action representation, Joel has created a new programme of perception and representation.

In an individual child's development, such a drawing may be an isolated case, so most studies of drawing have not captured such examples. Consequently, some psychologists have been sceptical about these representational achievements. However, with a research design which captures most drawing episodes of a few children - and not just the finished products - the evidence suggests that such emergent representation, in which the infant is forming understandings of projective relations, are not atypical but probably common. The investigator must, of course be present to observe and record the actions made and the words spoken by the child, and this was the case with the following two example observations. Here again, as in Joel's "mountain" drawing, the enacting with a marker the dynamic flow of another event, led to some startling transformational possibilities in 2D structure. The first is of Hannah and is taken from a recent chapter of the present author:

"Also contradicting popular opinion and the classic Luquet/Piaget theory of drawing development (Luquet 1927) is the evidence that children between 3 and 4 years convey projective understandings, when they specify two aspects or viewpoints of the same scene. This is achieved as a byproduct, as it were, of the child's dynamic enactment of events. In a drawing by Hannah (H 3:3:2, colour-transparency 68) for example, there occurs the embryonic specification of two basic aspects of the same phenomenon. She says 'The clouds are moving along...the rain is coming down' and she employs two contrasting mark-making gestures with which to represent the falling rain. Firstly, an oscillating zig-zag represents the rain's movement along and down and through a vertical plane, but to the right of this she impacts the pen against the surface, enacting the collision of the rain drops at right angles to the ground"

(Matthews 1989, p. 132).

Whatever is the most truthful way in which to account for this drawing, it is quite remarkable that such an intellectual and imaginative representation is achieved by Hannah's use of two fundamental mark-making actions whose evolution has been described earlier; one is the oscillating zig-zag (a development of the push pull) the other is one of the trio of the very earliest mark-making gestures of all, the vertical arc.

So much for the notion that the first drawings of the very young are meaningless scribble.

The other observation is taken from the study of Ben, when he was only 3 years 2 months. The following is a description of a drawing he made at that time: "Contrasting lines of sight are also represented by Ben at 3:2. Here Ben spills a glass of milk from one hand, whilst holding a slice of beans on toast in his other. We have a notional line of sight to the plane of the human face at 90 degrees. But we have a line of sight of 0 degrees to a flat plane here - the slice of beans on toast. This is an edge-on view of a flat (or flattish) plane. Planes can in effect be rotated through 90 degrees - an ability not predicted by Piaget, who thought children below 4 years of age showed 'a complete lack of understanding of any sort of pictorial perspective' (Piaget and Inhelder 1956, p.173)" (from Matthews 1989, p.133). (Colour-transparency 69.)

Again, though a somewhat more complex drawing than that of Hannah, and although Ben did develop drawing to an exceptional level, this drawing is nevertheless composed of those drawing schemas which most children around the world also discover during their third or fourth year - closed shape and nuclei, core and radial, notionally parallel lines, dashes. It is the meaning attributed to these forms which is significant. The questions which remain as to how justified we

are in attributing to the child abilities to conceive and represent changes of viewpoint will be returned to when consideration is made of these possiblities in early symbolic play. Before this however, there is one more important point to be made about Joel's "mountain" drawing.

In fact, in his attempt to display simultaneously more of the truth of the situation, it is not just two basic vectors he has combined here but three. The unfolding play scenario also requires him to make the climbers go through the mountain. How to achieve this? The answer is to push the pen through the paper!

At this point then, it is necessary to consider this very important deep structure and its representation. It is the dynamic invariant going through.

Going through

In the symbolic play episodes observed and recorded by the present author, scenarios frequently involved the placing of thinking and feeling agents (represented by handheld figures) in dangerous or life-threatening situations. Typically the participants would be obliged to cope with either forces of evil, or natural forces and obstacles. The scenarios tended to show a developing appreciation of the vulnerability of mortal life within a gravity field. This was often a prominent concern upon which the structure of play was formed.

In miniaturised symbolic play from around two years and a half, Ben Joel and Hannah exploited all manner of objects for the tracing of basic vectors around and around; and up, over and down. In the observations made of Joel described above, we see him describing rotational and ascending/descending vectors around objects ranging from a milk-bottle top at 2:9:14 to large stones at 2:11:16. In this latter example he used handheld figures and this was typical of the play scenarios of these three children, plus

many of the nursery children studied.

To these two major vectors of movement the children started to add a third dynamic structure, that of going through bound volumes.

At 3:2:0 Joel makes two handheld figures pursue each other around and around a coffee-grinder. He shows an understanding of the occluding nature of corners of walls around which one figure may hide from another. As others have shown, in contexts with which the young children are familiar, they show - contrary to Piaget's (1956) experiments - surprising non-egocentic understandings (see for example, Hughes, Donaldson and Borke 1983). In play, the children are sometimes quite would be able to put themselves into the position of others. As well as the enormous social implications of this, this is also forms the background experience for later concepts (for example that light travels in straight lines) necessary for the creation of projective relations in 2D.

Joel's toy figures are also made to fly or climb up over and down the other side of the coffee-grinder. They also descend into and through the gadget, as far as it will allow. In the narration of his play, Joel is talking about the people going into "...a magic land far away". (Colour-transparencies 70, 71, 72.) Because the coffee-grinder will not allow complete passage through, Joel "edits out", as it were, that part of his actions in which he is obliged to re-place them in the little wooden tray at the base of the machine. as if they were emerging from the interior. Such jumping in and out of play state in order that rearrangements and adjustments can be made, or so that new techniques can be practised, and the ongoing editing that this entails, is part of the complex language of event-representation which the child is formulating. We saw an example the beginnnings of such an interplay between accommodation and assimilation in the observation above of Hannah and the tape measure. Here, she would break away from ludic

flights of the tape measure to investigate and consolidate one of its affordances, for example, that it could be coiled.

It may be that it is this editing, re-structuring and re-running of sequences that increasingly structures the child's interiorisation of these event scripts.

It is important to make one more point about Joel's use of the coffee grinder which exemplifies a principle underlying all ludic behaviour. Whilst he tranforms this object in the Vygotskyan sense that words are detached from the object and actions are severed from meanings, it is also true that his ludic use of this object remains rooted in reality. He symbolically utilises the key properties of the machine. As was mentioned near the beginning of this work, the playworld is not a state of complete disassociation, but is linked to the non-play world by a rich network of meaning - involving those deep structures which here concern us.

Going through is one of these structures and it is discerned and represented across a range of different situations. At 3:2:13 Joel is again playing with handheld toy figures. In this adventure, one character pursues another. At several points in the play, Joel displays considerable understanding of the viewpoint of another by pretending that the one figure is hiding from his pursuer. One particular moment is especially telling. The pursued character is lodged in the open palm of Joel's left hand whilst the other figure looks towards him, but not seeing him. Even though Joel himself can see both figures quite clearly, he is saying, in effect, that figure A is out of the line of sight of figure B . Figure A then descends down and through a small metal tube, and analysis of a sequence of photographs taken of this moment shows figure B adjusting his position in order to visually track the other's descent (colour-transparencies 73-74). Frame-by-frame analysis made by the present author of his own videorecordings of the infants' games with

toy figures or dolls reveals an exquisitely orchestrated interplay between agents' lines-of-sight.

The observations suggest that infants do at around this time feel the need to encode this going through vector onto the 2 dimensional surface. The example of Joel pushing the pen through the paper to show this vector is typical. Sometimes children will dance around the room peering through the holes they have made in their drawings or paintings. Here is an example from the study of Hannah:

> H. 3:5:6
>
> Hannah is making a drawing in pencil. The movement of the pencil point emulates the movement of a "dancer". She pushes the pencil right through the paper, saying as she does so: "I danced through the hole and fell through. It has a hole in the other side..." She considers her last statement and then says - bursting with laughter - "It has to have!"

She laughs at this realisation. Does the going through from one side to the other mean that there are not two holes but only one?

The observations show children carrying their understanding of the dynamic invariant <u>going-through</u> over onto the 2D surface in another way. In drawings by Ben, Joel and Hannah during their third years and in several of the nursery children at around 4 years, configurations or dynamic traces are produced within the passage formed between two notionally parallel lines.

Where in pretend play small toy figures are passed through physical tubes, now two-dimensional, drawn forms represent the movement of entities through tubular volumes depicted with the use of two parallel lines. A very good example can be seen in Ben's drawing of 3:3., in which Santa Claus is depicted descending through a chimney. (Colour-transparency 75.)

As has been shown, the infant seeks out any new manifestation of the same dynamic invariant. If Santa Claus can go through a chimney, then - in a striking drawing by Ben at 3:3:15 - music can go through a trumpet (colour-transparency 76). Is it fair to say that Ben is actually representing sound-waves here? (For further descriptions of these events see Matthews 1988, 1989).

As was mentioned earlier, it is quite difficult to ascertain whether the child is depicting a section rather than a holistic volume, but in this and other examples, it would seem quite likely that this in fact the case. Further evidence is supplied by Ben's depiction at this time of "a man, digging in the ground for the bones of animals" (colour-transparency 77). Is it true to say that Ben is here drawing a section through the ground? Specifying that the bones are below the surface of the ground does not necessarily mean that a section is explicitly intended. However, from the evidence of the drawings which follow, it seems likely that as a consequence of his representation of on-top-of and underneath relations, he is discerning the capacity of lines to specify section-through-plane. This development is part of a continuous interaction between the child's intentions, translated into graphic actions, and his/her perception of the unanticipated representational affordances which appear on the page.

The child's depiction of section is a notable achievement, for here the child is creating a view which exists in the imagination alone.

Conclusion to Part 5

The evidence suggests that children are not locked into one or other transformational system (whether it be views, holistic volumes or sections) but that they will alternate from one to another depending on the kind of information they want to show. Typically, the child's concern is not with the depiction of objects in or for themselves, but

with the coordination of the imagined movements of thinking, feeling agents in imaginary worlds. It is these settings which require the production of one or other of the available transformational systems, or a combination of these.

There remains one last aspect of the drawing production to be discussed. This is the interpersonal context out of which such representational systems arise. As has been mentioned several times throughout the present work, such symbolisations do not arise either from imitation from cultural models nor from within a cultural void. Many errors in research have arisen because of basic misunderstandings about the relationship between internal programmes of development, interaction with others and surrounding cultural exemplars. Until this moment in this study it has been not possible to do more than hint at the web of interpersonal relations out of which early symbolisation arises. This has been due to a variety of factors. Drawing acquisition is really a little understood field within which have arisen some erroneous ideas and prejudices. In order that the stage could be set for the human theatre within which the scripts for representation are written, it has been necessary to dispel some of these notions and prejudices. So far it has been important to alert the reader to the meaningful nature of the graphic stuctures designed by the very young from their play behaviours. The identification of these forms has been a prerequisite for an account of the unfolding of meaning between caregiver and infant. Such an account is vital for the completion of this work, for this will suggest the kind and quality of interaction and support which enable the child's construction of symbolic systems.

With this groundwork now established it is now possible to turn to the interpersonal basis for representation.

Expression, Representation and Drawing in Early Childhood

Part 6

Interpersonal Basis for Representation

There follows a transcript of a videorecording made of Hannah drawing with brush and paint at 2:2:28. She is standing on a chair at a table upon which rests a sheet of A1 size paper, some brushes and 6 pots of pigment; black, red, yellow, purple, green and blue. Hannah's mother, Linda, is seated at Hannah's left, within touching distance of her. The videorecording made was later slowed down to one quarter of normal speed, to allow a microanalysis to be made of the content and structure of Hannah's drawing behaviours.

Initially the author's intention had been to study the perceptual-motor organisation behind the acquisition of the graphic schemas described above. This indeed was achieved. Here we can see the orchestration of many of the structural procedures described in foregoing parts of this work; including the coordination of different understandings about forces and objects; about the relation between action and image; about locations and the relation of these to axes of movement and also about the expressive values of these.

She also demonstrates some striking displays of those cross-modal associations between actions issuing from different exterosensory systems yet which occur in synchrony and which act as metaphors or analogues for each other. An infant not yet 2 years 3 months attaches expressive values of great power to those basic mark making actions described above in this work.

However, in addition to this, the analysis revealed hitherto unsuspected and complex levels of interaction between Hannah and her

mother. The infant is seen to be initiating the attribution of meaning to marks and shapes within an unfolding spatio-temporal event in which both mother and child are engaged a web of shared perceptions, anticipations and predictions about what is occuring at the interface between action and emergent form. With the mother gently and sensitively supporting the lead taken by the child, they participate in a sphere of interaction which is ongoing through time. This spatiotemporal arena has been termed by Winnicott (1971, p. 47) a "potential space."

Unfolding Events

H.2:2:28 (videorecording - normal speed and slow-motion sequence)

The sequence opens with Hannah picking up the front of her dress to inspect a tiny speck of paint which she finds there. Using a pincer grip at this minute point, she bunches up the dress and looks carefully at this (unwanted) spot of pigment. "Nanna wash,"(Hannah wash) she says. Linda explains: "You've got to put it in water. I'll do it for you later. Don't worry."

Hannah looks down at the spot of paint for another fraction of a second, and then lets go of her dress. Her arms outspread at waist level for a moment as she regards - for a fraction of a second - the paint brush in the red pot and the area of paper beneath it. Linda quickly and discreetly reaches across and tucks Hannah's dress under the edge of the table, so that it is out of Hannah's anticipated field of action. In the meantime Hannah is already moving her right hand to paint brush, her fingers splaying out in anticipation of its cylindrical form before she grips it palmer fashion.

Hannah attempts to pull the brush out of the pot but the brush is stuck in the pigment, so that the pot, attached to the brush, is lifted off the surface of the table. Linda's hands are moving in to assist, but it is only necessary for them to hover in readiness at the lip of the

pot, for when Hannah lowers the red pot to the table, it this time dislodges from the brush.

Hannah pulls the brush away from the pot and she immediately presses it against the paper. Then she raises it away from and 15cms above the paper where she pauses for a fraction of a second. Whilst Linda's hands remain on the red pot as if to hold it steady, Hannah now presses brush down vertically and firmly at about 4 cms to the right of the spot she has just made.

She hunches her shoulders over the targetted bristles, putting weight and pressure to bear upon the point of contact between bristles and paper, the handle of the brush oscillating slightly from side to side as a result of the displaced pressure she exerts on the irresistable, immovable point. Linda is opening her mouth in interest and surprise and, with the merest movement of eyes, looking up to Hannah's face and back down again to the painting, focussing her central attention on and around the brush tip.

As Hannah presses the brush down, she compresses her lips and slightly screws up her eyes in tension. She presses down for about one and a half seconds. Towards the last fifth of a second of this action there comes, from her compressed lips, a farting or "raspberrry" sound which is synchronised to the action which at this moment she stresses even further. This raspberry sound lasts just less than a second and is continued on into the raising of the brush about 15 cms above surface of paper.

About 15 seconds have elapsed as Hannah now stabs the brush down vigorously to the same point, synchronising a raspberry sound to the moment of impact and continuing it over into the pressured contact of the brush against the paper. As she concludes this action and raises the brush about 15cms above the surface, she looks toward Linda, who returns her glance.

This was impact no.3.

The fourth impact is the first of a series of four rythmically spaced stabbing actions each accompanied in synchrony by a raspberry sound. The first of these gestures is impacted around the first small locale, but with each successive impact she reaches over the paper making a series of 4 spots which run along an axis extending away from her. With impact no.4 she has increased still further the volume of the synchronised raspberry sound, carrying this sound on as she presses down on the brush for a fraction of a second.

As she raises the brush to its hovering waiting position, her elbow forming an approximate right-angle, she takes an indrawn breath, like a little sigh.

During impact no.5 which occurs at a site a few more cms further away from her, and again synchronised with a raspberry sound, Linda's open mouth tranforms into a smile which develops through collision no.6.

After the seventh impact (the sixth with synchronised vocal) Hannah sighs again and pauses. Holding the brush from its non-bristle end, she allows it to dangle and, like a plumb-line, its diminishing oscillations cause it to move toward a vertical. Whilst this occurs, Hannah's direction of gaze seems to be guided to the point at which the bristle-end of the brush, acting like a pointer, seems to indicate. She completes the steadying of the brush and allows it to descend at this point, the bristles coming to rest on the paper.

Then, with tongue sticking out, she presses down on it, synchronising the raspberry sound. After this eighth stab, she makes a longer pause, looking toward Linda. Linda smiles at her, just re-aligning her eyegaze up toward her, and then immediately returning her line of sight back toward the field of action.

Hannah then makes 3 more impacts, each punctuated with marked pauses till after impact no.10, there is a smaller pause which acts like a

prelude to a gradual quickening of tempo from impact 11 to 24. At the start of this sequence she holds her breath, but then gradually releases it in an audible sigh, breathing out as she increases the pace - no longer synchronising vocals, but crashing the brush down at around the same locale till impact 18 when, gradually rotating from her hips and shoulders, she makes a series of spots describe a wide arc away from her and around to her left. From impact 20 this stabbing movement is carried back to her right, translating as a series of spots.

The last impact is translated to a pull stroke, the movement of which she visually tracks with an inclination of her head. The brush, maintaining contact with paper, is pushed away from her and finally pulled again back towards her.

This seems to give her a new idea.

Hannah then aims the brush in the direction of the red pot but appears suddenly to reconsider this.

She drops the brush and moves her left hand towards a lid. At one quarter of normal speed, one can clearly see her fingers splay out in anticipation of the circular shape. She grasps and carries the lid toward the pot, her right hand now moving into the centre of action to support the pot, whilst her left hand places the lid onto the pot.

The lid is upside down however. Apparently Hannah has not differentiated between the two horizontal orientations, the lips of the the edges of the lid being very narrow and therfore not constituting salient features - till now.

It is at this moment that Linda's hands move in to assist, and in slow motion there occurs a beautiful ballet of interchanging hand movements between child and adult and which centre around the paint pot. Linda "scaffolds" the task (Gray 1978, p.169) but only to the extent that this enables Hannah to take the lead. Linda's hands move into the field of action, where they each grasp the lid at two opposite points

equidistant on the circumference at left and right, and rotate it to its top-side-up position.

Hannah, not to be deflected, brings her right, then left hand in to press firmly down, together, on the lid.

Linda is completing the securing of the lid whilst Hannah is leaning over to retrieve the blue pot with her right hand. Again her fingers splay out in anticipation of the form of the pot. She picks up the pot and successfully pulls off the lid with her left hand. Linda asks: "What colour is that?" "Bu," answers Hannah.

As she puts down the blue pot near the centre of the field, the lid about 15 cms to the left of centre, and picks up the brush, Linda is already anticipating and reaching into the field to remove the lid from Hannah's field of view/action. As soon as Linda has done this she resumes her position at the side of the table.

Linda seems to have timed this discreet assistance to coincide with Hannah's search for the best grip on the brush. In "slomo" there is a beautiful ballet of hands and fingers as she exchanges grips on the brush till she is satisfied that she has the best grip for her projected task.

Then she targets the brush into the pot. Again, when she tries to lift the brush, the pot remains attached. Hannah bangs it down three times, synchronising three raspberry sounds which seem to emulate the action of the brush squelching in the viscous pigment.

The brush suddenly becomes free of the pot and she targets the brush at a spot below her (does she do this purposely?)

She then traces with the brush an anticlockwise course around the blue pot which serves as an axis. As she draws this line, she visually tracks the movement with great concentration.

Her empty left hand is to be seen flexing in empathy with the unfolding phenomenon.

The brush sticks at one point and then skids to become a push line. She alters its course to her left, around the pot, where at a point approximating a 12 o'clock position relative to her own station-point, the brush parts company with the paper and swings, pendulum fashion over the paper.

She brings it down at a point nearer her, tracing a new section of line which she brings up to the beginning of the original blue line.

She again describes an anticlockwise course around the pot, re-tracing the previous route.

With her voice she starts to make a "shhhhhhh"-ing sound which is synchronised to the slow moving brush as she moves it around the pot to a position approximately 2 o' clock (from her view).

Then she traces it back, following the line to its beginning, where resistance, plus the natural arcing vector of her arm, cause the brush-tip to fly away from the surface. Brush-tip again swings, pendulum fashion out to the edge of the paper, but she corrects its flight to a course which traces a line back to the previous line, retracing over this line to a 6 o'clock position, around to a 3 o'clock position, synchronising the "shhhhhhh"-ing sound with greater strength.

She looks up to Linda for appreciation as the brush skids away yet again from the exact same 2 o'clock position. She corrects its flight path again and retraces the course to the 2 o'clock position where it again flies off paper to swing back against the edge of the table causing a loud bang.

Linda and Hannah both pause for a moment to regard this point.

Hannah then brings back both her arms in readiness and looks towards Linda who returns her glance.

Hannah makes one more downward stab at the paper beneath her, an action which seems to serve as a full-stop - an exclamation mark even - for the entire sequence. Then she stands, open-mouthed, panning her head

from side to side, surveying the entire scene, first centering on the painting itself, then panning over this to her right, and then to her left. With her brush hovering, she looks up toward me, compresses her lips in a slight smile.

"That's amazing Hannah," I say.

For about two seconds or so, the attention of this young child and her two parents are centred on the painting.

Then Hannah, moves her left hand into the field palm uppermost and curled into the prelude of a pincer grip in anticipation of a lid which, as she closes in on the pot, turns out to be absent. She apparently remembers where it is and moves toward her left to retrieve lid.

A new painting sequence then commences. A mark-making event like the one described above constitutes a development of those exquisitely orchestrated interchanges between mother and child which involve actions of the body, face and vocalisations (Stern 1977, Trevarthen 1987). Here we see rythmical patterns of action of each partner coupled together precisely. According to Trevarthen, these acts of cognizance sharing are possible because humans (including infants) are able to detect universal indices of intention and motivation which are signalled in the subtle changes and nuances in the synchrony of body action, facial expression and speech. Because of this capacity we are able to gauge and assess the inner experience - the psychological state - of another. Because we can couple precisely our own patterns of action with those of another, we are able to enter into deep states of empathy with that person (Trevarthen 1987).

Trevarthen has postulated the existence of a biologically standardised time-base for these universal indices against which we evaluate the significance of any variation in tempo, amplitude, cadence, accentuation or stress. It is the controlled use of such variations which Hannah uses for such powerful expessive effect in her use of painting materials.

Trevarthen's research has illuminated the social context of early representation. Within the earliest interpersonal relations the infant gains access to symbolic reality. This is well illustrated by the above example. In this observation one can see that the interpersonal dance has been extended to include tools, tool use and the beginnings of a new level of symbolic ordering. Meaning is attributed to actions, events and objects in this interpersonal, intersubjective space (Trevarthen 1980). This is part of the framework for early mark-making. In the videotapes recorded by the present writer, there is an interplay of shared understandings and intentions within a 4D psychological "bubble" (Stern 1977, p.29) in which "...coordinated packages...of separate behaviours..." (Stern 1977,p.30) are integrated together. These "packages" are what Condon (1975, p.83) has described as "behaviour quanta".

Let us now consider these integrated behaviours.

Hannah is initiating and controlling complex unfolding scenarios involving actions of the limbs, facial expression, speech, object-manipulation, tool-use and emergent image. Both infant and mother are sharing a field of view which is also a field of action. This consists not only of the physical surface of the paper, or the pots of paint, brushes and so on, but is also a window opening onto a variety of potential but unknown futures. They are both predicting and anticipating events. They are not playing with objects alone, they are playing with ideas.

Both infant and mother know something of each other's viewpoint. They each orchestrate their actions with the viewpoint of the other taken into consideration.

In a sense they are stepping hand-in-hand into the unknown.

Consider now kind and quality of the mother's support for her child's behaviour. It is notable that few words are spoken. Most of the

communication between them consists of exchanged glances. There are different types of glance. Both parent and child seem to be able to effortlessly distinguish these. There is, for example, a questing glance made by Hannah to which Linda frequently responds with an action as well as - and sometimes instead of - a word. There take place communications at a level deeper than, and more fundamental than, spoken words.

There is a need for more studies on the structure of this interpersonal gestural and expressive language, for it is part of the key to the principles of teaching interaction.

Linda is aware of Hannah's salient field of view/action and only enters into this space when absolutely necessary. She also withdraws from it as soon as is possible, moving her hands out to wait at the periphery of this spatial envelope and allowing Hannah to quickly resume command of the action. When Linda assists Hannah's actions, her hands hover empathetically around Hannah's, only helping when necessary and then moving her hands in a clear, defined way, respecting Hannah's field of view. In this way the infant is allowed to see what is happening and is able to take control again as soon as is possible. To a certain extent this scaffolding of the tasks allows Hannah the illusion of complete mastery and control. Winnicott's (1971) neo-Freudian ideas concerning an area of magical illusion are not out of place here.

Linda is sensitive to a shared "theatre" into which hands and objects have to make controlled entrances and exits. Linda stage-manages with great discretion, allowing Hannah's performance and concentration to continue fluidly, without disruptions. Linda moves in and out of this stage unobtrusively, her actions of management and maintainance timed to coincide with Hannah's preoccupation with a brush or a pot of paint. In this way, the uninterrupted process of the painting scenario itself is preserved.

Both mother's and child's responses to unforeseen events are

illuminating. When Hannah's brush flies off the paper to collide with the edge of the table with a loud bang, neither child nor parent is upset by this, but rather regard this event with the greatest interest. Some researchers habitually conceive of drawing as of necessity a problem-solving situation. This is incorrect and misleading. There are no problems here. Painting is part of an event which is only partially predictable and in which accommodation and assimilation are in a fluid state of balance - a situation perhaps not attainable in any other medium. There is an interplay here between the child's intended actions and the random perturbations which effect these. The child is not disturbed by this and whilst continuously monitoring and correcting flight of brush, does not do this toward a fixed, internalised model or goal, but is tolerant of a wide range of variation from the projected action programme. Indeed, it is the child's perception and use of these "accidents" which is at the heart of drawing development.

How the caregiver responds to the fluid variey of such events is of course crucial. At no time in these observations has the child been given any sense that she is "misbehaving". The mother observes and responds to events with no pre-conceptions of "correctness". She responds throughout with an openness; in fact she shows, if anything, a marked increase of interest at unforeseen events. There are no adult pre-conceptions - no artificial limits or ceilings placed upon this event. The child herself is given the opportunity of defining the painting experience.

Further consideration will be later made concerning optimum learning environments in which both "permission" and support is given the child, so that he or she feels able to explore a wide range of phenomena without either coercion or sense of failure.

It should becoming clear that caregiver and child are not only sharing experiences of objects and materials - nor even just the skills

alone of handling these - they are sharing expectations about a "potential space" (Winnicott 1971, p.47). Hannah initiates sequences of action which are ludic games requiring Linda's participation - even if this means Linda simply watching. Hannah looks up at her mother after impacts, requesting, without speech, acknowledgement of her actions. This she receives in the form of a smile, an open mouth or just a raised eyebrow.

It is Hannah who structures the entire event, determining the expressive values of the sequence; the tempo, cadence, nuance. It is she who orchestrates actions, materials and ensuing marks into a dynamic rythmical structure which has syntax, phrases, climaxes, beginnings, middles and ends, and even a full-stop to mark its completion.

There is also humour here. Hannah is sharing a joke. She perfectly realises that it is funny to synchronise "raspberries" with marking actions but more than this, the actual pacing of the actions and the interchanges between her and caregiver (in this and subsequent observations) are also controlled with humourous intent. (The structuring of humourous interchange and action recalls that developed by great clowns and comedians. An investigation of such dawning ablilities in infancy would constitute an important study).

There are many aspects of cognitive development which are revealed in the above observation. The child is building up interiorised and dynamic representations that enable anticipatory descriptions to be generated of events at the interface between organism and environment. As has been mentioned earlier, research has suggested that object repesentations are a derivative of interiorised action scripts (Bretherton 1984). This again supports the idea that action representation, in children's symbolic play and drawing, makes an important contribution to cognition. There is much evidence to be derived, from the slow-motion sequence described above, of the interrelations between

internal blue-prints for actions and objects. In studying, for example, the graceful flight of Hannah's hand as it closes in on paint-pots or brushes, inferences about the child's formation of internal representation of objects and events can be made. For example, Hannah's in-flight adaptation of the form of her hand as it closes in on a paint-pot, or a lid, suggest that she has developed internal representations of these forms. That such representations are internal can be deduced from some interesting errors she makes. For example, at one point, when she moves her hand toward a paint-pot, her hand is adjusted to a delicate, upturned pincer-grip which closes in to the top of the pot, in clear anticipation of an encounter with its lid. In fact, it turns out that the lid has already been removed, and she has to scan the paper's surface to find it, altering the form of her hand accordingly. The upturned pincer-grip evoked by her expectation of finding the lid on the pot is a response-specification to an internal representation, rather than to perception of the object itself.

There is at least one other instance in the observation where she seems to be responding to an internal representation which serves as a cue for action. This concerns an earlier expectation she has of a lid's presence on a pot, and again the failure to see it in the place anticipated (or perhaps the sight of the un-lidded pot) triggers a search programme.

On other occasions in the observation Hannah will undoubtedly be making modifications to the specifications of both action and object representations.

The development of symbolic systems requires other forms of accommodation. In the use of the brush Hannah is accommodating her actions to a planar surface. This obliges her to modify the natural, swaying, oscillating movements of her skeletal and muscular system to this 2 D plane. At times the brush loses contact with the paper surface and she

makes repeated efforts to correct its flight. Painting is becoming less of a Self-referential act, more guided and coordinated by the use of external landmarks or targets. These local orientation cues have gained a new significance and potentiality for the infant.

That the infant's actions are so carefully controlled and modified by internal descriptions of objects and events, is further evidence that early drawing is an intentioned act, controlled and guided by developing concepts.

However, this development cannot be couched solely in terms either of the child's accommodation to external objects or in terms of his or her coordination of motor-movements. Painting and drawing episodes produced by the young infant are events which occur at an interface between natural action performed in the round, and a new emergent reality of graphic expression and representation. These highly detailed, recorded observations have shown the infant systematically seeking out the potentialities or affordances (Gibson 1979) of the graphic or mark-making materials, not only in the sense of the properties of the physical materials in themselves but also in the sense of their expressive potential. The infant seeks within these external objects and materials the potentialities these offer in terms of what they allow one to do with one's own mind and body. Trevarthen (1984) in discussing the development of motor-control, has said "...it is in the nature of motor coordination to 'explore' the mechanical periphery, to conduct a search for programs of activity that will exploit the potential of the body and of the objects that come in contact with it..." (Trevarthen 1984, p. 259).

This is exactly what we see happening in the very young infant's encounter with graphic and mark-making materials. Some of the potential exploited within interaction between body and object consists of expressive power. Actions are grouped together for reasons which cannot

be accounted for in terms of object mastery alone. There is here a controlled variation in the use of action schemes; delicate fluctuations in stress, tempo, amplitude, direction, duration and velocity - aspects of action which Mounoud and Hauert (1982, p.5) term the "cinematic". These authors say that the child's selection and coordination of these variables reflects both the child's representation of the object and representation of his/her own body. They make the point that cinematic aspects of action - unlike logical aspects - have not been used as indicators of intelligence, yet of course they are. Cinematic aspects of action are of significance to the present work for another reason too - they are fundamental in the specification of the expressive values of action. Hannah's modulation, calibration and synchronisation of actions - including speech - is guided and organised by an orientation to media which can only be adequately characterised as expressive and aesthetic. The actions are grouped together according to creative purposes. They are organised by a particular attitude to form. This is why one must consider aesthetic sensibility a very special aspect of cognition.

Cross-Modal Associations

Of special significance here is her use of distinctly different characters of vocalisation to accompany what are equally distinct characters of marking action and mark: "raspberries" for vertical impacts and resultant red blobs; continuous "shhhh"'s to accompany continuous, slowly moving blue line.

Built upon early synergistic responses to stimuli, such cross-modal analogues make possible symbolisation. As well as detecting structural and transformational invariants, infants also discern and start to use, invariants or deep structures of expression. (See also Matthews 1989 and forthcoming).

During the videorecording over the next two days, Linda and I were to see the development of these expressive, ludic scenarios which involve the forming of equivalents across sensory domains. Again, it is Hannah who sets the pace and tempo of these games. It is she who sets the rules. It is I, or Linda, who, following her lead, imitate her.

The humourous aspect of the relationship between sound, action and appearing mark is developed. For example, in one painting episode which followed on shortly from the one described above, Hannah is again punctuating the termination of a linear trajectory with an onomatopoeic vocalisation- "Ba!" This vocalisation is also underscored by intense facial expressions - a grimace, screwed-up eyes, compressed lips. (See videorecording). She develops this expressive synchrony by then fanning the pen to and fro in a horizontal arc, synchronising in a one-one correspondence, a series of "Ba-ba-ba-ba!"'s after which she waits, brush poised, clearly inviting me to enter into the game. Not understanding, I fail to respond other than to merely smile, so Hannah makes a second series of expansive arcing gestures with the pen, synchronising again to these marking actions a series of "Ba-ba-ba-ba"'s. She lifts her pen up above the shoulder height again, allowing it to hover in its waiting position outside the action-envelope. She is clearly waiting for me to do or say something, so I repeat back to her, an imitation of her vocalisation, saying: "Ba-ba-ba-ba!". In the slomo version of this recording we see her start to smile as her hand goes down to make 3 horizontal arcs, almost perfectly continuing the tempo set by my rhythmically spaced vocals. Having completed these arcs, she looks up to me, this time smiling widely and raising her pen to shoulder height. I say "Ba-ba-ba!" and her lips move silently but in empathy, almost compressing to make the "ba". She makes three more arcs, again in a near perfect continuation of the rhythmn. This happens one more time and then I refuse to cooperate. Realising I will not continue, she reaches right

across the paper and makes 6 horizontal arcs which open up into more expansive rotational movements before she abandons the drawing.

On the following day, this game is developed. At the end of a lengthy painting session, I wonder if Hannah would like to stop. At my use of the monosyllabic word "stop", Hannah impacts the brush once more against the paper. Clearly she does not want to stop! Realising I have received a cue for a game, I repeat the word but emphasise it slightly as an exclamation: "Stop!" Hannah follows this by impacting the brush down onto the paper, I exclaim the word "Stop!" again - Hannah impacts the brush again. This happens 8 times , Hannah sets and perfectly preserves the rhythmn between my word "stop" and her impact of the brush. (See videorecording).

Built on early instinctual rhythms, this behaviour is now more than instinctual. Such games require her to make predictions; calculations which involve not only her own actions but those of another. Some of these calculations involve timing, counting.

Not only does she make these cross-modal associations between her own actions, she also analogues the actions of the cognitive-sensory system of another.

Can one legitimately argue that Hannah is here representing speech, both her own speech and that of another? Is it the case that the vocalisations "Ba!" and "Stop!" are represented by marking actions both in terms of the actions themselves, and also in terms of their resultant 2D graphic structure? At some points in the episodes, it seemed as if I was dictating words which she then drew or "wrote". If these speculations are correct then this is of great import regarding the beginnings of writing.

How far one is justified in locating precisely the denotational meanings of actions remains questionable. Nevertheless, it is quite clear that the dynamic structures whose origins and development has been

traced in the foregoing parts of the present work are here being imbued with - highly charged with - expressive values. It seems fair to say that we are here seeing the emergence of expressive and repesentational modes which are probably operating at many levels. It is possible that the effortful compression of lips and eyes is echoed in the intense pressure she applies to pen or brush. The repeated opening and closing of her mouth for the pronouncing of "Ba-ba-ba-" may be finding an equivalent in the fanning of the brush or pen and in the "opening" of these arcs to become rotational ellipses. In another observation made during these two days of videorecording, Hannah holds the brush in her teeth, repeatedly biting the wooden handle. The vertical arcs made before and after this might also be in some sense equivalents of this biting action. This is of course controversial, but certainly one can see that actions are being associated with each other to express deep feelings, states or moods.

It is important to note that Hannah is making different kinds of expression and representation. One kind is that which depends on varying the amplitude, stresses, tempo and/or intensity of natural mark-making gestures. This derives from the rythmical sources deep in early infancy which have been described in Part 3. In this expressive mode the child is exploiting a universal time-base, from which any variations immediately take on emotional significance.

One can also differentiate between sound/action/mark combines which establish a relationship to phenomena in the world, whether these be physical objects or axial coordinates, and those which are expressive structures in themselves.

There are other orders of represention which can be distinguished from the cinematic expression. At various points during these videorecorded sessions, Hannah would make closed-shapes which she called "watches". One such example has been cited earlier. Here, an enclosing

line represents either the boundary line of a volume, or the edge of a face of an object (and very likely, the child may blur the two somewhat different denotational values into one another). This representational achievement also issues from natural movements of the body, and has had a long developmental history, as has been described in earlier parts of the present work. In this case though, she is moving toward defining the rules of a drawing system.

There are then, several kinds of representation forming here. Hannah is forming an understanding of equivalences in some rather different modes. One mode is perhaps best understood as belonging to an emergent mathematical class. The counting words or other onomatopoeic vocalisations which she associates with the appearance of marks might be best defined as equivalent to these marks in the special sense that they are the same as the marks, rather than that they stand-for an object in the configurative sense (like the closed shape "stands for" a watch).

From all this it is clear just how rich in emergent representational possibilities so-called "scribbling" is!

The term "theatre", "scenario" and "stage-manage" have been used both in connection with the potential space between caregiver and infant and also in descriptions of miniaturised symbolic play. Here, cinematic terms like "editing" were used, and also terms associated with artistic practices; selecting view-points; field of view. It has been suggested by some that our representations of experiences are heavily influenced or mediated by, or even determined by such cultural forms as theatre and painting. Wartofsky (1980) makes the claim that the formation of internal representations is made possible by the prior existence of these cultural forms. This is a very important point and which in some respects is supportive of the present author's conception of the role children's drawing in the guiding of perception and the formation of internal descriptions of reality. However, the present author departs

from Wartofsky's argument when he insists that the "visual postures" (Wartofsky 1980, p.135) we adopt are completely reliant on the prior existence of certain culture-conventional artifacts, for example; paintings and theatre.

The present writer sees it rather the other way round. I can agree with Wartofsky's notion of "visual praxis" (Wartofsky 1980, p.140) but only if this is extended to include those subtle disciplines of watching and viewing devised by children in their play.

According to the present writer's data, and supported by the work of Trevarthen, the beginnings of such special modes of "watchfulness" (described so well by Wartofsky) are constructed at level earlier and deeper than engagement with cultural artifacts. These modes of perception are present in the infant's engagement with others; in the sharing of fields of view with another; in the stances and selections of visual frames in symbolic play. Contrary to Wartofsky, the present writer would argue that it is the construction of these potential spaces which in fact makes possible the construction of culture-conventional forms.

Where Wartofsky is perfectly correct is in his emphasis on the importance these cultural products in terms of the feed-back loop they form, and how this serves to consolidate certain constraints we voluntarily place upon our perception. Such constraints are guides to further interaction with the environment. The intertwined relationship between of nature and nurture can be glimpsed here; how the cultural forms we create further modify and change our nature.

2D Images as Forms of Social Mediation

There are further points to be made here about the various kinds of cultural input. Brent Wilson has drawn our attention to the fact that pictures and other 2D and 3D art forms in themselves constitute a type of cultural interaction. I am distinguishing this from the kind of

interpersonal interaction described above. Even lacking a rich interaction with others in the form of speech, there may be other forms of interaction available. The existence in Nadia's life of certain picture books with which perhaps she "conversed" in some way, has been mentioned earlier. It would be ludicrous it ignore the influence of existing cultural forms on children's aquisition of drawing skills. The present research has however shifted the emphasis away from a cultural determinism surely equally as deadly as a biological one. This cultural determinism conceives of development as being totally reliant on the prior existence of conventionalised modes. Some ways of thinking about development misleadingly stress cultural input as if this were a completely one-sided process. Rather, the present work suggests very strongly that children are only able to utilise cultural forms in so far as they are already in the process of generating these forms themselves in terms of the deep structures described above. This study has hopefully set the stage for a more sensible and effective study of the interaction between these deep programmes of representation and the products of ambient culture.

Pictures and visual images of various kinds, including static and moving forms, figured strongly in the lives of the children studied in this work. However, the influence these artifacts had upon the children and the use the children made of them can only be correctly understood within the framework of the programmes of search through which the children viewed and explored these forms. There is not the space here for an extended discussion about the mechanisms of the pictorial interaction systems developed by the child. Such a study forms the basis of a new project already underway. Its results promise to be surprising and contrary to some popular opinions. However, there is a place here for 3 examples of this interaction between infrastructural investigation and what is available in the environment. To understand how children

interact with found, ready-made pictures from adult culture it is first necessay to consider the interrelationship between the child's drawing schema and what is available in the optical array. The first example illustrates this interaction:

B.3:2:3 (colour-transparency 78)

Ben is sitting at the kitchen table with a small notepad (210 x 150 mm) and red felt tip pen. Linda (his mother) is standing next to him. Ben looks back and forth between her standing figure and his drawing paper, and starts to produce a drawing which is drawn at least partially from observation. The outermost lines of the drawing are a development of those notionally vertical, notionally parallel lines described earlier. These might represent the occluding boundaries of his mother's body. One line is indented and protruded from the vertical to form breast and waist, the other is indented and protruded from the vertical to denote back, small of back and behind. Two other interior parallel lines represent the straps of his mother's dungarees. Two small lines attached at right angles to either side of the top of each ot the outermost parallels represent the arms. He has been quite happy to squeeze a polygonal closed-shape in at the small area of available space left at the top of the page so as to represent her head (and/or face). (For further accounts of this drawing see Matthews 1983, 1984, 1989).

The denotational values he ascribes to the lines is extremely interesting. Physically, the lines are, more or less, of similar thickness and quality. Yet the denotational values he ascribes to these lines varies dramatically if one considers them each in turn. The reader should now be familiar with the use of closed shapes for the representation of volumes and/or faces of objects. Likewise, the background for the understanding of another denotational affordance has been described earlier. I am refering to the use of lines attached at right angles to baselines to represent tubular volumes in their entirety - in this

drawing they represent Linda's arms. Two roughly parallel lines are used to represent thin strips of denim - the straps of Linda's dungarees. This, like the arm lines, is a variation of the use of line to map almost isomorphically onto volumes saliently extended in one dimension (see Willats 1985). There is possibly another, quite different use of similar parallel vertical lines. I am now refering to the outermost boundary lines which may denote the surface of Linda's body as an occluding boundary or pair of "horizon" lines. This example contradicts the classic Piaget/Luquet account which describes the child as moving from intellectual realism to visual realism (see Part 2 of this work and Matthews 1984, 1988, 1989). In this drawing, what have been traditionally thought of as distinctly different transformational systems become synthesised as one. How is one to describe a drawing like this in the terms of a theory which falsely splits "seeing" and "knowing"? Clearly the child is conveying different types of knowledge within a single drawing and that different stimuli prompt different types of transformational system. This was true of Joel's mountain drawing, described earlier. (See also Freeman and Cox 1985 and my own review of this book - Matthews 1987).

The author's intention here is not of course to imply that the encoding of view-specific information is of greater value that other systems of representation. Western society puts great pressure on its children to conform to a restricted set of representational modes and even within a single mode, their expressive options are narrowed further. This is easy to see in the case of drawing. That children will sometimes draw from observation has been seized upon by some who have pushed children's drawing prematurely into a narrow, still-life drawing mode. In doing this such people tend to simultaneously devalue children's graphic schema, falsely perceiving these as rigid stereotypes from whose grip children must somehow be freed. Because of this failure

to identify the nature and role of children's drawing schema, part of the means by which children make sense of the world is stolen from them.

In the above observation, it is possible to see the rather startling use Ben makes for the graphic structures described in the present work. From about 2:10 Ben has worked with a surprising systematicity to develop these forms. By 3:2:3 he has at his disposal a range of structures including; angular closed shapes ; right-angular attached lines and roughly parallel-roughly vertical lines. These structures have become part of a dynamic programme of search with which Ben can engage in an intersubjective relationship with the optical, haptic and kinaesthetic environment. Having these structures at his disposal, he seeks out any new manifestation of these. His mother standing next to him, wearing dungarees, forms an unusual example of a combination of these structures. Another way of putting this is that what Ben detects and draws in the environment reflects those deep stuctures he himself has initiated.

The same is true for the child's investigation, interpetation and use of ready-made 2D imagery. In the first place, programmes of inquiry arising from the child's CNS alert him or her to their presence within the environment. Pictures and visual imagery of various kinds contain some of the structures to which the child's attention is turning. These forms however, cannot merely be replicated from the original, rather they are filtered through the dynamic templates of the child's own schemas.

Here is another example from Ben, about a month after the last observation was made. At this time Ben is serialising images in his drawing. This seems to be a concept carried over from the cinematic transformations arising out of his mini-world play. The forerunning dynamic adventures of line, either as a continous unbroken thread, or broken down into its ryhthmical intervals, has already been noted. Such

trajectories are reiterated in symbolic play, either in the whirling flight of vehicles, planes or figures, or in their discreet position changes as demonstrated by the child as the clonk-clonk-clonking of figures from position to position (Matthews, 1984, 1988, 1989).

Without the influence of television or cinema being necessary, the child will attend carefully to the changes of state and changes of position he or she initiates and controls. It is the existence of this dynamic structure which leads Ben towards certain forms within the cultural environment. What he discerns and utilises in these forms is governed to a large extent by the development of his own programmes of inquiry. So it is that, as he matures, features about the structure and organisation which thus far remained hidden, now become revealed. It is for this reason that an image found by the child cannot be considered a single, static entity which he/she merely mimicks. A single picture found by the child unfolds layer after layer of meaning for the child as he or she matures. Consider the discoveries Ben makes about the fascinating picture stories (by the great British artist Alfred Bestall) of Rupert's adventures. These he enjoyed looking at with me from about 1 year. It was at around two and a half years of age that he entered a phase when he was clearly trying to work out the structural conventions of the serialised image mode. He would ask questions like,"Why are there more than one Rupert?", and "Why hasn't Rupert got any legs?" I would explain, in appropriate terms, that there was really only one Rupert but he was shown in several positions over time and space. I also explained that the man who drew the pictures had selected a sample field of view and that this was true of many kinds of pictures which showed views of things or people. Again I used terms that he would understand - I said the edges or frames of each picture were a little like the frames of a window - they cut off our view of certain aspects of objects. Rupert really did have legs but these were out of sight, hidden behind the

frame of the picture.

Ben was extremely interested in these explanations, and the serialised-image aspect of his drawings developed. One such drawing shows an extremely interesting relation to a sequence of pictures in a Rupert adventure.

B.3:3:10 (colour-transparency 79)

A lateral line represents the interface between the surface of water and the medium of air - a cross-section of a waterline. A closed shape drawn above this represents a boat (probably shown in section) taking off out of the water and flying into the air. Ben has repeated the image four times on the same sheet of paper to show it moving through positions 1 - 4.

"It takes time, " is his explanation to me for his drawing four images of the same object.

From the base of each of the four versions of the same boat, are those roughly parallel grouped lines with which the reader is familiar. In this drawing they represent streams of water trailing off as this mysterious sailing boat ascends.

Interestingly, in position 4, to the furthest right hand side of the drawing surface, the boat has been rotated through ninety degrees so that the trails of water (grouped parallels) run out horizontally (from the viewer's station- point) and stop at a right-angular junction with the last vertical line of the preceding boat's water trails. There are various ways this part of the drawing episode might be explained. It could be consistent with the episodic nature of the drawing adventure that Ben does not consider the finished drawing as a whole as seen from a single station- point. In this case, in the alignment of the horizontal water trails from boat position 4, Ben might - at this moment in his drawing scenario - temporarily forget or mislay, or choose to abandon, the denotational meaning of the last vertical line (that which

issues from the bottom of boat 3) and use this line as a convenient termination point for boat 4's water trails. Object-centred knowledge might also be implicated. Since the water has to fall from the bottom of the boat, then this remains the rule for boat position 4 - even though this is turned on its side.

These explanations are not mutally exclusive and a combination of them might be in play. However, in the light of other drawings that he produced at and before this time, it is not sufficient to invoke either the "perpendicular error or bias" theory, nor the Piagetian explanation (at least on its own) which describes the child as only gradually integrating elements into an overall Cartesian coordinate frame.

It is very revealing to compare Ben's drawing with a page in the Rupert picture story book. Bestall shows the boat taking off in a sequence of brilliantly drawn stills. Water does indeed trail off from the bottom of the boat. However, in some very important respects, both in terms of the sophisticated graphic system adopted by Bestall and also the form of the depicted boat itself (a sailing yacht) these pictures differ fundamentally from the ones produced by Ben. Ben assimilates the knowledge he acquires from Bestall's drawings into his developing schemas of this kind of phenomena, which includes a complex of abstractions of a range of types and orders of specification. Some of these schemas have been developed in his own self-generated play, including the adventures of handheld boats he flies in his bath and from which water drips or pours. Again, there is not the space here for an extended debate about the reasons for popularity and success of certain cultural forms, but suffice it to say that Bestall's picture story is successful for Ben precisely because underlying it are trajectorial events which are represented in Ben's own C.N.S. and which are of extreme salience to him at this age of three years, three months. Bestall's picture story incorporates a smooth linear ascent and descent

involving humans who are contained within a vessel of some kind and which is suspended in 1 G field. There is an added feature which is also of high salience to Ben - the boat drips water. These are deep structures generated by the children themselves, which go through many different manifestations as the child matures, but which peak in significance at a certain times in a child's life - just after three years being one of these times.

The child interprets the media in terms of these deep structures which are represented in the CNS and which are continuously developed. The example of a forerunner to this flying boat drawing is offered to help convey something of this continuum: When Ben was 2:10, he drew a Rupert adventure in terms of a convoluted and rotational linear adventure, like one of the earlier action representations with which this study commenced. The sophisticated serialised image discussed above, is a development of these early sensorimotor adventures of line.

This leads me to my final example for this work. It was at the age of 2:10 that Ben started to develop drawings about steam-engines. We were on the Isle of Man at the time, and he was lucky enough to travel on a steam engine. From two years and a half, train journeys figured in miniature play and were represented in drawings using the linear action representations described by this author earlier and in other works cited above. On the Isle of Man there was a renewal of interest in the locomotive engine, an interest which was supported in part by the availability on the island of postcards depicting steam engines and also children's picture story books about steam engines. I also bought him a cheap, plastic toy engine which ran on plastic rails.

He played full-size play, his own body performing the actions of a steam engine. He had seen how the engines were able to travel backward along the tracks, and sometimes he would insist on trotting backward through the streets making engine noises.

I later bought him a small, cast-metal steam engine, with which he played, in fact for several years. From about three years he covered portions of this toy with an undulating surface of plasticine which issued from the funnel and which emulated the way in which the smoke of these engines would sometimes envelope and cover large areas of their forms.

About a year after Ben had produced his flying boat sequence, and after he had produced an astonishing series of other serialised images, he produces some drawings of steam engines in which he is clearly trying to extend the range and order of information he can encode about such volumetric solids. Consider a drawing he makes at 4:3. "Oblique parallels are used ...to show what in reality are horizontal edges of planes - the sides of the carriage - receding away from us in this drawing of a steam train coming straight toward us. Two sides of the carriage are shown, plus a front view of the engine, and a plan view of the railway tracks. This drawing then conveys both object-centred and view-centred information (Marr 1982; Willats 1985)." (From Matthews 1989, p. 137-138). (Colour-transparency 80.)

The difficulties of using lines and line-junctions to specify projective relations cannot be described in terms of production problems. It is not the case that children cannot produce the necessary lines. Experimental work has shown that children can produce the lines, line orientations, line junctions and vertices necessary for the depiction of cuboidal forms when these appear in non-representational designs (Phillips, Hobbs and Pratt 1978).

John Willats (1985 personal communication) has suggested the part of the child's (or, for that matter, adult's) difficulty in using a projective system is not due to any motor problems in producing oblique lines. It is rather, a symbolic difficulty of using an oblique line to represent what in reality remains a horizontal edge but one which

recedes back away from the viewer.

Now, again it is illuminating to consider what was available in the pictorial environment, and how Ben has used this. At this time, he has started to notice and collect perspective drawings of steam and deisel trains either zooming toward or away from the viewer, or photographs of these scenes - which are automatically in perspective.

In regarding the drawing under discussion, what has he been able to accept from the examples he has been collecting and studying? Well, he has accepted the new idea that oblique lines need not necessarily represent a sloping surface, but can denote an edge of a plane which remains horizontal but which recedes back through the picture plane. As was mentioned earlier (regarding Joel's "mountain" drawing) different contexts may elicit different perceptual (and thence representational) modes. It may be that within a view of a railway train - an object "saliently extended" along one dimension - to use John Willats' (1989, p.5) terms - the apparent or optical "slope" of the horizontal edges is, to the child, very striking indeed. This new, optically derived information may in such instances override other forms of knowledge of the object - the ecological knowledge that horizontal edges remain horizontal. This effect may work with both 2D representations and the sightings of the real, 3D object.

In the perspective system of course, parallel lines meet at infinity. It seems to the present writer that Ben is not able to accommodate - at this moment in time - to this feature of the perspective system. He assimilates this to another system, which he does possess at this moment.

Possibly his very rich play with blocks and Lego has contributed to the knowledge he has acquired and the significance he has attached to parallel lines. In building towers and buildings, he has realised that the congruence between pairs of parallel sides can be crucial. He has

discovered that in order that his toy trains run along the railway lines, the wheels must be aligned exactly parallel on the tracks. It is this kind of information about structural relations which is very hard for the child to abandon.

His detection of invariants tells him that carpentered, rectangular objects retain these despite changes of position relative to one's own station-point, or to movements to which the objects themselves may be subject.

Mention has already been made of the child's representation of the relation parallel in drawings made half way through year 2, long before the concept parallel could be understood in words. Such experiences, however, form the basis of later, more conceptual understandings.

Now, at 4:3, a new kind of viewer-centred information is vieing with Ben's knowledge about the invariant relations of parallel edges within real objects. However, Ben is still resistant to those features of this new information which sacrifice some of the knowledge he has acquired about the enduring relations within the structure of objects in the world. So it is then (it seems to this writer) that he interpretes the converging parallel line system of perspective into an oblique projection system which preserves the parallels of the railway carriage. For perhaps similar reasons, he has felt obliged to attach two sides of the carriage, one to each side, left and right, of the circular face of the engine. It is almost as if the sides of the objects have been opened out like flaps - an action one could perform on, say, a cardboard box. In fact, the very young child's drawing of a cube can be very like this in his or her attempt to capture more of the main features of the object (see Willats 1981; Phillips, Hobbs and Pratt 1978). Such drawings are sometimes referred to as "fold-out" drawings.

This drawing constitutes a resolution made by Ben between two conflicting kinds of representation. One kind is the ecological informa-

tion which tells him that carriage roof and floor must remain parallel and cannot converge. Another type of information is that which specifies the optical array as seen from a single station-point. It is sometimes extremely difficult to form representations of this latter type of information from the optical array - to abstract a visual field from a visual world (Gibson 1979) for when there is conflict between the two types, the ecological information may override and take precidence.

It is important to emphasise that at no time had Ben seen in the surrounding pictorial environment a system of representation anything at all like the one he adopts in this drawing. Like Joel's drawing of mountains it is again, for the child, an original solution to a representational problem, that of encoding the 3rd Dimension onto a flat surface. The moves the child makes toward the encoding of depth on the drawing surface is spontaneous, and is not the result of Western Ethnocentric conditioning. To invoke controversy further, the present writer would speculate that the encoding of depth is a universal desire. As was mentioned earlier in Part 2 another aspect of this which is of great significance is that it is a discovery made by artists, independently of each other, all over the world at different times in history.

So, the child's detection, search and use of cultural examples is strongly guided by those deep structures initiated and developed within the child. In this last example one sees different orders of structure either in synthesis or in competition with each other in a single drawing. One set of structures preserve the natural and persistent features of the object or array - the essential structure irrespective of viewpoint; another set of structures convey features of an array as seen from a certain station-points. This is a transitional drawing - he did no such drawing again - but took further steps in sorting out the inconsistencies, paradoxes and ambiguities arising out of the fusion of these systems. From 4:3 to 4:4, in a stunning series of drawings of

trains and other forms, Ben begins to use a controlled, graded decrease or increase in optical or apparent size differences to specify recession to optical infinity. In some steam engine drawings he omits the carriage, as if to simplify the problem. (Colour-transparencies 81-82.)

Gibson might be right in saying that our visual perceptual system is best suited for viewing the real world than for the construction of pictures, but the child is very sensitive to the feedback from the finished drawing and is informed and guided by the contradictions he or she detects within a drawing like this.

Arnheim's ideas on this have already been noted in Part 2. He has quite rightly said that drawing is not so much guided by somehow looking harder at nature but rather arises out of the child detecting inconsistencies in the systems within the drawings and drawing processes themselves (Arnheim 1974).

Conclusion

This account of the interaction between programmes unfolding from within the individual and what is available within ambient culture focuses our attention on the vital role drawing can play in assisting the infant's development of representations both external and internal.

Both sets of longitudinal studies; those of Ben, Joel and Hannah, and those of the 40 nursery children support the claim that drawing, far from being peripheral to cognitive development is actually central to it. Videotapes of self-initiated, self-motivated drawing episodes, in home and classroom settings, reveal processes of development, sometimes unfolding over periods of days - or even seconds - in which childen make a series of moves through drawing processes in which one can see in detail the change occuring in the values they attribute to shapes, lines and line-junctions.

None of this can be explained by invoking the idea of "copying" - a point to which I will shortly return. Nor can this development be accounted for in terms of motor-skills development alone.

The videotapes show that the quantum leaps made by the children are primarily in cognitive development.

Nor is the term "stereotype" applicable. In the videotapes one is witnessing the children's discovery of structural/representational principles which are - for the children - fresh and brand new.

These recordings are compelling evidence that for the young child drawing has a biological importance. Otherwise, why should they spend so much time so intensely engaged in this activity? (Willats 1989 personal communication).

This work has stressed that the act of drawing itself alerts the child to certain forms and relations within the world. Our forming representations of the structure of events and objects guides our search and perception of this structure. There occurs an interaction between the external and internal representations as they constantly inform and modify each other in a mutually reciprocal process. There have been many examples of this in the present study but a clear example occurs in the observation in Part 5 of Hannah, when she represents a descending vertical, first in 2D, and then goes on to enact this descent with a real object. Immediately after making the "descending" line she carefully watches the descent of an object which she herself drops. She even augments its moment of impact by synchronising a monosyllabic sound effect.

The initiation of the child's programmes for the detection and use of the deep structures described above is not dependent on the existence of these forms within the environment. For example, it is probably not the case that the child's use of the right-angular attachment is unduly affected by the presence or not of carpentered forms in the environment.

Nor, for example, were Hannah's rotation-and-fall routines copied from certain cultural models which in some respects they resembled - for example the "Ring'O'Roses nursery rhyme. It is rather the other way round. Hannah generated this form and then her family supplied the nursery rhymes and other forms which embody this structure. Significantly, in this observation it was her attendant family - her brothers, her mother and father - who imitated her! Trevarthen has also noted that whilst the tendency has been to think of the baby learning by imitating the caregiver, in his observations, it was most usually the mother who imitated the infant (Trevarthen 1975). He has shown that there is a universal rhythmical time-base to the action games and rhymes played by infant and caregiver (Trevarthen 1987). It is the very existence of this deep rhythmic patterning which gives any variation from it - in terms of emphasis, amplitude, repetition and duration - its immediate emotional, and ultimately symbolic, significance. This view of the relationship between development and cultural forms is the very opposite of those propounded by some others.

Nor can subsequent development be accounted for by any simplistic notion of the availability (or not) of these forms. Simply that "they are around" is not sufficient explanation either for the way they are used, or for their particular moments of onset in development. Nor can such cultural "image-pool" models explain the extraordinary hybrids - so unlike any pictures or models the children see - which are constructed from them. As has been described above, the child's sensitivity to certain of these forms at certain times is a consequence of the existence of these structures which are represented - in various states of completion - in the nervous system.

It is almost certainly generations of infants who have ensured the retention within societies of the plethora of certain images, stories, rhymes, television programmes and films - precisely because they can

recover from these forms those dynamic structures they themselves are generating. (In this regard, a new study of the interaction between television and children's schema generation would be a valuable area of research.) Again, this is rather the reverse argument from those who see children as the passive recipient of propaganda - and those who construct education curricula upon this notion.

The study has considered how children understand and use ready-made pictures and other cultural artifacts. The notion that children simply "copy" their drawings from those around them has, for some very cogent reasons, been rejected. The study has described how the child's detection and use of pictorial forms is mediated by the child's developing schema. The child is only able to imitate cultural forms insofar as he/she is also generating them him/herself. Pictorial and 3D forms are further mediated, to a greater or lesser extent, and in a variety of ways, by the caregiver. In the examples of Ben, Joel and Hannah cited above, conscious attempts were made by their parents to help the children interpret pictures and other available images. In these instances, the caregiver plays an important role in helping the child in the moves he/she is making towards new levels and types of description. It is important to consider the child's discovery and use of existing pictures made by others within this social setting. He or she does not discover these in a desert. These forms are an extension of the 4D language created between infant and caregiver.

This may also be the situation in unusual cases of surprising drawing ability in autism, of whom cases like Nadia and Stephen Wiltshire are examples. It may be extremely misleading to account for such ability in terms of abnormal pathology. The idea that autism is an artistic benefit is a notion that this writer at least finds unacceptable! It may be that autistic draughtspersons of such calibre use the one channel of communication left open to them. Certainly, in Stephen

Wiltshire's case, no child artist could wish for more applause and support for his drawing, and - although one must be cautious here - Stephen did seem to acknowledge this interest.

There are clearly some important questions to be asked about educational provision. In order that a caregiver or teacher is able to support and encourage development, it is necessary first all that he/she be in a position to identify these modes of representation which are unfolding within the child.

Though the evidence offered in this study is not extensive, along with the research of others (Athey 1980; Wolf and Fucigna; Smith 1983; Court 1987) it supports the theory that, at a deep level of description, the principles which guide expression and representation are universal. Moreover, as in the model proposed by Bickerton, this biological language does not deal in vague urges to be creative, but rather contains within it explicit structural-representational principles. This idea can stir up a great deal of controversy, very often because it is confused with some other, rather romantic and idealised or Western Ethnocentric notions of this universality. This author disassociates himself from such accounts.

However, this author also disassociates himself from those others who stress cultural influence whilst remaining ignorant of and insensitive to the deep structures within which variance occurs. As I have stated elsewhere, such people confuse content with structure, denotation with decoration (Matthews 1988). There are of course, profound differences in the styles of representation we see in the world; there are gender differences in drawing and there are striking individual differences. (This latter variation is probably more significant than the preceding ones).

It is probably the case that different cultures and different social settings emphasise different features of this universal structuring.

Clearly, one should develop a sensitivity to these differences. Indeed, this is what this study hopes to promote. However, unless one can identify those deep programmes of action which underlie representaton, one is in no position to detect and describe cultural - or any other - variation. What is it that is varying? What is it that develops? This writer suggests that only in an approach similar to the one outlined in this thesis is it possible answer these difficult questions.

It is being argued then that individuals contain within them the software for the "creation of culture" (Trevarthen and Grant 1979, p. 566) and that educational provision should be organised with this model in mind.

Studies of the relationship between gesture and language as these evolve between infant and caregiver have been a great help in this regard. Petitto (1987) has postulated that infants' gestures belong to an intermediary interaction system - that is, a system of behaviours between actions and signs. The present writer's work has shown that - for some children - the actions of their bodies signify even more than this - especially when they are used in early drawing. Trevarthen's work has shown actions acquiring their symbolic values within an interpersonal envelope formed between infant and caregiver.

The present work has described how behaviours evolved in this intersubjective micro-world are developed in later infancy to become a cluster of mark-making actions which are highly charged with expressive values, and to which the child quickly attributes denotational values. Certain experimental research models separate and isolate these graphic actions from their setting within a complex of actions the child uses to form descriptions of reality. As with the very beginnings of symbolisation, the true significance of behaviours at this later level have largely been missed. The present writer has described elsewhere how the beginnings of representation in childhood can go unnoticed, con-

sisting as it does of commonplace, even trivial seeming behaviours that one might see in any nursery (Matthews 1988). Across a "...range of different behaviours, children investigate an array of semiotic possibilities. They find within these different activities, conceptual concerns, representational and expressive structures which remain essentially similar or unchanged throughout transposition from one medium to another.

The child's discovery and use of these structures signals the beginning of understandings which are logico-mathematical, spatial, musical, linguistic and configurative. Embedded initially in the organisation of the child's actions, they are nevertheless the beginnings of symbol and sign usage. These patterns of action become interiorised to form internal descriptions of reality" (Matthews 1988, p.163).

Most research into drawing has not come near to making the important connections between this family of behaviours and the child's drawing. In the terms of much recent experimental psychological research on drawing, all actions except those used by the child to make accurate copies of geometrical figures, or to form unambiguous depictions of volumetric solids in space as seen from a single station-point, have been regarded as extraneous interference to the graphic act proper. Laszlo and Broderick, for example, in an otherwise important chapter about motor performance in drawing, call such behaviours "over-inclusive, inefficient programme(s)" (Laszlo and Broderick 1985, p. 360). As has been shown, such programmes, far from being inefficient, actually form the basis of early representation! Evidence has been offered which supports the idea that even in the hands of an 18 month old, mark-making becomes an expressive vehicle through which the child may respond with acute sensitivity to the most subtle shifts, nuances and changes in interrelational ambience.

The present study has sought to relocate drawing within a programme

of symbolisation that is the child's own and which is used intelligently for the child's own purposes. The study has shown then that drawing development is not to be considered as a hierarchically tiered series of drawing systems, with earlier, inferior ones gradually replaced by later superior ones. Development in drawing cannot be measured solely in terms of how well one shows occlusion or relative sizes; nor by how well one adds heads to shoulders of human figures, nor by one's use of oblique lines in the drawing of cubes! (Wolf and Perry 1988). The notion is often glibly stated that children soon become dissatisfied with their drawings and if they only knew how to draw in perspective, then they would do so. The present research has revealed that it is far more complex than this. Children are often very reluctant to move toward drawing systems which sacrifice what they consider the essential structure of objects. Perspective actually fails to preserve any of the structure of objects. Except for very distant objects, all objects depicted in perspective are violently distorted. Children create drawing systems from which they can recover those features and relations of objects which remain invariant regardless of certain other transformations the objects might undergo or they, the children themselves, experience.

It is interesting to note, in this regard, that the Chinese had been aquainted with the depiction of three-dimensional solid form as early as the 7th Century (when such an approach had been introduced by the Buddists) but that this form of representation had largely been considered by the Chinese as unsuitable for the aims of their painting. The Chinese had never been interested in the notion of the painting surface as a "window" looking out onto a physical world. They were concerned with the rendering of a metaphysical, transcendental space itself - not the portrayal of physical objects within space. So it was that again, in the 17th Century, the Chinese knew about the perspective

system but generally chose not to use it because it could not convey the kind of spatial information they required in their pictures. (Sullivan 1973, Edgerton 1980, Costall 1988, personal communication).

Whilst the unambiguous depiction of three-dimensional volumetric solids is important and does constitute one of the uses of drawing, and whilst children themselves seem to spontaneously move toward the depiction of projective relations, this is not the most important aspect of drawing - either in childhood, or in terms of the world's art. Interestingly, the beginnings of the encoding of projective relations occurs much earlier in infancy than has commonly been assumed - a fact which, ironically enough, is actually hidden by those very research models designed to reveal it!

Those who overemphasise close-observational drawing do not understand the significance of the child's graphic schemata and quite incorrectly see these as rigid "stereotypes" from which the child must be freed. Such people are not supplying the child with a "tool for learning". On the contrary, this approach actually contributes (along with other limited and limiting forms of pedagogy) to the destruction of the very "literacy" of sensory systems (Eisner 1985, p. 163).

In any case, drawing is not primarily about the representation of objects but is an interplay of forces (Arnheim 1974). The infant begins, from the outset of life, the activation and guidance of these forces in the service of expression.

Experimental work has been very valuable in teasing out some of the task demands which arise when children try to represent objects, but the true significance of this work will never be realised unless it is located within the evolution of graphic structure in itself. When Freeman (1989) asks how children form "recognisable" depictions, he is of course using his own definition of "recognisable". In order to find out about the strategies they employ when drawing the human figure,

Freeman (1980) supplied very young children with two closed shapes joined together in vertical linear relation, mimicking head and body unit relations. In a series of experiments he asked them to attach arms in the "correct" place to these configurations. The size relation between the two shapes was varied; sometimes the top one was the bigger. Why children either attach lines either to the bigger of the two closed shapes or to the join in-between these shapes, is a real problem (see Freeman 1980, 1989).

The question remains however as to how much this is an artifact of short-circuiting the child's spontaneous drawing development. It is interesting to note that out of thousands of observations of spontaneous drawing processes, the present writer has seen only a very few drawings produced in which lines representing arms are attached to the join between head and body units. This in itself does not form the central objection to Freeman's approach. Such experiments can recover important information regarding internal representation and external representational strategies - information which is not always revealed in spontaneous behaviour. The question being raised has to do with the structural procedures which arise from the child's own, self-initiated enquiry about representation. Once again, it is about the uses to which children themselves are putting drawing media.

The answer to the drawing strategies as revealed in Freeman's (and others') experiments may be found in looking at the structural significance that children attach to certain relations of shape, and to certain principles of formal differentiation which arise out of a programme of development designed to capture and cope with far more important concerns than these so-called "recognisable depictions".

The idea that the child is the originator of graphic structures which are not derived from existing cultural models is supported by research into other aspects of development. Of especial importance has

been recent work on language acquisition. This has provided a powerful analogy for drawing development. In particular, Bickerton's (1981) work on Creole language has suggested that language acquisition may be driven by an internal bioprogramme which frees the child from dependence on imitation. Such a model has been useful in helping dispose of the mistaken belief (which continues to hamper research and education) that drawing ability relies on skills in copying. Like Willats (1983, 1985) the present work has offered empirical evidence that the child's drawing is - in a quite strict, technical sense - creative.

Recent research in neuropsychology has likewise strengthened this writer's thesis that drawing development is, at root, a naturally unfolding process driven by innate mechanisms. The concept that living organisms have standards and objectives of their own, which are housed in subcortical structures, and which require, for their development, certain external conditions to be met is, for the present work, a very cogent idea indeed (Young 1978). Currently, so-called educational "reforms" have been introduced in Britain which demand - by law - the establishment of external, fixed "aims and objectives". These are conceived in isolation from any identification of the unique requirements of human individuals. To the best of this writer's experience and understanding, these policies cannot do other than damage development. This view is shared by others - Dewey (1938); Eisner (1985); Blenkin and Kelly (1988).

A curriculum has to be designed which is sensitive to the child's internal aims and objectives and which assists in the child's realisation of these.

For these processes, though generated from within the organism, require for their development a certain kind of physical and interpersonal environment. Neuropsychology has shown that certain internal perceptual programmes cannot be initiated and developed unless certain

external conditions are available at particular times. Development is partly due to changes in the architecture of the brain which allows for new types of organisation of old programmes, and for the initiation of new ones. These changes in the CNS do not take place if the organism is deprived of certain key experiences in the environment which trigger the onset of such neural growth. A consequence of the failure of these requirements to be met is that the learning that such neural organisation affords, also fails to take place (Blakemore 1988).

There are clearly some lessons for education here. The present research shows that programmes of symbolisation, whilst self-generated and not culturally determined, neither are they completely biologically determined.

It is precisely in the nature of these internal programmes that they are sensitive to ambient culture. (This is why this author's concept of universality is not to be confused with a Cizekian notion of development occuring within a cultural void). It is precisely because our internal schema is of such sensitivity that educational curricula have to be designed with great care. These programmes are easily damaged or distorted by certain kinds of environment and by inappropriate curricula imposed by external agencies lacking any understanding of these internally driven processes.

If then, a society genuinely cares for the cognitive and affective growth of its members it has to a responsibility to plan carefully those experiences to which it exposes these internal programmes.

There are those persons who say that there is no society, only individual men and women and their families. This is a silly thing to say, for it actually signals a return to mere barbarism. The much demeaned tribal unit cares and provides for its individual members, including its children. If a government really does not care about this, then we have no civilisation worthy of the name.

The ideas of the present writer are supported by Elliot Eisner (1985). He has also argued that in childhood we have an array of representational modes, but that behaviourist or mechano-industrial models of education cause the majority of these modes to wither and atrophy. Even the remaining ones are cruelly delimited - partly as a consequence (the present writer would argue) of the destruction of the other modes. For these modes actually "...'speak' to one another..." (Wolf 1989, p.23); inform each other, enrich each other. Until we recognise the purposiveness and potential completeness of these internal modes of representation we will continue to produce incomplete people.

Young (1978) has said that living organisms are themselves representations of their environment. We are incomplete representations when we are born. We are equipped with the software for the seeking out of those very experiences which will complete us as living symbols of our world.

I would like to say that educators need to be encouraged to help in the infant's search for completion. Unfortunately, the truth at present is more basic. We need first to be allowed to provide for their pupils in this way. At present, the approach to education proposed within this document is endangered. It is in the interests of certain people to undermine our propensities to become competent symbolisers. The characteristic form that domination of one human group over another takes is the destruction of the dominated group's language. An even more destructive form of domination is to rob people of the capacity of symbolisation in itself.

Here then is the fine balance: the young human organism is the initiator of a programme of representation and expression, but becomes in itself a medium that is highly responsive to any changes and disturbances occuring in the extra-corporeal environment.

We need to develop methods of enquiry which help identify these deep structures. If we do not do this we continue to be guilty of a kind

of institutionalised child-abuse of which the so-called "reform " of British education - unless educators are allowed to improve upon it - is but one example.

The present work does, in fact, constitute one form such an enquiry can take. The present work is more than just another of those well-intentioned but ultimately vague global statements about the worth of art. This writer's evidence points towards the way in which positive interaction and provision for childcare might be conceived and constructed.

Analysis of the descriptions above of painting and drawing episodes reveal a multi-levelled arrangement of learning and teaching modes which appear to be present within the sphere of interpersonal relations between caregiver and child. This nested arrangement takes the form of a fluid, dynamic structure of different modes of interaction which range from the simple instructional to the more complex; including various levels of support, cooperation, sharing and extremely subtle levels of empathy and exchanges of understandings. Some recent government proposals regarding education only appear to understand Level 1 - the instructional.

Using this author's approach it now seems possible to identify these modes and describe the interrelationship between them.

The form and content of children's symbolic scenarios have been studied in sufficient detail within interpersonal contexts to allow for the mapping of certain guiding and ever-present principles to be outlined (Blenkin and Kelly 1988) rather than the establishment of "aims and objectives" mentioned above. The "aims and objectives" model conceives of knowledge as a product - a commodity - owned by a few and doled out only in prescribed and limited doses by a ruling minority.

It is an illusion that one can plan for the future in the sense that this is so often couched. One cannot build a railway track, or conveyor

belt into the future, and establish in advance, not only the stops on the way (spot-checks for quality-control) but also the ultimate terminus!

The only realistic way to prepare for the future; the only truly "relevant" skills that children must learn, are those which are developed in the symbolic scenarios described above. It is at this level that the child develops the skills without which the construction of an objective world is just not possible. It is at this level that the child engages in an intersubjective dialogue with the environment itself (Lorenz 1971). It is this level of learning which requires support from adults. For this to be possible requires that the language in which these dialogues are written be identified and interpreted.

The present research has gone some of the way in the translation of this language.

It is in these dialogues that children construct and prepare themselves for any of those "probabilistic futures" described by Partington and Grant (1984, p.217) and mentioned in Part 4 of the present work. They can do this because, in the construction of objects and events, they are simultaneously engaged in internal representations of themselves, and of their relationship with a range of possible unfolding scenarios.

The study has shown that in synchrony with the child's discovery of the representational potential of graphic structure, he/she also discovers what Nancy Smith (1989, p. 1) has termed "...the expressive characteristics inherent in media."

The term "representation", when it applies to drawing, has been used, in this study, to mean the potential of lines, marks, shapes and colours to denote or specify the form of objects and events; by "expression" is meant the capacity of marking actions and resultant effects to convey mood, feeling or emotion. That the early mark-

making of very young children sensitively records changes in emotional temperature has been confirmed by Steve Harvey, who has used the present writer's work in experimental settings (Harvey 1989 personal communication).

In this work, drawing has been located within the general development of the child's construction of Self and World. More than this, drawing has been shown to play a special role - not replicated by any other behaviour - in the formation of these internal descriptions. The child uses drawing to build up descriptions not only of objects - the configuration of cars, cats or clouds - but also the configuration of events, the movement of the cloud, the crashing of the car. The child uses drawing to express not only the only states of things but states of mind.

This kind of construction is occuring in the observation with which this study commenced, when Ben, at 2:1, with a whirling paintbrush describing the elliptical course of a car, is the driver who considers what is awaiting him, "around the corner".

THE END

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Videorecording

The videorecording consists of 78 minutes of edited sequences taken from the 300 hours of videorecording made of the 43 children.

The following sequences are shown:

Hannah: 18 Minutes

H. 0:0:4 days of age. Interaction between infant and mother.

H. 0:0:7 " " "

H. 0:0:8 " " " Interaction between infant and older siblings.

H. 0:0:14 " " "

H. 0:0:28 " " " Reaching toward object.

H. 0:1:17 " " " Interaction between infant and mother.

Hannah-Rotations:5 Minutes

H. 1:9:28. Rotation in 4D.

H. 2:0:3. Rotation in 2D.

H. 2:2:26. Rotation to closed-shape. Configurative values.

H. 2:6:12. Rotational closed-shape with lines attached.

Hannah Painting with Linda. Real Time and at One Quarter Speed: 45 Minutes

H.2:2:28

Jason:10 Minutes

3:10:23 - 4:0:3: