I declare that this thesis is all my own work.

Jacqueline H. Kujawski
To my father
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**APPENDIX**
Abstract

This thesis examines one particular aspect of the infant self-concept, namely gender identity. The main experimental paradigm is simultaneous presentation of films of boy and girl infants to other infants aged between 10 and 14 months. Prior research has indicated that, at this age, infants will fixate photographs and films of same-sex other infants longer than those of the opposite-sex. This effectively constitutes an identification of gender.

Here, this is explored further by means of moving patch-light displays of infants. On presentation of boy and girl infants simultaneously it was found that, by one year, infants will again preferentially fixate those of the same-sex. It is suggested that this indicates the ability to recognize same-sex other infants from movement information alone.

In addition, two groups of younger infants were presented with the same display. For both groups, no preferential fixation of same-sex emerged. As all of the infant Ss in these experiments were pre-walking, it is argued that this provides further support for the contention that type of movement is included in the early self-concept.

An analysis of infant movement was also performed. Some differences between boys and girls were noted, including arm-swing and stepping-patterns.
Finally, a test of the efficacy of reinforcement in the ontogeny of differential movement was attempted. For this, films of young infants smiling were presented to mothers. It was found that perceived gender label appears to alter responses by mothers to the same infants. It is argued from this that differential reinforcement may be at least one factor in the ontogeny of differential movement in infants.

The implications of the above are discussed within the broader context of the developing concept of self in infancy.
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CHAPTER 1

THE INFANT'S SELF-CONCEPT
INTRODUCTION

This thesis is concerned with the development of the self-concept, with particular reference to gender identity. A concept of self is, of course, the understanding of self as we relate to the world, particularly the world of others. It is how we define ourselves relative to others.

By way of example, consider a friend of mine. She might describe herself as an intelligent, lively, small, brunette female. From this, it is clear that the particular components used to define self are descriptors which function entirely in relation to others. To call oneself "intelligent", for example, is to imply that there are a greater number of people less intelligent than self, rather than more. Or, to continue the argument, that there are fewer people more lively than self, rather than less. In other words, a concept of self functions to delimit how we both differ and resemble others. That is, it is how we define ourselves relative to the numerous others we encounter in the course of our lives.

In this sense, probably one of the most significant means of delimiting self is gender. With only a very few exceptions, it is safe to say that everyone belongs to one of the two gender categories. A case may also be made that, due to its very generality, gender must be one of the earliest descriptors to appear in the developing
self-concept. Indeed, it is virtually impossible to conceive of a concept of self which does not include the gender categorization.

It is from this premise that this thesis aims to explore the development of the self-concept as indexed by the presence of a gender identity. In particular, an attempt will be made to examine the possibility of an infant awareness of gender, as one means of considering the understanding of self in infancy.

Despite its significance and despite an abundance of theory, there are, in fact, very little empirical data on the development of the self-concept, particularly in infancy. As with other areas of infant research, the problem is to find methods appropriate for indicating the existence and state of psychological concepts. Nowhere does this problem appear to be more acute than in studies on the developing self-concept.

Indeed, even with older children, researchers have tended to side-step the issue altogether and, instead, have concentrated on evaluative measures such as self-esteem (Damon and Hart, 1982). Unlike other research on concept formation, in self-concept research the explanatory factor is self-generated rather than externally-observed. Naturally, the area that has suffered the most here is infancy. Later in the chapter, the available empirical infant research will be discussed.
in more detail, after a consideration of theory.

With regard to the latter, it should be stressed here that, in a developmental context, many theorists propose that there is initially a lack of differentiation between self and others. Instead, the task in development is to establish the limitations of self in relation to others. In this sense, the self-concept is considered to develop through a progressive differentiation of the self from others. That is, there is an increasing awareness of the parameters by which self differs, as well as resembles, others.

William James

William James (1890/1950) provides a formulation of the self-concept which continues to influence developmental research to this day. According to James, the self has two aspects - the "I" and the "me". The "I" is the knower, as the basic principle of existence. It has been variously dubbed as the pure ego, the phenomenological ego, transcendental ego, the Soul, the Thinker; while the "me", alternately, is the known, the object-self, empirical ego, categorical self, self-consciousness, the self-concept. Essentially, as mentioned earlier, it is how we define ourselves in relation to the external world.

Of the former, according to James, very little can be said in an empirical context. Behind every "passing state
of consciousness", is there something permanent, or is it the state itself?

The states of consciousness are all that psychology needs to do her work with. Metaphysics or theology may prove the soul to exist; but for psychology the hypothesis of such a substantial principle of unity is superfluous. (p. 203)

In other words, for psychology, only the "me" - how we and others see the self - is important. Only the "me" is open to empirical investigation.

Developmentally, many believe that central to the I-You distinction, is the I-Me distinction as outlined by James. Moreover, as the "me" is how we define ourselves in relation to others, the development of understanding of "me" is highly dependent on others. For example, G.H. Mead (1934) proposes that the self can only be known through others. A corollary of this is that how we define others must be inextricably linked with how we define ourselves. Researching the infant's understanding of others, therefore, may be the only means of clarifying his awareness of self. However, it should be noted that many theorists assume that self-other differentiation does not take place until after the period of infancy. One in particular is G.H. Mead, in the social-behaviourist tradition.
Mead

Mead (1934) was largely influenced by James, and his theory provides one of the earliest accounts of the origins of the self-concept in this tradition. For Mead, there is initially no self-other differentiation. Rather, a concept of self is assumed to be actively derived from the social process. As with others, Mead proposes that language is the salient mechanism, and therefore, infancy is not considered here.

For Mead, it is through language that the child attains a mind and a self. Although certain physiological capacities are necessary, it remains for language to provide the vehicle for thinking, and in particular, see ourselves as we appear to others.

In this conception, an important component is the gesture. According to Mead, the gesture, in order to be effective or meaningful, must consistently give rise to the same response in others. Furthermore, the agent of the gesture must be aware of the likely response. That is, he must be able to see his act from the others' point of view. The most effective system of meaningful gestures is, of course, language (vocal gestures). Language is the communal legacy of past minds which, according to Mead, gives rise to new minds. It enables the individual to see
himself as others see him, by providing him with vocal gestures which will produce a consistent response in others.

In this way, language enables the differentiation of self from others. The individual can look upon himself as an entity, in much the same way that others look upon him. In this attainment, Mead outlines two important mechanisms, namely, play and games.

In play, the child singularly assumes the roles of others he has encountered (persons and animals); while in games, a more sophisticated enactment takes place. Here, the child has to incorporate the roles of everyone in the game, in order to participate successfully. In this way, the attitudes of others become "generalized". By adopting the roles of others, the child gradually takes the attitudes of others into himself — that is, he effectively elaborates the notion of "me".

In this theory, therefore, the acquisition of a concept of self comes late in development (after infancy), and is inextricably linked with language.
In a different tradition, the psychoanalysts have produced many accounts of self-other differentiation; as here, it is considered to be closely linked with the genesis of pathology. Unlike the social-behaviourist approach, the emphasis tends to be on the unconscious aspects of self.

Freud

For Freud, a concept of self was considered to arise relatively late, around 6-7 years, on resolution of the Oedipus complex (1923). As this is discussed in detail in the next chapter, it will not be considered here. However, one component of Freudian theory should be noted, namely, the concept of narcissism.

Freud derives the term from the Greek mythological figure, Narcissus, whose fate it was to be in love with his own reflected image. To Freud "His Majesty the Baby" is initially in such a state. The infant world is governed entirely by the strivings of the instincts (called the state of "normal autism" by Mahler interpreting Freud, 1968). However, despite the assumption of an initial asociality, Freud was aware of some significance of the other in the search for oneself. In particular, an important component in the deflection of the original narcissism to the outside...
world is the "ego-ideal" or "superego". The figure who provides the model for this idealized version of the self is, in fact, the same-sex parent (1914).

Additionally, in Freudian theory, the distinction between psychosis and neurosis is characterized as a distinction of differing states of withdrawal of libidinal narcissism from the external world. While the neurotic, according to Freud (ibid, p.74), maintains relations with the external world through fantasy, the psychotic, alternately, has withdrawn to the state which resembles the original narcissistic state of the infant.

It remains, however, that to Freud, the motivation for the development of a concept of self was ultimately physiological. Essentially, reflection of the original self-love to objects in the external world is in response to a threatened withdrawal of the object (person) providing gratification of the instincts.

For Freud, the concept of self (ego) constitutes a mediation between the strivings of the instincts (the id, or central self) and the external reality of the environment. Where gratification is not obtained as an immediate response, the self attains an increasing awareness of self in relation to the world (importantly, the world of persons).

Since Freud, there have been many re-interpretations of the psychoanalytic position on the differentiation of
the ego, or self-concept. One in particular is the theory of Jacques Lacan.

Lacan

Lacan (1966/) is a structuralist and has produced important interpretations of Freudian thought in keeping with the principles of structuralism. Like Mead, he stresses the role of language in the development of a concept of self. Unlike Mead, Lacan considers the role of infancy here.

For Lacan, as with Freud, the dissolution of the Oedipus complex (and subsequent identification with the same-sex parent) signifies the entry of the child into human culture. Here, however, it is considered to be synonymous with an entry into the symbolic.

This is because, prior to the Oedipus, the infant is in a direct, immediate relation to reality and there is no distinction between self and other. The father, by prohibiting incestuous desire for the mother, institutes the notion of "mediate" in the child. This effectively enables the child to establish the awareness of his own subjectivity, and henceforth become capable of dealing with the symbolic.

The unconscious, according to Lacan, is structured like a language (the particular form of theoretical linguistics employed by Lacan is pre-Chomskyan structural
linguistics, which is concerned with the surface layer of utterances). The unconscious signifiers are considered to be organized in various relationships of association, like a language. Language itself is a network of signifiers which bridges the unconscious and consciousness. Once the child has become capable of apprehending the symbolic, language will shape him in accordance with the structure inherent in it, enabling the child to become an autonomous member of society.

To attain the symbolic order, the child must satisfactorily resolve the Oedipus conflict. That is, the child must accept the restriction placed on an immediate relationship and come to terms with the mediate. By doing so, it becomes possible for the child to register self as distinct from others. Only through the mediate can it be possible to apprehend self as an entity in relation to others. The "I" can become distinct from the "me" when the immediate, direct relationship with reality is prohibited by the father.

For Lacan, an important component in this attainment is what he calls "the mirror stage". This occurs around the age of 6-8 months which is when the infant first displays self-recognition to a mirror. (Others, including Darwin (1877), Preyer (1893), Freud (1920) and Laing (1960), also consider this event, with varying degrees of emphasis.)

Lacan, in particular, was struck by the joy with which the infant greets himself in the mirror, and believed it
represented a highly significant occurrence in the
development of the "me".

The mirror stage is interesting in that it
manifests the affective dynamism by which the
subject originally identifies himself with the
visual Gestalt of his own body.

For Lacan, prior to this stage, the body is experienced
as fragmented. It is only at this point that the infant
can grasp his wholeness in time and space.

Lacan further invests this stage with an elaboration
of the Freudian concept of narcissism. As mentioned above,
the infant at birth is considered to be in a state of total
self-love, or primary narcissism. Freud suggests this
becomes gradually reflected outward, in a series of
identifications with external objects. In Lacanian theory,
the image which the infant first sees in the mirror is
considered to receive the primary narcissism which
previously had always been directed "inward". For the
first time, this undergoes an alienation, the outcome of
which is the first total identification.

Before attaining the secondary identifications with
the parents which establish the "me" proper, at the mirror
stage, the infant celebrates the realization of the "I".
This primary identification with the double provides the
framework wherein the "me" can eventually be apprehended
by the "I".

The jubilant assumption of his specular image by
the little man, at the infant stage .... would
seem to exhibit in an exemplary situation the
symbolic matrix in which the I is precipitated in a primordial form, before it is objectified in the dialectic of identification with the other, and before language restores to it, in the universal, its function as subject. (p.2, 1966)

For Lacan, language gives to the child the means to develop the I-me distinction proper. The importance of the mirror stage is to make it possible for the infant to grasp "I" as an entity. This, coupled with the eventual acceptance of the symbolic at the dissolution of the Oedipus complex, makes it possible for the child to attain language and thereby become acquainted with self as a social being.

In this theory, therefore, the mechanism which organizes the original realization of self as distinct in the world, is the sight of self as a whole in the mirror. This constitutes the first deflection of self-love into the external world, and provides the original matrix into which the "me" can be inserted.

One theorist who considers Lacan’s formulation of the mirror stage is D.W. Winnicott.

D.W. Winnicott

Unlike Lacan, Winnicott (1967 ) considers the role of the other as providing the initial feedback derived from a mirror. Indeed, Winnicott suggests that a mirroring "other" in early experience makes it possible to recognize self in the mirror. Thus, for Winnicott, his
theory is concerned with the primary caretaker (the mother) in the capacity of providing the young infant with a mirror of the self.

What does the baby see when he or she looks at the mother's face? I am suggesting that, ordinarily, what the baby sees is himself or herself. In other words, the mother is looking at the baby and what she looks like is related to what she sees there. All this is too easily taken for granted.

(Winnicott, 1967, p.131)

That is, the mother is considered to give back to the baby his own self, thus providing him with an important means to differentiate self from others. This is continued, in normal circumstances, by the family of the child, who continue to provide a consistent reflection of self in relation to others. For Winnicott, a lack of this initial feedback will bring pathological outcomes in later life, including an inability to respond appropriately to the reflectant mirror.

In this sense, the (m)other is considered to act as a mirror for the infant. In this mirror, the infant first constructs an idea of self. Without this initial feedback, a pathological version of self will develop.

By way of illustration, Winnicott considers some examples of what can occur in the absence of normal responsiveness.

Some babies do not quite give up hope and they study the object and do all that is possible to see in the object some meaning that ought to be there if only it could be felt. Some babies, tantalized by this type of relative maternal failure, study the variable maternal visage in an attempt to predict the mother's mood, just exactly.
as we all study the weather. The baby quickly learns to make a forecast: 'Just now it is safe to forget the mother's mood and to be spontaneous, but any minute the mother's face will become fixed or her mood will dominate, and my own personal needs must then be withdrawn otherwise my central self may suffer insult.' (ibid, p.132)

Thus, for Winnicott, the other constitutes the primary means by which a self is constructed. Indeed, in a classic statement, Winnicott proposes that "there is no such thing as an infant", meaning, of course, that an "infant" also indicates the presence of maternal care (1940). For Winnicott, the infant and maternal care together form the basic unit out of which the later autonomy of the self arises. Under normal conditions, the mother, through consistent and responsive care gives meaning to the infant's experience, both in time and space. This "continuity of being" constitutes the basis of the infant's individual existence. Without consistency, existence becomes rather a series of reactions to the environment.

Although Winnicott does not deny the importance of instinctual gratification, he differs from the original Freudian position with regard to its primacy in the development of a self-concept. While Freud sees inadequate gratification as the first means of delimiting self-in-the-world, Winnicott, alternatively, sees the (m)other as providing the basis by which instinctual gratification can be known. That is, inconsistent gratification will not give rise to a sense of self-in-
the-world, rather, it can only give rise to a series of reactions to environmental impingement (1960).

Thus, in Winnicott's theory, the other assumes all-importance for the developing self-concept. Effectively, the (m)other provides the infant with both his first environment, as well as his first awareness of self-in-the-environment. In this sense, the mother is taken to be the initial mirror of the infant ego, or self-in-the-world.

R.D. Laing

This theory differs from the original Freudian theory in many important respects. In particular, Laing (1960), as with Winnicott, assumes a basic role of the other in the construction and maintenance of a concept of self.

The words of the current technical vocabulary either refer to man in isolation from the other and the world, that is, as an entity not essentially 'in relation to' the other and in a world, or they refer to falsely substantialized aspects of this isolated entity. Such words are: mind and body, psyche and soma, psychological and physical, personality, the self, the organism. All these terms are abstracta. Instead of the original bond I and You, we take a single man in isolation and conceptualize his various aspects into 'the ego', 'the superego', and 'the id'. The other becomes either an internal or external object or a fusion of both. (p.19)

For Laing, man must be considered always in the totality of his existence, his "being-in-the-world".
Particularly illustrative of this is Laing's theory of the schizophrenic. According to Laing, the schizophrenic is unable to maintain any relations with reality (be-in-the-world) because others constitute a threat to his very existence. Instead, the schizophrenic experiences a fundamental division between his inner, true self and the rest of the world, including his own body.

For most people the experience of "being alive" is taken for granted. Laing terms this the "ontologically secure" position, wherein the autonomy of self, and identity in time and space are the basic facts of existence. Schizophrenics, alternately, do not experience this differentiation from the world; they are "ontologically insecure". Everyday living for these people constitutes an unceasing effort to maintain themselves against a constant threat of the destruction of self by others.

The schizoid (sane) individual deals with this by developing a false-self which he presents to the world, while simultaneously keeping his inner self hidden and divorced from the false-self. This is to ensure a degree of safety for the real self, and often there is a corresponding drift further and further from reality. Paradoxically, without the confirmation of others (and no-one needs this more than a schizoid individual), the inner self also feels threatened with a loss of being. Often a point is reached, according to Laing, where only
two choices remain in this desperate plight. The individual can choose to "be himself" no matter what, or he can try to "murder" his self. In both cases, the likely outcome is psychosis.

For Laing, as with Winnicott, the roots of psychosis belong in infancy, in the original differentiation of self from others. Where this is inadequate, schizophrenia may ensue in later life. As one patient of Laing's remarked of herself, "She's an I looking for a me" (p.158).

Central to this process in infancy are the significant others in the individual's world. According to Laing, the infant can only "be" in the presence of the mother (caretaker). Thus her absence means, for a time, a loss of being.

To support this, Laing considers Freud's famous example of the little boy with the cotton-reel and string (Freud, 1920). This boy, while temporarily in the care of Freud's family, began to play at throwing the cotton-reel away, and then retrieving it by means of the string attached to it. Freud suggests that the reel represented the absent mother, and that the boy was attempting to master the anxiety of her absence by repeating her departure and hoped-for reappearance in play. Around the same time, he also played at making himself disappear by crouching in front of a mirror, so that his own image disappeared.
Laing suggests that the fear in both instances was fear of the loss-of-being incurred by the mother's absence. The observing self, the "me" develops as a result of a striving to maintain being in the absence of the other, who, up until this point, has provided the only means of being-in-the-world. In other words, development is the process of seeing oneself despite the absence of others.

Several developmentalists have noted the delight evident in children during the game of peek-a-boo. According to Bower (1979), the pleasure seems to rest in experiencing self while others cannot see self (as in the case of children covering their eyes with their hands). Nor is this restricted to the visual domain. The need in general seems to be the need to have one's existence confirmed, recognized - the need to be loved, as Laing puts it. Ontological insecurity is the result of never having reached the end-point of this development, that is, "being" in the absence of others.

Thus far, in the consideration of the psychoanalytic position of the self-concept, it can be noted that in the formulations which succeed the original Freudian position, there is an increasing tendency to define the "me" or ego in terms of the other. Unlike Freud, where the ego constitutes that part of the id or "I" which responds to
reality entirely as a means of gratifying the biological urges of the "I", later theorists assume that the "me" is dependent on others for its very existence. In this sense, psychoanalytic formulations can be seen to begin to resemble the theory of James, wherein the "me" is considered to be how we and others define "I".

Particularly illustrative here is the redefinition by Winnicott of the other as mirror of the self, unlike Lacan's original formulation of the experience with the physical mirror as the means of projecting self into the world. In fact, Winnicott proposes that total recognition of self in a mirror will not take place in the absence of an earlier "reflection" of the infant by the mother.

In addition, in the later psychoanalytic accounts, greater weight is given to the role of infancy in the development of the self-concept. Unlike Mead, Freud and indeed, Lacan, theorists such as Winnicott and Laing consider possible mechanisms by which the infant can attain a consciousness of self, particularly in his transactions with the other. Whereas Mead and Lacan predicate language as the vehicle for deriving the distinctions between self and others (and, of course, the similarities), Winnicott and Laing assume that this is occurring prior to the onset of language. Central to the use of language, in the latter case, is the belief in its significance as providing the means by which to represent (symbolize) self in relation to others. Indeed here, it is assumed that
language provides the conceptual tools for defining attributes of the self and others which would otherwise be unknown, such as gender (see Chapter 2).

**COGNITIVE DEVELOPMENTAL THEORY**

This assumption of the role of language, however, has not gone unchallenged, particularly in the context of the next group of theorists, namely the cognitive-developmentalists. In some cases (particularly in more recent work), it is argued that the concepts employed in language of necessity must exist prior to the onset of language, that is, in the period of infancy (e.g. Bower, 1979).

In more general terms, the theoretical speculations considered above lack the important confirmation of actual infant observation. This, of course, is a relatively recent innovation in the cognitive-developmental tradition, beginning with Piaget. Yet even Piaget relies on Freudian interpretations with regard to social development (see 1951 ), wherein the infant is not considered to distinguish between the social and the physical world until around 18 months. In addition, the infant is believed to perceive all action in the world as the outcome of self ("egocentrism"). This is not unlike the
Freudian formulation of narcissism. Altogether, Piagetian methods of experimentation have failed to consider in any detail the development of a self-concept. As Papousek and Papousek (1974) state:

Perhaps early attempts to explain the development of the self-concept with various theories on the origins of ego and self-consciousness were too speculative and thereby discouraged behaviourally-oriented researchers. (p.149)

Piaget

The consideration Piaget (1932) does give to the differentiation of self relies heavily upon other theorists, in particular, J.M. Baldwin (1899/1973). Here, Baldwin considers the development of a consciousness of self. From an initial position of ignorance of self-as-subject, the infant is considered to attain a sense of self mainly through the act of imitation. That is, the discovery of self is a function of learning the analogy between self and others, through the progressive comparison inherent in the act of imitating.

How does the child ever come to discover himself? As far as his own body is concerned it is easy enough to see that he does so thanks to a progressive comparison of it with other people's bodies, a process that is part and parcel of that of learning to imitate. It is because it has a visual perception of another person's mouth and imitates the movements of this mouth that the baby of 10 to 12 months learns to give its various buccal sensations an analogous form; and so on. In the same way, with regard to psychical qualities, it is by imitating other people's behaviour that the child will discover his own. In this way the individual passes to the "subjective" stage in which he is conscious of possessing an "I" that is identical
with that of others. But once his attention has been directed upon himself in this way, the child becomes capable of the converse process. Having little by little come to assign to himself all the forms of conduct he has observed in others, he learns simultaneously to ascribe to others the feelings and motives of which he is conscious in himself. (Piaget, 1932, p. 393)

Thus, for Piaget, the "other" in the infant's world assumes the importance of providing the basis for recognition of the analogy between own body and others', and later, between own mind and others'. Central to this is the act of imitation. Imitation initially arises as a response to the perception of physical similarity between self and others. This in turn strengthens the original analogy, and still later, enables the recognition of the similarity between self and others, at the level of mind.

Ultimately, however, Piaget assumes that the basis of all conceptual development (including the self-concept) is self-initiated action in the world. While persons contribute importantly to the outcomes of this action, development is essentially the result of cognitive maturity both with regard to the world of objects and the world of people. For the infant, in Piagetian theory, the two worlds are not considered to attain distinction until the end of the sensori-motor period, around 18 months. This last is discussed further in the following chapter.

Others, since Piaget, have alternately proposed a capacity to apprehend the social distinct from the
One in particular is T.G.R. Bower (1979, 1982).

T.G.R. Bower

As with Piaget, Bower applies the model he outlines for perceptual-cognitive development to social development. Unlike Piaget, Bower proposes considerable representative capacities in the neonate onwards.

Bower essentially views the self-concept as a theory utilized by the individual for interpreting the social world. In the same way that theories (rules) are necessary for interpreting the physical world; so too for the social world.

Just as a scientific theory of cognition is concerned with the way that individuals arrive at an interpretation of the physical world, so should a scientific theory of personality be concerned with the way in which individuals arrive at an interpretation of themselves and the social world. I would maintain that the structures that determine individual differences in 'personality' are in fact different 'theories' about the self and the social world. (1979, p.397)

In Bower's view, the developmental progress of social theories is similar to the progress he has proposed for rules regarding the physical world. Unlike the accumulative model of Piaget, on Bower's model, the infant is held to be endowed with inherent abstract rules for interpreting the world. Through development, these become differentiated into more specified rules appropriate to more specified situations, events, objects, etc.
For social development, Bower has proposed an account of the progressive differentiation of this personal theory of the self and others (see Fig. 1.1).

Some of the decisions or descriptors Bower suggests may be innate - such as human/non-human and self/other. There is evidence (Money, Hampson and Hampson, 1957) that male/female may be initially plastic until a critical period has passed. Thereafter, the choice appears to become irreversible. Also, according to Bower, the decision to
be competent or incompetent may again be environmentally-determined. In turn, the specific behaviours generated by such rules may themselves be plastic. In this way, Bower explains the "plasticity of personality" as evidenced by workers such as Kelly (1955).

Unlike Piaget, therefore, Bower proposes the possibility of an innate differentiation of the social (human) and the physical (non-human) world. This is also compatible with recent research on the social capabilities of neonates, which are indeed immense by the standards of Freud, Piaget and others.

For example, the neonate can display a variety of behaviours which appear to be specifically intended for the "other", such as interactional synchrony, babbling, imitation and smiling (see Chap. 14, 1979). Bower argues that, as such behaviours are exercised in their own right, and are not the result, for example, of an association with discomfort, they fit Buber's (1973) criterion for I-Thou behaviours as distinct from I-it behaviours. In this sense, Bower proposes that there is at birth an identity of self with others.

After Michotte (1962), this is suggested to be initially an "empathic" (undifferentiated) identity with the other. That is, the newborn may be unable to distinguish an act performed by self, and that of another. Both self and other, alternately, are distinguished from the world of objects. Here, developmental progress
toward a more specified description of self-distinct-from-other is considered to be initiated by a break in empathy, just as conflict between existing rules and the world of objects gives rise to more specified representations for the physical world (1982).

Thus, in Bower's theory, the "other" constitutes a vital role in the development of the self-concept, for one reason, as providing the conflict in initial empathy necessary to specify a description of the self. In more general terms, the other constitutes the basis for defining self, as development here is the process of differentiating self from others. As Bower predicates considerable representative capacities from birth, he goes on to suggest the possibility of an early appearance of concepts which can define self and others. In particular, those aspects of self which have wide generality are held to be represented in infancy. Of these, Bower includes a concept of gender.

The latter is discussed in more detail in the next chapter. With regard to the social capabilities of infants, this receives support from a different approach to social development proposed by Trevarthen (1979). Here again, it is suggested that infants possess the capacity to enter into the social world from birth.
INNATE INTERSUBJECTIVITY THEORY

Trevarthen

For Trevarthen (1974a, 1979), infants are endowed with an inherent capacity for self-other exchanges, and indeed, enter into communicative routines with adults from a very early age. This is known as Innate Intersubjectivity Theory. Here, as with Bower, the newborn is considered to be aware (albeit not consciously) of the social distinct from the physical.

By examining in detail patterns of mother-infant interaction, Trevarthen proposes that all the elements necessary for the sharing of mental processes are present at birth. These include intentionality, emotional expression and mutuality. Thus the infant is not merely a passive receptor of social stimuli, but rather an active participant in social exchange. It is this capacity which enables the later development of cooperative activity, such as the mother and infant playing with a toy. The particular culture to which the infant is thus introduced becomes the framework by which the infant elaborates his knowledge of the world of things.

Murray (1980) provides clear evidence that, even by 8 weeks, the infant is sensitive to intersubjective elements in his mother's behaviour towards him. Such elements include the form and timing of her behaviour in relation to his own, as well as her emotional expression.
From this, Murray argues that the young infant is, in fact, highly committed to reciprocal interaction.

For Trevarthen, Murray and Hubley (1981), this precocious sensitivity for the social world is taken as an indication that social development in fact supports development in the world of things, contrary to the Piagetian position. Unlike Piaget, some form of self/other differentiation is believed to be present at birth.

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From the above, it is clear that recently there has been a growing tendency to empirically consider the role of infancy in the development of social understanding. From Piaget onwards, there is an increase in the degree of social awareness prescribed for the newborn. In this, of course, the role of the other is taken to be of central significance for the understanding of self in infancy. On this basis, the later developmentalists maintain a similarity with the later psychoanalysts.

Although relatively few cognitive-developmentalists consider the development of the understanding of self in relation to others, at least one exception is Bower. He proposes that concepts which have wide generality, such as competence (efficacy) and gender, are functioning in infancy to differentiate self from others. By providing the theoretical support of a representative capacity in the
infant, it becomes possible here to examine in empirical
detail the role of the other in the development of a
concept of self.

However, many infant researchers have alternatively
considered the development of the understanding of self
as an entity, by way of examining the developing self-
concept. Here, the central paradigm is visual self-
recognition. The next section discusses the findings
which have occurred during systematic presentation to the
infant of his visual self.

EMPIRICAL WORK ON SELF-RECOGNITION

Naturally enough, for this paradigm, the mirror has
been extensively (though not exclusively) used here.
The history of observation of infants towards their
mirror-image is, in fact, a long one. Both Darwin (1877)
and Preyer (1893) noted the sudden appearance of apparent
self-recognition in their own children. Darwin saw it
at 9 months and Preyer, 14 months. Lacan (1966), alter-
natively, notes it around 8-9 months.

Following this, Dixon (1957) observed longitudinally
the mirror behaviour of five infants from the age of 4
months to 12 months. He outlines four stages of a
developmental sequence.
At 4 months, there is no interest in own image, although there is interest in the mother's. This is known as the stage of "Mother". After this, until around 6 months, there is interest, but it is indistinguishable from the interest shown to the image of another infant. This is the stage of "Playmate". Between 7 and 12 months, a distinction in the behaviour towards images of self and images of other infants was noted, that is, visual self-recognition of some kind is taken to have emerged. At this stage, the infant often makes very deliberate actions repeatedly, while observing his own image. Dixon calls this the stage of "Who dat do dat when I do dat?" Finally, by 12 months, the infant can demonstrate unambiguously that he is aware that it is his own image in the mirror. In particular, in response to "Where's (own name)?", he can turn to look at his own image.

However, the above did not correspond to the results obtained by Amsterdam (1972). Here, in a cross-sectional study of 88 Ss, infants were placed before a mirror after a spot of rouge had been surreptitiously dabbed on their noses. Visual self-recognition proper was not assumed to be present unless these infants responded by touching their own noses.

Unlike Dixon's results, by this method, visual self-recognition was not considered to emerge until 20-24 months. In addition, at this age, there is an emergence
of "self-conscious" behaviour, such as strutting, preening and even embarrassment! For Amsterdam, therefore, the ages indicated in other work on apparent self-recognition are in fact indicative of something else. In particular, she considers the deliberate mirror-directed behaviour noted by Dixon (and herself) prior to 12 months, as rather a response to the opportunities to observe contingency afforded by the mirror.

Two other sets of studies, however, disagree with this speculation. One is a study by Papousek and Papousek (1974). Here they found evidence of self-recognition based on eye-to-eye contact prior to an interest in the contingency aspect of the mirror-situation. This was because infants displayed more interest in non-contingent movies of the self which afforded eye-to-eye contact over live recordings with no eye-to-eye contact. Additionally, they noted an increase of interest to the mirror throughout the course of the experimental situation. This, they felt, was due to the infant learning the mirror-situation there and then.

Lewis and Brooks-Gunn (1979), in an extensive series on visual self-recognition, attempted to examine more closely the aspects involved. In general, they replicated Amsterdam's findings, although they place the age of proper self-recognition at 15 months, rather than 20 months. Unlike Amsterdam, however, Lewis and Brooks-Gunn equate an interest in the contingency of the mirror
with self-recognition.

According to Lewis and Brooks-Gunn, the mirror-situation involves two types of cues, contingency and feature-detection. To separate these experimentally, they used videotapes and photographs for presentation of the visual self to infants.

In particular, to demarcate the significance of contingency in visual self-recognition, Lewis and Brooks-Gunn presented three different types of video recordings to infants aged between 9 and 15 months. One was "live" images of self; the second was images of self recorded one week earlier, and the third was images of another infant. The measure employed here to index self-recognition was tendency to imitate and play with the image; as well as positive effect, including movement toward or away from the image, attention and positive vocalization.

In all, the contingency condition of live images of self received the most attention from all age-groups, suggesting to the authors that initial self-recognition is derived from the principle of contingency-detection. Additionally, as age progressed, the infant Ss demonstrated a corresponding growth of interest in the contingency situation. More importantly, however, featural distinction, as evidenced by the recognition of self from non-contingent movies of self, did not appear until around 15 months. From this, Lewis and Brooks-Gunn
argue that visual recognition based on features of self, does not emerge until around 15 months, which corresponds to their findings at least, on self-recognition to a mirror-presentation.

From the above, as well as other work on pictorial presentations (see Chapter 2), Lewis and Brooks-Gunn present a theory of the development of a notion of self in infancy. Particularly notable in this account is the use of infant observation, unlike many of the theories outlined earlier. Here, Lewis and Brooks-Gunn consider the development of both a sense of "I" as subject and "me" as object.

For the former, they propose that the contingency pertaining to self-initiated action contributes importantly to the sense of "I". As an example, they cite the outcome contingent on closing the eyes as "the world becomes black", or "cannot see" (1979, p.9). According to Lewis and Brooks-Gunn, the feedback from the environment contingent upon action provides the basis for a sense of self-as-subject. This, they speculate, is present between 0 and 3 months (although they present little data to support this). This becomes consolidated between the ages of 3 and 8 months, where self-recognition can occur in the contingency situational upon the presentation of a mirror, or live videotape. Thereafter, between 8 and 12 months, the latter notion of self-as-object begins to emerge. That is, for Lewis and Brooks-Gunn, a self-concept
develops toward the end of the first year of life.

Central to the latter, they argue, is the beginnings of a notion of the permanence of objects as first described by Piaget. In a similar sense, the self can only be apprehended as an object when there is awareness of permanence. Thus, in this theory, self-permanence is primary for the sense of self-as-object. The salient mechanism here is the capacity to distinguish self from others at the level of features. By this means, self is considered to be initially delimited in infancy by at least three categories: age, familiarity, and gender. For Lewis and Brooks-Gunn, this represents the infant’s categories of self in relation to others, described at the level of featural distinction such as size for "age", and clothes and toys for "gender". It enables both the perception of the distinction of self from others, as well as the perception of similarity.

Thus, for this age-group (8-12 months), self is apprehended in the dual sense of self-as-subject (cued by contingency) and self-as-object (cued by features and contingency). Only here can visual self-recognition proper take place. That is, through the capacity to apprehend self both by contingency-detection and featural detection, mirror recognition (indexed by touching own rouged nose) can occur. In this outline, therefore, self-recognition is derived from both the sense of self-as-subject, and self-as-object. Later, between 12 and 24 months, apprehension
of self in the absence of contingency cues (such as in watching recent video recordings of self) begins. Here, the cognitive sophistication necessary for self-recognition from featural cues has developed. Figure 1.2 summarizes Lewis and Brook-Gunn's proposed account for the development of the self in infancy.

| Development of Self Knowledge, Emotional Experience, and Cognitive Growth |
|---|---|---|
| Age | Self knowledge | Emotional experience | Cognitive growth |
| 0-3 | Interest in social objects: emergence of self-other distinction | Unconditioned responses to stimulus events (loud noise, hunger, etc.) | Reflexive period, primary circular reactions |
| 3-8 | Consolidation of self-other distinction, recognition of self through contingency | Conditioned responses (strangers, incongruity) | Primary and secondary circular reactions |
| 8-12 | Emergence of self permanence and self categories; recognition of self through contingency and onset of feature recognition | Specific emotional experiences (fear, happiness, love, attachment) | Object permanence, means-ends, imitation |
| 12-24 | Consolidation of basic self categories (age, gender, emergency of efficacy); feature recognition without contingency | Development of empathy, guilt, embarrassment | Language growth; more complex means-ends; symbolic representations |

FIGURE 1:2. Lewis and Brooks-Gunn's account of social development.

In the above theory, observation of infant's reactions to presentations of self has been extensively employed. Here, an account is offered whereby development of the self-concept is based on featural detection of self
and others. By the end of the first year of life, with increasing cognitive sophistication, recognition of self can occur entirely on the basis of featural detection. A necessary corollary of this last is the ability to recognize others at a similar level of features. Unlike the earlier cues of contingency-detection, which give rise to the sense of self-as-subject, demarcation of self by features can occur only in relation to others (although it is initially supported by contingency feedback with reference to the self). As mentioned earlier, Lewis and Brooks-Gunn propose three social categories which are likely to be employed by the infant, namely, age, familiarity and gender. In this theory, visual self-recognition proper does not occur until there is the capacity to represent both the self-as-subject and the self-as-object.

DISCUSSION OF EMPIRICAL WORK

One of the striking features of the results from visual self-recognition studies is the absence of consistency, particularly with regard to age of onset. Here, the range is as wide as 5-20 months. By way of explanation, it is possible that it is a function of the paradigm itself. For example, as Damon and Hart (1982) point out, it is reasonable to expect that other senses
such as hearing and smell, may be involved in self-recognition.

More importantly, the lack of visual self-recognition cannot be taken as an indication of a lack of self-awareness. Seeing oneself in a mirror (or live video) is a unique situation, and one which involves considerable intellectual adjustment. According to Merleau-Ponty (1964), understanding the specular image of self,

.... is a problem first of understanding that the visual image of his body which he sees over there in the mirror is not himself; and second, he must understand that, not being located there, in the mirror, but rather where he feels himself introspectively, he can none-theless be seen by an external witness at the very place at which he feels himself to be and with the same visual appearance that he has from the mirror. In short, he must displace the mirror image, bringing it from the apparent or virtual place it occupies in the depth of the mirror back to himself, whom he identifies at a distance with his introceptive body. (p.129)

Here, therefore, the complexities of the mirror situation are given full weight, and suggest caution to extrapolation from this to self-awareness in general. In the same vein, there is the evidence (i.e. Dixon, 1959) that the other is recognized in mirror before self, indicating that perceiving the specular image of self is an especially difficult accomplishment and should, in fact, be interpreted with care as a developmental measure of self-understanding. It is always possible that the infant is in command of an understanding of self and others well before the onset of visual self-recognition.
From the foregoing theoretical discussion, there has been a consistent stress that the self-concept is not an isolate entity. While self-recognition must be an integral aspect of a concept of self, it is ultimately in reference to others that we entertain a notion of ourselves. Indeed, many propose that self is initially seen in others (e.g. Mead, 1934; Winnicott, 1967).

However, of the available developmental theories, only two in the cognitive tradition suggest aspects of the self which may be functional relative to others in infancy. These are Bower (1979) and Lewis and Brooks-Gunn (1979). The latter propose age, familiarity and gender described at the level of features by infants. The former proposes competence and gender amongst others, which are different from the adult equivalent because they are represented initially in a more abstract form.

In light of the suggested significance of gender in the notion of self, this thesis is an attempt to explore further the concept of gender in the infant. The next chapter reviews existing developmental theories of gender identity, with a view to illuminating the case for its origins in infancy.
CHAPTER 2

THEORIES ON THE ORIGINS OF GENDER IDENTITY
INTRODUCTION

The question of the origins of the awareness in personal identity that "I am a boy or girl", was first formulated, not in experimental psychology, but in psychoanalytic theory. For the experimentalists, the concern rather has been to demonstrate the origins of sex differences in behaviour from either innate tendencies or differential socialization patterns.

To this day, the issue of sex differences continues in psychology (e.g. see Levy, 1980). Only relatively recently have there been attempts to account for the origins of "gender identity" as part of personal identity. Particularly illustrative of this is the decision to draw a conceptual distinction between behavioural differences as a function of biological sex, and cultural differences pertaining to the expression of one or other gender role (Stoller, 1968; Kessler and McKenna, 1978; Archer and Lloyd, 1982).*

To account for the origins of gender identity, there are three classes of theory - psychoanalytic, social-learning and cognitive-developmental. Despite major differences in the proposed account of development, they

* However, this is a relatively late distinction. In earlier literature, sex and gender are used interchangeably. To avoid confusion, it should be emphasized here that the concern of this thesis is with the origins of the cultural notion of gender. Where "sex" is used, it is as a convenience of style, as in "same-sex" and "opposite-sex".

share some subtle similarities. All three, albeit in varying ways, utilize the concept of parental "identification" wherein the child is assumed, at some point in development, to identify with the same-sex parent.

A further similarity is a common assumption that there is no innate capacity for apprehension of the social world distinct from the physical world. Instead, the understanding of persons as evinced in the emergence of gender identity tends to be explained in the broader context of an account of the origins of "sociality". Largely as a result of this tendency, in all three of the following theoretical accounts, there is little or no concern with infancy. Instead, childhood is taken as the starting point. Only later in this chapter will the evidence from infancy be considered.

**PARENTAL IDENTIFICATION**

Central to the use in theory of a concept of parental identification is the belief that a close relationship exists between the child's gender-specific attitudes and those of the same-sex parent. Basically, it serves as an account for the apparently spontaneous appearance of gender-typed behaviour and attitudes which occur relatively early in the child, and quickly become well-established (Sears, Rau and Alpert, 1966).

"Identification" is variously defined as a process of
internalization (psychoanalytic), modelling (social-learning) and imitation (social-learning and cognitive-developmental). In general, there is an assumption that the child learns from others - in this case, the same-sex parent, appropriate social behaviours and values specific to his role in society.

Without doubt, gender appropriate behaviours must result from some form of imitative learning. "Gender", by definition, is the cultural expression of biological sex. However, there is considerable disagreement amongst the three established theories regarding the relation between parental identification and gender identity expressed as "I am a boy or girl".

Both psychoanalytic and social-learning theory assume they are synonymous. Cognitive-developmental theory, on the other hand, sees self-identity as the prerequisite for appropriate parental identification. In cognitive approaches, therefore, the salient other for the origins of gender identity is considered to be peers, not parents. In one instance, parental identification is believed instead to function with regard to the development of the "idealized" or moral self.

From this, it is clear that "identification" does not attain theoretical unity in definition. Yet, in general, there is agreement that the other constitutes the basis of gender identity. This, of course, seems only reasonable, as it can only be in relation to the other that gender is delimited.
Freud (1923, 1924) was the first to outline the origins of gender identity within the context of parental identification. For Freud, identification is the outcome of the development of the ego as mediator between the instincts and external reality. Essentially, parental identification represents an incorporation or internalization of the external in the organization of thought. In this way, the child progresses beyond the fantasy-governed mode of thought of the infant (primary process), to an apprehension of the roles, mores, and taboos of culture, including gender identity. Freud defines this development as a differentiation of the ego or "superego".

The psychoanalytic formulation of the mechanisms underlying differential superego formation, however, are beset with problems. Freud himself, particularly in later writings (1931) recognized his difficulty in explaining the development of a feminine identity. In earlier work, he simply assumed that it paralleled masculine identity formation. Today, his theory of the feminine position continues to be a source of outrage to many women (e.g. see Friedan, 1963; for reply, see Mitchell, 1974).

In Freudian theory, the infant and young child are seen as bisexual until approximately 6-7 years of age. Prior to this, total self-love (narcissism) predominates
and thought is governed by the internally-defined reality of the instincts. Although the sexual drive is assumed to be present at birth, the objects of desire are not persons as such, but "part-objects" which are essentially those components of the mother's body which provide satiation. The first of these is, of course, the breast.

Through the mechanism of "introjection", the infant and young child gradually attain external reality. Out of fear of loss, the developing ego "sets up" the particular part-object in thought. As the libido matures, desire becomes focused on different erogenous zones of the body in a stage-like sequence. This begins with the oral stage, progresses to the anal, phallic and, finally, the genital. Correspondingly, the ego acquires a representation of the relevant part-objects. In this sense, the original narcissism becomes projected to the outside world.

By the end of the phallic stage (6-7 years), attachment to the mother as object providing gratification reaches a new peak of intensity. For the boy, this is expressed as a desire to replace the role of the father with regard to the mother. The Oedipal constellation, however, also initiates in the boy a fear of paternal retaliation, which is assumed to be an expectation of castration to render him "female". Eventually, fear of the aggressor leads him to relinquish rivalry and, instead, gratify his desire for the mother through identification
with the father. Here, unlike the earlier identifications with part-objects (introjection), this is in the form of a totalistic incorporation of the father as an ideal version of the self. Further, it differs from the earlier form in that the motivation is fear of retaliation, while the earlier form is motivated by fear of loss of love.

For the girl, Freud was faced with the major difficulty of explaining the development of paternal attachment and maternal identification. Whereas the boy continues his attachment to the mother based on maternal care, the girl turns from the mother (according to Freud) and takes the father as the primary object of desire.

To explain this, Freud used the notion of penis-envy. He assumes that the penis is interpreted by children as an indication of superiority. In addition, given the fantasy structure of children's thought, they see genital differences as evidence of the reality of castration. For the little girl, therefore, the discovery of genital differences leads her to turn from the mother, who is blamed for the lack, and take the father as primary object. As a substitute for penis-envy, girls maintain an unconscious wish for a baby.

In this sense, castration anxiety is proposed by Freud to instigate the transition from the initial bisexual phase to an appropriate sex-typed identity. For the boy, fear of castration leads him to relinquish Oedipal wishes,
while for the girl, hostility as a result of "castration" leads her to replace the father as the object of attachment.

Thus, in Freudian theory of the origins of gender identity, two instinctually-derived mechanisms of identification are proposed. One is the fear of loss (anaclitic identification) which is the basis of ego differentiation. The second is an extension of the first (defensive identification), wherein the child internalizes a total model of the same-sex parent. This model constitutes an idealised version of self and represents the values, mores, attitudes etc. of the parent. It effectively will serve to guide "civilized" conduct throughout life.

For Freud, therefore, there is no gender identity in self until the end of the phallic stage, around 6-7 years of age. This occurs on the realization of genital differences and a corresponding emergence of castration anxiety. As a result of this anxiety, the child identifies or internalizes a model of the appropriate-sex parent. In this sense, the onset of gender identity is considered to be synonymous with the beginnings of mediation with the social (cultural) world.

However, the evidence from younger children clearly contradicts Freud on at least one point. In fact, prior to 6 years, children often demonstrate quite clear gender-typed preferences and behaviour. For example,
Serbin et al. (1979) found that, by 3 years, children can identify toys appropriate for boys and girls. In addition, Block (1980) notes gender-specific differences in children's behaviour by 4 years.

Some later psychoanalysts did study younger children. One in particular was Klein (1932). From her work with a younger age-group, Klein reformulated Freudian theory with reference to infants. Unlike Freud, Klein saw in infantile part-object relations, an awareness of the sexual function as well as a corresponding desire and fear of retaliation.

She also disagrees with Freud's assumption of femininity as a castrated version of masculinity. According to Klein, both sexes undergo a "feminine" phase in development, related to an early awareness of the maternal body (see Klein, 1932; Segal, 1979). In addition, for Klein, the conflict between the love and death instincts, originally proposed by Freud (1920), characterizes the earliest object-relations. In this sense, fantasized terrors, as well as love and dependence, are associated with the earliest relations with reality. Thus, objects of instinctual drives are psychological objects as well.

From these early identifications, Klein traces the beginnings of the severity of the superego which even Freud acknowledged was excessive relative to actual parental behaviour. For Klein, this is an indication
that the infant and child impose their own structures of thought on the world, although it is ultimately a product of the instincts.

Criticisms of Psychoanalytic Theory

However, despite attempts to relate Freudian theory to younger children, psychoanalytic theory in general can be criticized on a number of points. With regard to the development of gender identity, there tends to be agreement amongst the psychoanalysts on at least two counts. Firstly, there is a common assumption that this is derived from an awareness of genital differences. Secondly, gender identity in self is considered to be synonymous with a totalistic internalization (identification) of the same-sex parental model. Regarding the first point, even very recent theories predicate the primacy of genital differences in the differential development of personality. One particularly interesting example is the theory of Erikson (1968).

Erikson sees all development as a process of regulation of the environment by differential modalities as a function of the various erotogenic zones. Genital differences, therefore, encompass differences in modes of regulation which affects all later personality development. While the boy, for example, continues the "intrusive" mode in
thought and behaviour, the girl has to revert to the "incorporative" modes characteristic of the initial oral stage in development (1950).

Doubtless, body imagery does have an important role in children's ideas of gender. Whether this constitutes the origins of gender identity, however, is open to question. For example, Kohlberg (1966c) argues that, while there is evidence of universal patterns of stereotypes in children's notions of gender which are clearly derived from physical differences, of these, genital differences are only one factor.

In a study of the social ideas of 4-8 year olds, Kohlberg (1966a) found that children who were "enlightened" regarding genital differences were no more advanced in their conceptual awareness of gender in general than "unenlightened" children. In another study, Thompson and Bentler (1971) gave a doll with anomalous sex characteristics to children between the ages of 4 and 6 years. These included genitals and secondary sex characteristics such as breasts, manly torso and differing hair-length. On being shown various combinations, the children demonstrated that hair-length was, for them, the primary cue for gender. Out of 144 children, only 14 mentioned secondary sex characteristics and only 24, genitals.

In addition, Donehower (1983) notes that hair, clothing, physical size and strength appear to be the most important cues for the attribution of gender by young children.
Altogether, there is a wealth of evidence to suggest that, contrary to the psychoanalytic formulation, genital differences are not, in fact, a causal factor in the developmental origins of gender identity.

Regarding the second point, namely unitary parental identification, there have been several attempts to empirically test for evidence in children of clusters of personality traits which would correspond to totalistic parental identification. One in particular is that of Sears, Rau and Alpert (1966). Here they studied the intercorrelations between standard tests on gender-typing, as well as some objective measures of their own. Amongst the standard tests were choice of activities, toys, objects and play behaviour, both real and symbolic. For the objective tests, observations by independent observers were included.

On a unitary identification theory, there should be a high correlation between the various measures of masculinity and femininity. In actuality, for 21 boys and 19 girls, the obtained correlations failed to attain significance \( r = 0.35 \) for girls; \( r = 0.15 \) for boys. This suggests that, contrary to psychoanalytic theory, in young children there is a wide diversity in gender-appropriate attitudes and behaviour. This would appear to contradict the notion of totalistic parental identification. This last point was taken up in some detail by theorists belonging to the next type of theoretical formulation, namely social-learning theory.
SOCIAL-LEARNING THEORY

As with psychoanalytic theory, social-learning theory predicates same-sex parental identification as the original organizer of the gender role. Contrary to psychoanalytic theory, however, this theory explains identification as an additional principle of general learning theory.

This principle is known as observational or imitative learning. As with other principles of learning theory, the motivation to identification is ultimately the desire for rewards. Gender identity constitutes an organization of appropriate responses to guarantee rewards, both in the present and in the future. As Mischel (1966) states:

According to social-learning theory, the acquisition and performance of sex-typed behaviours can be described by the same learning principles used to analyse any other aspect of an individual's behaviour. (p.56)

It should be noted here that social-learning theory represents the environmentalist position of the long-standing debate on the origins of sex-differences. In this sense, the ultimate concern of this theory is to account for the origins of sex-typed behaviour within the domain of experience. Gender identity, therefore, is generally conceived here as the organization of a class of environmentally-determined responses specific to the gender role.

In addition, as response-performance is considered to be a function of reinforcement history, social-learning
theorists assume that gender identity does not emerge until childhood. Essentially, the infant is defined in terms of limited opportunities to learn from the environment. In learning-theory, behaviour is considered to be modified by the environment through two types of conditioning, classical (Pavlov, 1927; Hull, 1943) and operant (Skinner, 1953). Basically, they serve as accounts of the processes by which S-R connections are formed and maintained.

The factors which are considered to facilitate successful S-R connections are contiguity in time and space, the principles of generalization and discrimination, as well as differential reinforcement (both positive and negative). For example, in operant conditioning, generalization allows for the transfer of responses to a new set of stimuli providing they share a functional similarity with the original set. Alternately, discrimination maintains responses to one particular set of stimuli only. Important to both mechanisms is differential reinforcement. Where reinforcement occurs for responses to a new set of stimuli, generalization is also likely to occur. In its absence, discriminatory responses will be strengthened. Both principles are considered to operate for gender-specific responses.

However, with regard to social behaviour in general, more recent theorists, particularly Bandura (Bandura and Walters, 1963; Bandura, 1969), have noted the failure of
traditional accounts to explain both the acquisition of novel responses, as well as rapid learning of complex social response-systems (including the gender role).

For this, Bandura et al. posit the principle of observational learning, wherein exposure to models is considered to effect the rapid acquisition of novel responses. For gender-typed responses, observational learning from the same-sex parent is taken to be particularly salient (Mischel, 1970).

Although some social-learning theorists make a distinction between identification and observational learning or imitative learning, Bandura (1969), Mischel (1966, 1970) and others argue that, essentially, they are one and the same.

In the interests of clarity and parsimony the terms 'identification', 'imitation' and 'observational learning' will be employed interchangeably to refer to behavioural modification resulting from exposure to model stimuli. (Bandura, 1969, p.219)

Unlike psychoanalytic formulations of parental identification, wherein there is a sudden and total incorporation of parental qualities, attitudes and behaviour; social-learning theory views identification as a situationally-determined phenomenon. That is, the degree to which a model's behaviour can influence the child is a function of a number of factors, which can vary from child to child. Bandura (1969) outlines his dissatisfaction with the psychoanalytic account of
identification with the following illustrative example:

In order to get a boy to emulate a baseball player such as Mickey Mantle, it would be necessary for the youngster to develop an intense attachment to the brawny model, who would then withhold affectional responsiveness, thereby motivating the child to incorporate the modeled stylistic behaviour. Or the athletic youngster would have to develop strong incestuous desires toward Mrs. Mantle, hostile rivalrous feelings toward the baseball slugger, and, as a way of reducing anxieties generated by his libidinal feelings and the anticipated threat of castration, the boy would begin to swat home runs and otherwise behave like his threatening competitor (Bandura, 1969, p.233).

To avoid absurdities such as above, there have been a number of attempts to explain the motivation for identification within the principles of social-learning theory. Some authors have retained the original Freudian concepts of anaclitic and defensive identification, while substituting dependency through nurturance and the desire for power for the sexual drive and fear of Oedipal retaliation respectively. Others, alternatively, have emphasized a more generalized desire for rewards.

For anaclitic identification, Mowrer (1950, 1960) and Sears (1957) have proposed that the qualities of the nurturant trainer (gestures, postures, expressions, beliefs etc.) become rewarding when they are practised by the child himself. The conditions which will enhance imitative behaviour are dependency, parental nurturance, as well as clear presentation of models and labels. On this explanation, conditions of withdrawal or absence of the model should increase the reward value of the imitated
response.

However, Hetherington (1965), in a study of father-present and father-absent boys, found that if the father leaves after the boys are 5 years, there is little or no difference in the degree of gender-typing in the boys' behaviours. Kohlberg (1966c) additionally cites two similar studies (Barclay and Cusamana, 1965; Smith, 1966) which again show little or no difference in the masculinity-femininity scores of father-present and father-absent boys. Furthermore, as Kohlberg (1966c) points out, this formulation cannot explain the shift to paternal identification which occurs for boys assuming that the mother is the primary caretaker. Unlike psychoanalytic theory, here there is no recourse to sexual desire for the mother.

For the alternative consideration of defensive identification, here motivation is seen in terms of social power rather than nurturance (Brim, 1958; Burton and Whiting, 1961; Kagan, 1964). On this hypothesis, at least for boys, a higher incidence of paternal aggression should lead to a higher score of masculinity. However, it has been repeatedly shown that paternal warmth, rather than aggression, facilitates the development of masculine attributes in boys (Kohlberg, 1963).

In addition, Sears, Rau and Alpert (1966) noted that fathers influence their daughters more than sons with regard to aggression, which is the opposite to what would be expected on a power theory of identification.
Overall, the literature does not lend much support to either identification based on dependency or as a defensive mechanism. Indeed, some authors (e.g. Bandura and Walters, 1963) have demonstrated the occurrence of modelling in the absence of a nurturant relationship with the model, or direct rewards.

For example, in a study on aggression, Bandura, Ross and Ross (1963c) gave four groups of nursery-school children four different conditions of outcome to a model's aggressive behaviour. In general, children who witnessed the aggressive model rewarded, later demonstrated more physical and verbal aggression than those who witnessed the model being punished. In a further study, this was extended to symbolic models such as in books, film and television (Bandura, 1965b). From this Bandura et al. suggest that vicarious reinforcement (to the model) is sufficient to account for observational learning or identification.

Indeed, Mischel (1966, 1970) provides an account of the possible role of vicarious reinforcement in facilitating the development of a gender identity. The basic organizing principle, according to Mischel, is the desire for rewards. Initially, there is direct reinforcement by the parents of responses which are imitative of the same-sex parent. Thereafter, through discrimination and generalization, the child will perceive the rewards pertaining to the appropriate parent for certain responses. As part of the
general desire for rewards, children will acquire, through observational learning, various responses characteristic of that parental model. In some cases, the rewards are inferred rather than directly perceived.

Mischel points out that behaviours which are appropriate to both sexes will be acquired through observational learning. For the performance of gender-appropriate behaviour, however, the past reinforcement history of the individual will play a determining role, ensuring that only responses appropriate to one's gender will be displayed. Later, through learning by association, the verbal labels "boy" and "girl" will be used to organize gender-typed responses. Again, the basic motivation behind this organization is the desire for rewards, both in the present and in the future.

In this sense, the unitary identification theory of Freud is rejected in favour of a situationally-determined identificatory process. Instead, the social-learning view explains individual differences in gender-typed behaviour as a function of model experience. However, the existence of stereotyping in the gender role will lead to a certain similarity in responses.

In this account, Mischel predicates the existence of "cognitive" or "mediating" variables between stimulus and response. This enables learning by observation to occur, as in the case of inferring rewards contingent on a model's behaviour. In this way, the social-learning theorists
believe they can adequately account for the complex variety of social behaviour in keeping with the principles of learning-theory.

Evidence for Social-Learning Theory

In support of a social-learning account, without doubt, parental differential reinforcement does take place from a very early age. For example, in one study, Will, Self and Datan (1976) observed mothers playing individually with a 6 month old. Half were told that the infant was a boy and the rest, a girl. Although all denied differential treatment, the mothers who thought the child was a boy were more likely to offer "him" a train, while the mothers who thought the child was a girl were more likely to offer a doll.

In another study, Moss (1967) observed maternal treatment at 3 weeks and again at 3 months. He concluded that gender-appropriate behaviour (in this case, verbal for girls and aggressive for boys) was given consistent reinforcement by mothers. Similarly, Goldberg and Lewis (1969) studied 32 boys and 32 girls at 13 months, as a follow-up to an earlier study of the same infants at 6 months. They found that, at 6 months, mothers of girls touched and talked to their infants more than mothers of boys. By 13 months, girls were more reluctant to leave their mothers, touched them more than boys and also vocalized more.
This is but a few of the studies demonstrating differential treatment of infants as a function of gender. Not only does it appear very early, there is also evidence that it does have an effect on the incidence of gender-appropriate behaviour in the infant and child. In later life, children are dressed differently and are given different toys to play with. For example, Rheingold and Cook (1975) examined the contents of the bedrooms of 48 boys and 48 girls, all less than 6 years old. They found that girls' rooms tended to contain dolls, doll-houses, and domestic toys. They were generally decorated with floral motifs, lace, fringe and ruffles. Boys' rooms, alternately, contained vehicles, sports equipment, toy animals, depots, machines, fauna and military toys.

Behaviourally, Sears, Maccoby and Levin (1957) noted that girls are encouraged to express "prosocial" forms of aggression, such as verbal; while boys are only generally inhibited in overt aggression when it is adult-directed.

From this, it does seem clear that differential reinforcement occurs for gender-appropriate behaviour from quite an early age. Similarly, it seems reasonable to accept that imitation also occurs. However, there are a number of criticisms to be made of the social-learning account of the origins of gender identity in general.
Criticisms of Social Learning Theory

Ultimately, the concern of social-learning theory is to demonstrate that gender-appropriate behaviour is a function of experience rather than innately-generated factors. In doing so, it is apparent that the end assumes primary importance over the means for social-learning theorists.

To recap, social-learning theory introduces the notion of observational learning as identification in the acquisition of gender-appropriate behaviour. This is suggested as an explanation of the breadth, as well as complexities of social behaviour which seem difficult to account for on the basis of trial-and-error learning. For the learning of gender-appropriate behaviour, therefore, the child is assumed to identify with the same-sex parent. Correspondingly, the child will learn as a result of reward consequences to the model, which are both directly perceived and inferred. In this sense, social-learning theory predicates the existence of mediating variables between stimulus and response.

Having introduced the notion of "cognitive" variables in learning, however, it becomes difficult to see where social-learning theory ends and cognitive-developmental theory begins. Some do argue (e.g. Gewirtz, 1969) that, at some point in reinforcement history, there must have been direct reward. One who does not is Mischel (1966,
Mischel instead argues for a distinction between acquisition and performance. As noted earlier, he states that both sexes, through observational learning, acquire behaviours that are appropriate to either sex. With regard to performance, on the other hand, this is determined by the past reinforcement history of the individual.

In our culture both men and women know how to curse, or to fight, or use cosmetics, or primp in front of mirrors, although they differ in the frequency with which they perform these activities. The acquisitional phases of sex-typing to a large extent involve cognitive and observational processes through which concepts and potential behaviours are learned. On the other hand, the individual's choice or selection of sex-typed behaviours from the available array that he already has learned and knows how to execute depends on motivational considerations.... Direct and vicarious reinforcement .... is an important determinant of response selection in performance. (Mischel, 1970, pp.41-42).

Nevertheless, once cognitive processes are proposed, the question of their relation to behaviour becomes predominant. With reference to this, Mischel states:

Empirically, the relations between the individual's attitudes and values and other indices of his behaviour .... are far from strong. Moreover, the causal effects of attitudes and cognitions on other (non sex-typed) aspects of behaviour are not clear, and it may be hazardous to assume a unidirectional causal chain in which attitudes and cognitions are taken as the invariable causes of other forms of behaviour.

(Mischel, 1970, p.58; this author's addition in brackets.)

However, this position is clearly contradicted by the existence of age-linked changes in children's ideas
of gender, which is the substance of the next section on
cognitive-developmental theory. Here, there is quite clear
evidence of organizational change in attitudes and behaviour
which cannot be explained in terms of past reinforcement
history. Instead, it is more likely that this is an
indication of behaviour varying as a function of cognitive
change.

A further criticism can be made with regard to the
universalality of the gender concept. If gender identity
were the outcome of organization as a function of
reinforcement history, then it would seem only reasonable
to expect a greater incidence of aberrant or unusual
labelling. Why, for instance, do children never
categorize more than two classes of gender? Similarly,
the incidence of transexuals also seems difficult to fit
into a social-learning framework. There are, of course,
people who have the subjective feeling of being in the
wrong body, although they are genetically normal, and have
been labelled appropriately throughout life (see Morris,
1974).

In terms of imitative learning from the same-sex
parent, there is evidence to the contrary that, in fact,
children's behaviour bears little relation to extent of
parental sex-typing (Maccoby and Jacklin, 1974; Smith and
Daglish, 1977). More importantly, social-learning theory
fails to account for age-linked changes in children's ideas
of gender. This is the substance of the next class of
theory, namely, cognitive-developmental.
COGNITIVE-DEVELOPMENTAL THEORY

In this account, gender identity is formulated as a cognitive category of self and others. As with conceptual development in the world of objects, the gender concept is purported to undergo similar transformations as a result of interaction with the world of persons. In cognitive theory, structural universals, both in the environment and in persons as products of the environment, are predicated. Gender, therefore, is defined as a universally-available category of persons in relation to each other. It is taken as part of the general process by which self knowledge is acquired.

(1) Theory of Kohlberg

The cognitive-developmental account of gender identity as outlined by Kohlberg (1966c) follows Piagetian principles of development. In this view, there is a general assumption that development in the physical world and development in the social world are interdependent and mutually supportive. Indeed, Piaget does not consider that there is any distinction between the world of objects and the world of people, until the end of the sensori-motor period (around 18 months) where the capacity to represent self as a permanent object, distinct from the world, emerges (Piaget and Inhelder, 1966).
Piaget (1947/1950), however, does stress the unique aspect of persons in the developmental process, in the sense that they maintain identity with the infant as a member of the same-species. Further, as development progresses, the growing cognitive capacity of the infant and toddler enables him to perceive this unity and thereafter use this knowledge to advance his understanding of the world in general. Particularly important to this last process is the mechanism of imitation (1951).

For Piaget, imitation is the means by which the infant first attains a sense of the analogy between his own body and other bodies. This, according to Piaget, occurs at stages 2 and 3 of the sensori-motor period. Later, more elaborate forms of imitation appear, wherein it occurs when the model is no longer present (deferred imitation at 18 months). For Piaget, this is an indication that "representation" of prior objects and events is now functional; indeed, Piaget holds that the imitative function itself is one precursor of the semiotic function in general.

For this form of symbolic imitation, Piaget predicates two conditions. One is the capacity to perceive similarity between the imitator and model, and, secondly, a general desire for cognitive control or mastery of interesting events in the environment. In this sense, imitation, in its symbolic form, occurs once the child has the ability to perceive and represent similarity between himself and
others. Further, as persons are more likely than objects to perform interesting events, imitation generally occurs for people and not objects.

For Kohlberg, Piaget's account of imitation leads him to suggest an alternative role in the development of gender identity. Unlike both the psychoanalytic and the social-learning position where same-sex parental imitation is assumed to be primary, Kohlberg suggests instead the salience of peer imitation. Within the Piagetian framework, imitation does not arise from a prior relationship of nurturance or dependency, as suggested in the alternative accounts. Instead, it occurs under conditions of perceived similarity and interest. In this sense, Kohlberg argues that the capacity to perceive like-self is more likely to arise initially in relation to peers rather than adults. He states:

In our view, then, imitation or modeling is a primary and 'natural' (though not instinctive) social tendency that does not require a physical drive-reducing or care-taking relationship but does require a relationship of similarity. The two-year-old boy exhausts himself tagging behind his older brother attempting to imitate his every activity. This imitation is not based on a past history of affection and care. The two-year-old is likely to imitate his brother more than his mother because his brother performs more grossly interesting and comprehensible activities. When he is in need or distress, however, the two-year-old boy quickly turns to his mother, not to his model. (Kohlberg, 1966c, p.129)

In this sense, Kohlberg is arguing that the original organization in gender identity is not "I am like Mummy or Daddy", but rather "I am a boy or girl". In fact, Kohlberg
sees the former as being a prerequisite of the latter. When parental identification does occur (around 4-5 years, according to Kohlberg, 1966a; Kohlberg and Zigler, 1967), this is a function of an increased cognitive sophistication which enables the perception of adult-specific similarity in the form of "we males" and "we females".

In other words, gender identity as a cognitive judgement is purported to exist in relation to peers prior to adults. Although social-learning theory does not deny the existence or relevance of peer imitation (for example, see Mischel, 1970), there are significant differences in their conceived function. For Kohlberg, the underlying rationale is not "I want rewards, I am rewarded for doing boy things, therefore I want to be a boy". Rather, it is "I am a boy, therefore I want to do boy things, therefore the opportunity to do boy things (and to gain approval for doing them) is rewarding" (Kohlberg, 1966c, p.189).

In Kohlberg's account, therefore, the decision that "I am a boy or girl" generates gender-typed behaviours, as opposed to being an organizing outcome of existing behaviours. This, of course, is in keeping with the principles of Piagetian theory, wherein cognitive concepts organize both experience of the world as well as behaviour in the world. To understand this properly, it is necessary to outline the broader theoretical context of cognitive-developmental theory.
Basically, Piaget's theory of transaction with the world holds that all experience and behaviour is in reference to cognitive structures or rules — both in the world of people and the world of objects. Development, therefore, is neither a biologically-based process of maturation or a passive process of learning. Rather, it is an active construction of categories which will, in turn, structure future behaviour and experience. Underlying this process is the need to maintain "equilibrium" between the organism and the environment. When conflict does arise (when existing structures are not adaptive to existing experience), development, in the form of a transformation of cognitive structure will take place, and this is described as an advance to a higher "stage" of development.

In a similar vein, Kohlberg (1966c) argues that gender identity is a cognitive category which organizes the child's experience of himself ("I am a boy") as well as his subsequent behaviour ("therefore I want to do boy things"). For Kohlberg, gender identity is actively constructed from experience and undergoes a similar stage-like progression in development as concepts of the physical world, such as the object concept.

Particularly important to Piagetian theory is the evidence of age-linked changes in children's ideas of the world. This provides strong support for the notion of development as a stage-like transformation of cognitive structure. Similarly, for Kohlberg, his demonstration of
age-linked changes in children's ideas on gender-related phenomenon, constitutes an important contribution to a cognitive approach to the development of gender identity.

Unlike the psychoanalytic formulation of age-linked changes as a function of physiological (libidinal) maturation, Kohlberg relates age-specific changes to Piagetian stages of cognitive growth. Thus, while the psychoanalysts explain fanciful, childish beliefs on castration as the product of libidinal fears, Kohlberg, alternately, relates these to a general state of cognitive immaturity. Social-learning theory, on the other hand, cannot explain age-linked changes, confined as it is to the mechanism of model experience.

Of particular interest to Kohlberg is the discrepancy between younger children and older children's understanding of the invariant nature of gender identity. Initially, from around 2½ years until about 7, children appear to define gender on the basis of superficial, physical criteria. When these are altered, most children in this age-group will agree that gender identity has similarly been altered.

For example, Kohlberg (1966a) showed children, aged 4-8 years, a pictured girl. On being asked whether she could be a boy if she wanted to, or if she wore boys' clothes and hairstyles, or if she played boys' games; most 4-year-olds said yes. By 6-7 years, however, most children said no. Similarly, a pictured cat was thought
to be capable of being a dog if it wanted to (or if its whiskers were cut off) by 4-year-olds but not by 6-7-year-olds. Devries (1966), using a dog mask on a live cat, found similar, age-specific results.

From this, Kohlberg argues that species and gender identity do not attain constancy until the stage of concrete operations (6-7 years), which is when constancy in the physical world is also constructed. Indeed, Kohlberg, like Piaget, predicates the interdependence of development in the physical world and development in the social world. Just as objects are not believed by children to remain invariant under perceptual change until around 7 years, so too for "category" identity such as species and gender.

To demonstrate this unity, Kohlberg (1966a) compared the results on gender constancy (measured by the pictured girl) with three other constancy tasks - species identity, conservation of mass and conservation of length. Although category constancy slightly preceded quantitative constancy, in general, Kohlberg obtained a substantial correlation between success on the gender task and success on the others ($r = 0.36$ to $0.64$).

In this sense, Kohlberg proposes that social concepts can be accounted for within the framework of cognitive development in general. Categorizing self and others is considered to be subject to the same principles governing the development of categories for physical objects. The
evidence of age-linked changes is taken as support for this view over the alternatives of psychoanalytic and social-learning theory.

By 7 years, in Piagetian theory, constancy of objects is attained as a result of the process of "decentering" in thought. That is, initially, the infant and young child are considered as maintaining an "egocentric" view of the world, whereby events and objects are perceived only in terms of the child as instigator of all action in the world. Gradually, throughout the pre-operational stage (2-7 years), the child establishes objectivity in the world, both with regard to objects as well as people. In this sense, the child becomes "free" to contemplate a reality beyond the immediate outcome of his own actions.

Similarly, for gender identity, Kohlberg argues that the process of decentering enables the child to progress beyond a definition based on immediate appearance specified by clothes, hairstyle and possessions (toys, handbags etc.). Instead, he comes to define gender in terms of constant cues, including anatomy.

Within this framework, therefore, Kohlberg stresses the active role of the child in the construction of a gender identity of self in relation to the world. As it is initially a category of self, Kohlberg suggests that this will be applied to others on the basis of perceived similarity to self. In this sense, peers will be labelled prior to adults, as similarity is initially
perceived on the basis of self defined by featural cues, including size. Only later, with increasing cognitive sophistication, will this become applicable to adults.

By way of support, Kohlberg (1966c) cites evidence that demonstrates children's ability to label themselves and peers correctly by 3 years, while still failing to recognize the adult equivalent. By around 5 years, however, children become able to respond correctly on being asked whether they will grow up to be a "Mummy" or a "Daddy". This, of course, contradicts the notion of an initial same-sex parental identification, outlined in both psychoanalytic and social-learning theory.

However, although the first application of the gender label is to other peers and not parents, it originates, according to Kohlberg, entirely in relation to self, before it becomes generalized to others. That is, the original use of the gender concept is considered to be as a self categorization. Only later can this be applied to others on the basis of perceived similarity to self.

For Kohlberg, the original premise of "self" is defined in terms of self-as-body. That is, self is considered to be originally apprehended as a physical entity defined in terms of physical attributes, before it is conceived in the social sense of self distinct from others. In this way, Kohlberg can strengthen the suggested analogy between development of concepts of the physical
world, and concepts or categories of the social world. In addition, this formulation maintains the framework of egocentrism, wherein the child remains unaware of thought originating from any source other than himself. Thus, for Kohlberg, gender identity originates as a means of describing self-as-body. Through the perception of similarity between self's superficial attributes such as clothes and hairstyle, and others attired in a similar way, the gender label becomes extended to others. Not until the child becomes capable of apprehending others as possessing minds and wills independent of his own (stage of concrete operations), can he similarly conceive of gender in terms of a self-other distinction proper (Kohlberg, 1966c, 1969).

In this way, in Kohlbergian terms, the originating mechanism is not, in fact, perceived similarity but rather verbal labelling.

Obviously, this process begins with the child's hearing and learning the verbal labels 'boy' and 'girl'. The child's verbal learning of his own gender label occurs quite early, usually sometime late in the second year of life .... and in the next two years [children] learn to label others correctly according to conventional cues.

(Kohlberg, 1966c, pp.93-94)

In other words, for Kohlberg, the original concept of gender is as a function of language providing the means by which to apply a label to self-as-body, in much the same way that the child's own name categorizes self. Indeed, in support of this analogy, Kohlberg (1966c) cites the
example of a 2-year-old applying the label "boy" to every member of his family, including his mother.

In Kohlbergian theory, therefore, infancy cannot constitute the starting-point for gender identity for a number of a priori reasons. By remaining within the Piagetian account, Kohlberg first of all begins with the assumption that, prior to the end of the sensori-motor period, there is no distinction between persons and objects. The only difference is that persons are more likely to do interesting things that are within the infant's own repertoire. This, of course, is the basis of imitation.

Secondly, for Kohlberg, the original distinction of self is in terms of self-as-body. Not until at least two years, therefore, when the child has constructed both a notion of the permanence of objects (and the related capacity to represent absent objects) can he similarly apprehend himself as a permanent object. The basis of this initial categorization is, of course, featural cues both for objects and persons-as-objects. An important cognitive tool for this is language, which provides a further means of categorizing (representing) self in the world. Through this description of self, the child, thereafter, can apply this to others at the level of physical similarity. For this reason, gender in other peers is recognized prior to adults. However, even then, the child does not understand the invariance of gender until the stage of concrete operations, where there is the first
awareness of the reality of others at the level of minds. In this way, infancy, for a priori reasons, is not considered in Kohlberg's account of gender identity.

Summary

In all of the three established theories discussed, there is no consideration of infancy. In general, all three assume that infancy constitutes a lack of the social capacity. In this sense, the emergence of gender identity is taken as synonymous with the emergence of a capacity for the social function.

In psychoanalytic theory, thought is suggested to be originally organized by the instincts (primary process). For the psychoanalysts, therefore, infants are not available for the cultural expression of the sexual instincts through the categories of "male" and "female". Instead, infants are assumed to be "bisexual". At this time, in Freudian terms, the infant can only maintain externally-directed part object-relations, until maturation of the libido enables him to apprehend objects (persons, including self) in entirety. Fear of loss and retaliation thereafter provide the motivation to identify with the same-sex parent.

For the social-learning theorists, infants are defined in terms of reinforcement history. A child is more advanced than an infant because there have been more opportunities to learn from the environment. In social-learning terms, the awareness of gender does not emerge
until the child has learned to discriminate rewards based on the parameters of masculinity and femininity. Only through experience (both of direct rewards and model exposure) can children learn to discriminate and generalize gender-appropriate behaviours. Again, as with psychoanalytic theory, identification with the same-sex parent is considered to be the original organizer of gender identity. Unlike psychoanalytic theory, however, social-learning theory relates this ultimately to the desire for rewards.

Cognitive-developmental theory differs importantly from both in that, here, gender identity is considered to develop with reference to peers prior to a generalization to adults. In the Kohlbergian formulation, gender identity is defined as a cognitive concept which is constructed by the child first of all for self-distinct-from world, then as self distinct from peers and, finally, as self with reference to adults.

However, Kohlberg employs the Piagetian perspective on development in both the physical world and development in the social world. For Piaget, the permanent reality of either are not constructed until the end of the sensorimotor period (around 18 months). Furthermore, reality is not differentiated as "intersubjective" distinct from "objective" until the stage of concrete operations (around 6-7 years). In this sense, Kohlberg does not attribute the awareness of self-as-body until there is awareness, in the Piagetian sense, of objects-as-bodies. That is, not
until the end of the second year of life can the child symbolically represent self as entity by the labels "boy" or "girl". Further, not until the stage of concrete operations, can the child apprehend the invariant nature of gender identity despite featural change.

(2) Lewis and Brooks

Into the above, carefully considered context, appears the work of Lewis and Brooks (1976). Contrary to all three of the established theories, Lewis and Brooks present strong evidence for a gender identity in infants. As with Kohlberg, this is also within a cognitive-developmental framework.

It is perhaps true to say that much of the history of infant psychology has been plagued by the lack of available techniques for measuring infant knowledge. One of the most significant innovations here is the use of infant looking-behaviour as an index of infant awareness.

Fantz (1956) was the first to use this technique on primate infants. In two related studies with human infants (1963, 1964), he proposed that, in a simultaneous-presentation paradigm, it is possible to obtain significant differences in mean fixation time to one stimulus over its pair. From this, it seems logical to take this as an indication that the infant can both perceive and differentiate between a pair of stimuli.
For example, Fantz (1963) presented neonates with static representations of varying complexity ranging from a human face to extracts of newsprint from current magazines. He found that infants at this age will fixate ("prefer") pictures of a face over pictures of circles and newsprint. From this, he argues for a more sophisticated perceptual capacity in the neonate than was currently believed. If there was no awareness of the parameters of difference between the presented stimuli, it would be reasonable to expect only a chance variation in looking-behaviour. Instead, neonates "prefer" one over the other. (In this sense, preference is an operational definition of longer fixation and cannot be taken as an indication of a more positive, affective response.)

In a similar vein, Lewis and Brooks (1975) also employ the simultaneous-presentation paradigm, only here the parameter of difference is gender category. For this, they presented 28 female and 28 male infants (divided into four age-groups of 10-, 12-, 16- and 18 months) with photographs of persons, including a same-age female infant and a same-age male infant.

On examination of the looking-behaviour of the infant Ss, Lewis and Brooks obtained a significant difference in the mean amount of fixation as a function of gender. That is, for all age-groups, girl infants looked longer at photographs of girls while boy infants looked longer at photographs of boys. Figure 2.1 illustrates the differences
obtained for looking to same-sex and opposite-sex.

FIGURE 2:1: Results obtained by Lewis and Brooks of looking-behaviour to photographs of other infants.

Of particular interest here is the obtained differences in fixation time for the youngest age-group (10-13 months). Girls in this group spent an average of 5.56 seconds on the girl photographs against 4.80 seconds to the boys. Male 10-13 month olds, on the other hand, looked for a mean of 6.81 seconds at the boys, and 5.75 seconds to the girls.

In other words, even by one year, infants appear to be able to discriminate between other infants on the basis
of gender, as indexed by preferential looking. However, Lewis and Brooks put a stronger interpretation on their results. They suggest that this preference in looking is not simply a function of an ability to discriminate between gender-specific cues, but rather is a function to identify gender, even at this early age. This is because the preference in looking is consistently for own sex, as opposed to being a preference for one picture over another.

Essentially, Lewis and Brooks take cognizance of the fact that their obtained responses from the infants were as a function of own sex in that preference in boys was for boys, while preference in girls was for girls. In this sense, the obtained preferences appear to indicate an ability to perceive similarity between self and other peers on the dimension of gender. If preference was simply for one set of "models" over another, this would indicate an ability to discriminate gender. Preference for own sex, however, suggests that it functions instead in relation to self.

As further support for this, Lewis and Brooks, in the same experiment, noted that photographs of self were fixated by the Ss for virtually the same time as same-sex infant. In general, there were no statistical differences between self regard and same-sex regard. From this, Lewis and Brooks (1974) argue that, by one year, infants are capable of both distinguishing and identifying other infants on the basis of perceived similarity to self in terms of same-sex.
Effectively, it can be argued from this that infants, contrary to the established position, have gender identity in the Kohlbergian sense of like-self (same-sex) versus not-like-self (opposite-sex). As further support, Lewis and Brooks (1975) also obtained no differences in affect for self-photographs and same-sex photographs.

In a follow-up study, Lewis and Brooks-Gunn (1979) replicated their original results with a further sample of 28 10-12 month olds. Here, first fixation to same-sex peer was 4.24 seconds against 3.35 seconds to opposite-sex peer. Total fixation also showed discrimination, with an obtained mean of 3.50 seconds to same-sex and 2.85 seconds to opposite-sex. In addition, they found that same-sex peer was smiled at more and received more vocalizations. As in the earlier study, this pattern held for older infants as well (16-18 months).

In the same work, Lewis and Brooks-Gunn also studied the verbal labels used by 15-, 19- and 22-month-olds. They found that, even at 15 months, there was discriminative vocalization. Picture of self and same-sex picture were equally labelled as both "Baby" and the infant's own name. Opposite-sex picture, however, was only labelled as "Baby". This is taken as a further indication that pictures of the same-sex peer is treated similarly to pictures of self by infants.

In general, Lewis and Brooks(-Gunn) present the argument that infants, by one year, can identify self and same-sex
as similar, and different from opposite-sex. In other words, this effectively constitutes gender identity in terms of perceived similarity with self, at an earlier age than Kohlberg's hypothesized age of 3 years.

However, Lewis and Brooks(-Gunn) continue to employ a constructivist (Piagetian) framework for explanation of the perception of like-self in infancy. That is, they predicate the primacy of featural cues in perceptual development.

In the above demonstrations of a "like-me" judgement at 10-13 months, same-sex and opposite-sex stimuli were presented in the form of static pictures or photographs. These specified the upper body and head of self and other infants. The evidence of preferential fixation from this enables Lewis and Brooks(-Gunn) to propose that like-self at this age is based on the perception of cues such as clothes, hair-length and facial configuration (Lewis and Brooks, 1975; Lewis and Brooks-Gunn, 1979). Later in development, they suggest, this becomes generalized to more complex cues.

In support of this position, hair-length often does differentiate boys and girls from an early age - boys rarely have hair longer than shoulder length. Clothes also tend to be different. In a study of mother-infant interaction, Brooks and Lewis (1975) observed clear variations in dress as a function of gender. Boys tended to be
dressed in blue, green or brown; while girls tended to be dressed in pink, red or yellow.

In addition, Lewis and Brooks-Gunn (1979) consider facial configuration. This, however, does not seem to be well-supported. In the absence of confirmation from the available literature, they cite Tanner (personal communication) who observed differences in facial muscles and shape prior to puberty. Unfortunately, it is not stated if this extends to infancy. Yet they do cite one study (Haviland and Lewis, 1976) on a sex difference in eye-openness to a stranger.

In general, Lewis and Brooks-Gunn appear slightly dissatisfied with their account of existing pictorial cues as providing the basis for perceived similarity in younger infants. When 18 adults were asked to sort their experimental baby pictures by gender, more accuracy was obtained for the 16-18 month olds than for the 10-12 month olds.

In addition to gender, as mentioned in Chapter 1, Lewis and Brooks(-Gunn) suggest two other categories which describe self and others in infancy. These are age and familiarity. All three, they propose, function to make sense out of the social milieu from an early age. All three categories of age, familiarity and gender become differentiated originally on the basis of superficial, featural criteria. Familiarity is suggested to arise first (around 3 months), then age (around 6 months) and
finally, gender. Figure 2.2 presents their diagram documenting a possible developmental pathway of familiarity, age and gender as categories of the infant's social world.

**FIGURE 2.2:** Lewis and Brooks-Gunn's proposed account of categorical social development.

Having noted earlier a theoretical unity between Lewis and Brooks(-Gunn) and Piaget, it should be apparent that there are some important differences. Unlike Piaget, Lewis and Brooks(-Gunn) propose an early (indeed, innate) capacity to perceive the social world as distinct from the world of objects. In this sense, unlike Kohlberg, they are free to examine the possibility of infant origins of gender identity.
Infants from the beginning of life, enter into a social world filled with a wide assortment of people. Predisposed to interact with the environment, especially the social environment, infants enter into and actively participate in a variety of social relationships. In terms of their own social networks, infants learn that they have different relationships with different people and that these relationships differ in terms of the nature of at least the social object, function and situation .... From these complex interactions, several categories of self and other emerge. (Lewis and Brooks-Gunn, 1979, p.233)

As a fuller discussion of this position is conducted in Chapter 1, the details of this theoretical construct will not be gone into here. The main point for the present is that, having postulated an innate tendency for the social world, Lewis and Brooks(-Gunn) can additionally explain the possibility of infant gender identity.

The attraction of Lewis and Brooks(-Gunn)'s account is its compatibility with the work of Money, Hampson and Hampson (1957), cited by Bower (1979). Here, it is suggested that a critical period for gender assignment may exist prior to 18 months. This is because reassignment after this age tends to lead to emotional and behavioural maladjustment. In addition, the (implicit) assumption in Lewis and Brooks(-Gunn)'s theory that infants are in possession of a capacity for "representation" prior to the end of the sensori-motor period, is also compatible with recent evidence on imitation in infancy (Meltzoff and Moore, 1977; Dunkeld, 1979). Here, it is suggested that infants can represent the similarity between self and others from as early as the first hour of life.
With regard to this last point, however, Lewis and Brooks-Gunn (1979) ultimately choose to remain within a Piagetian position. Essentially, they maintain that social behaviour originates as a reflex or "primary circular reaction". Later, around 3-8 months, recognition of self-distinct-from-others on the basis of contingency cues emerges. Not until 8-12 months does recognition of self on the basis of featural cues become possible. This is analogous to the emergence of object permanence (see Chapter 1). At this age, perceived similarity with (and difference from) others on the basis of featural cues is now available. However, Lewis and Brooks(-Gunn) go on to state that only later is there any representation of self "symbolically" between the approximate ages of 12-24 months, and again only at the level of featural cues.

In this sense, Lewis and Brooks(-Gunn) maintain a unity with Piaget's theory of perceptual-cognitive development. Despite the important difference of innate "sociality", like Kohlberg, they suggest that the original perceived similarity is derived from superficial, featural criteria. However, unlike Kohlberg, they propose that this is functional in infancy.

Thus, within the Piagetian account of cognitive development, there are two theories of the origins of gender identity, namely, Kohlberg's and that of Lewis and Brooks(-Gunn). Of these, only the latter proposes that infancy constitutes the beginnings of a gender identity.
As with Kohlberg, this is assumed to be based on featural representation of like-self.

However, within the cognitive-developmental framework, there exist several challenges to the Piagetian formulation of representation in infancy. One in particular is the theory of T.G.R. Bower.

(3) T.G.R. Bower

In this theory, a first principle of cognition is representation. Unlike Piaget, who proposed that representation, in its symbolic sense, does not emerge until late in the second year of life, Bower instead suggests that all behaviour and all thinking predicates the existence of a representative function (1979).

In Bower's theory, therefore, development is not a process for the attainment of representation, but rather, is one of a specification of existing structures (rules) of thought, in accordance with obtained experience of the environment. Thus, while Piaget defines the infant in terms of a capacity for representation only at the level of action in the immediate, Bower alternatively defines the infant as lacking the experience and processing capacity necessary to "express" representation at the level of specificity appropriate for an adult. In this sense, a certain degree of innate knowledge is proposed, both with regard to the world of objects and the world of people (Bower, 1979, 1982).
For objects, Bower (1974) suggests that, from birth, infants can represent the object as both a bounded volume in space, as well as a movement from A to B. This applies not only in the visual mode, but in the auditory and tactual modes as well.

In other words, the infant is considered to be aware of an "objective" reality at birth. However, it is expressed (represented) only in its abstract properties, which can be apprehended by all the senses in unison. In fact, Bower states that the neonate cannot distinguish between an auditorily-specified object and a visually-specified object (for example, see Bower, 1977d and Aitken and Bower, 1982). In this theory development is a process of specification of abstract properties in the world.

With regard to the social world, Bower similarly predicates an awareness of the subjective as distinct from the objective at birth (see Chapter 1 for fuller discussion). However, unlike Lewis and Brooks(-Gunn), Bower suggests, as for the world of objects, that the social world is initially apprehended by its abstract or "higher-order" properties. In support of this position, Bower cites Aitken (1977) and Bower, Turnbull and Aitken (in preparation) who extend the original Lewis and Brooks' (1975) paradigm.
Here, Aitken (1977) replicated the results of Lewis and Brooks (1975) with static presentations of pictures of infants to other 10-13 month olds. That is, the boy Ss preferentially fixated stills-photographs of two boy "actors" over the girl actors on a probability less than 0.01. Girl Ss, alternately, fixated the girls more than the boys on a probability of less than 0.001.

In a second experiment, Aitken (1977) attempted a closer examination of particular cues. This time, he presented stills-photographs of infants dressed in gender-inappropriate clothes, accompanied by gender-inappropriate toys. On Lewis and Brooks' account, what would be expected here is a corresponding change in preference. This is because they assume that featural cues, such as clothes and toys, define gender (perceived similarity to self) for 10-13 month olds.

However, in this condition, no significant differences in fixation were obtained. On a weaker interpretation of Lewis and Brooks, this could be taken as support for their position. However, in a third condition, Aitken showed the same actors, dressed in the same way, only this time the presentation was in the form of moving films as opposed to stills. In this event, Aitken again obtained a significant preference for same-sex (albeit closer to chance, with $p < 0.01$ for both groups). Figure 2.3 illustrates the reversal of preference obtained by Aitken.
from the stills to movement conditions.

![Chart](chart.png)

**FIGURE 2.3:** Aitken's results of looking-behaviour to same-sex and opposite-sex infants portrayed in the stills and movement conditions.

From this, it would appear that movement is in some sense more important for this early judgement of similarity. That is, on cross-dressing, infants at 10-13 months lose the capacity to judge like-self in other infants (as indexed by preferential looking). However, when movement is introduced, preferential looking becomes re-established, despite inappropriate dress and inappropriate toys.

In a further condition, Aitken only varied dress. Here, it was apparent that inappropriate clothes caused
greater "confusion" than inappropriate toys. Altogether, Aitken's results suggest a hierarchy of information-value pertaining to cues giving rise to a judgement of like-self. Movement appears to be primary, while clothes were more effective than toys.

From this, Aitken (1977) and Bower, Turnbull and Aitken (in preparation) argue that, at 10-13 months, infants use "higher-order" variables such as movement for defining like-self. Indeed, this type of information appears to override featural cues where necessary.

This contradicts the Piagetian position of Lewis and Brooks(-Gunn), wherein featural cues constitute the origins of a like-self judgement in infancy. Instead, Aitken's results provide support for Bower's theory of development. Here, the developmental path is proposed as one of specification of abstract representation. Bower (1982) has suggested that movement is of a higher-order type of information than static information regarding clothes, hair-length, facial configuration and toys. In this sense, "higher-order" is defined after Bateson's theory of logical types (1972), where higher-order descriptions or variables include the lower-order specification and their negation. In the present case, movement is of a higher-order type than clothes, for example, because a boy will still move in a similar fashion even when dressed in the opposite-sex clothes.
Aitken's demonstration, therefore, of the primacy of movement information for the infant's judgement of like-self effectively constitutes support for Bower's theory of development. Here, the higher-order information in movement appears to override lower-order cues. Unlike the constructivist position, Bower argues that self is originally defined (represented) in abstract terms. As Bower (1979) believes the infant to be social from birth, this self-representation can be readily generalized to others, again at the level of abstract information. Later, the original representations become available to more specific, second-order cues.

EXPERIMENTAL HYPOTHESIS

On this theory of social development, infants are predicted to have the capacity to judge like-self from higher-order information only. That is, in the absence of specific, featural cues, movement information will be adequate to specify the infant's judgement of like-self. The following four experiments constitute a test of this position. Experiments 1 and 2 use the same paradigm of Lewis and Brooks(-Gunn) and Aitken, only this time, featural cues are removed from the display and only movement information is presented. On Bower's theory, 10-13 month olds will demonstrate an ability to judge
like-self (fixate same-sex) from this type of array.
Experiments 3 and 4 constitute a follow-up to 1 and 2, this time with younger infants.
CHAPTER 3

EXPERIMENT 1
INTRODUCTION

To test Bower's theory of the development of representation of the social world, it was decided to present 10-13 month olds with the movement patterns of other infants, within the simultaneous-presentation paradigm.

If Bower's argument is correct, namely that self-other is represented initially by higher-order information, then it is predicted that, when specific, featural attributes are removed and only the patterns created by infants in motion are presented, 10-13 month olds will continue to fixate those of the same-sex over those of the opposite-sex. If they do not, then this would suggest that the alternative, constructivist position of Lewis and Brooks(-Gunn) is correct.

To present movement patterns of other infants, a technique of filming human movement was borrowed from Johansson (1973) and others. This involves placing light-spots at the 12 main joints (shoulder, elbow, wrist, hip, knee and ankle), and filming so that only the light-spots are visible against an otherwise black background.

Johansson (1976) has demonstrated that, for adults, such stimuli very rapidly give rise to the perception of persons in motion, whether dancing, kissing or walking (Maas and Johansson, 1971). As far as is known, infants
have not been filmed under these conditions. The experiment outlined here, therefore, constitutes a pilot of both the application of the "cyclographic" film technique to infants, as well as the presentation of such films to other infants.

The particular technique used here was a variant in the medium of video, with retroreflective tape instead of light-spots. The advantages of video are that it is cheaper, easier and allows for instantaneous feedback. However, there are some disadvantages, and these will be discussed at the end of the chapter.

Ideally, the selection of infant "actors" should have been those of the same age as the infant Ss (10-13 months). Lewis and Brooks(-Gunn) and Aitken both used same-age infant actors. The underlying rationale here is that judging like-self will be more likely to occur for same-age infants. In a similar vein, the infant actors here should also have been same-age. Unfortunately, several trials filming this particular age-group were not very successful, as there was a high incidence of upset. Older infants (15-18 months), on the other hand, were more compliant.

In view of this, it was decided that it would be necessary to redefine the limits of "similarity" between the infant Ss and the infant actors. Same-age, obviously, was not applicable. Instead, a criterion of "walking" was used. All of the infant actors were capable of walking.
Similarly, as 9-18 months represents the age for the onset of walking (Williams, 1983), then it is possible to define subject-actor similarity on the dimension of "capable of walking". This has the added advantage of delimiting the global term of "movement". In this case, it is reserved for movement pertaining to walking.

Having obtained suitable recordings of boy and girl infant actors walking to and fro, these were then edited and shown to a different group of boy and girl Ss, aged 10-13 months. As mentioned above, Experiment 1 was effectively intended as a pilot. Of particular interest here was the Ss response to the moving patterns of dots per se. It would be reasonable to predict that, if they found them confusing or frightening, they would make this quite plain.

With reference to the experimental hypothesis, it is predicted that, firstly, the infants would be able to see the moving patterns as human, if not infant walkers. Secondly, if Bower is correct, then same-sex fixation will be significantly longer than opposite-sex fixation. That is, boy Ss will look longer to the boy actors, while girl actors will look longer to the girl actors.
METHOD

Design

For simultaneous presentation, two videotapes of four walking infants, matched into two pairs (mean age 17 months) were used. They were presented in darkness to the subjects, who were all seated on their mothers' laps. The Ss themselves were videotaped (by means of infra-red lighting) as they watched. Later, their looking behaviour was assessed for first looks and total looks to the boy and girl actors. Order-effects were balanced by showing one half of the Ss infant actors Pair A followed by Pair B, and the remainder, Pair B followed by Pair A. This simultaneously provided a balance for side-effects, as Pair A always presented the girl on the left and the boy on the right, while Pair B presented the girl on the right and the boy on the left.

Materials

The videotapes were high-density Sony black and white. Using a Hitachi camera (HV15), sequences of infants walking to and fro were recorded. The infant actors were all dressed in a dark jumpsuit, to which 12 strips of glass bead retroreflective tape (2.9 cms wide) were attached. These could be adjusted to delineate the 12 main joints of each infant (shoulder, elbow, wrist, hip, knee and ankle). In an empty, light-sealed room, each infant was coaxed by E
and his mother to cross a diagonal (10 metres long), at one end of which was the camera and recording equipment. The only lighting was a 150 kW lamp, situated directly above the camera. With this method, it is possible to record only the light reflected off the glassbead tape. Any residual reflection from the infant can be masked by setting the contrast dial to full extent, and the brightness dial right down. Of a total of six infants, two did not relax enough for suitable recording. (It is advised to provide toys to help infants accept this potentially bizarre situation.) The remaining four recordings were divided into two pairs and edited into appropriate experimental form.

Editing

To edit the videotapes appropriately, two videotape-recorders (one of which was an edit-machine) and two monitors were used. Each run across the floor by the infant, either to or from the camera, was timed by a stopwatch. Having established a profile of each infant recording, two boy-girl pairs were chosen according to the extent of compatibility. Pair A produced slightly more matched sequences than Pair B. Particular care was taken to ensure that the sequences within each pair were matched for timing and content. It was felt that, if one infant did anything particularly eye-catching, then this could have an adverse effect on looking behaviour. To control for
this, only sequences of the infants crossing from A to B were used. Figure 3.1 illustrates the final edited version of the videotapes.

![Diagram of videotape sequences]

**FIGURE 3:1.** Experimental videotapes for Experiment 1.

In addition to this, the first pair (Pair A) were copied again after Pair B. This enabled a balance for order-effects. Half of the Ss were shown A followed by B. The rest saw Pair B followed by A. Side-effects were also balanced, with Pair A presenting the girl on the left and the boy on the right, while Pair B reversed this. This ensured that every S saw a boy and a girl on the left, as well as a boy and a girl on the right.
Equipment

(a) Presentation

For presenting the videotapes simultaneously, two monitors and two videorecorders were required. The monitors were 25" and the recorders Sony AV 3620CE (with the dials set for high contrast and low brightness).

(b) Recording

The infant's face was recorded by a Hitachi CCTV camera, complete with a zoom lens for adequate close-ups. An infra-red light with a double-polarised filter was also used. The recording included a digital timer.

Subjects

Thirty normal, healthy infants, all aged between 10-13 months, were obtained through a volunteer system covering the Edinburgh area. They were divided equally into boys and girls. Two Ss were discounted for crying, leaving a total of 28 Ss, 14 boys and 14 girls.

Procedure

The mothers and babies were brought by taxi to the Lab. On arrival, mother and baby were shown into the experimental room and settled before the monitors. The lights were then turned off, and by means of the infra-red light, E ascertained that S was adequately framed by the
camera. The videotapes were then begun and E noted this on the infant recording by means of the digital timer. When finished, this was again indicated on the timer, the recording was stopped and the overhead lights turned on.

**Analysis**

The first looks to both the right and left screen were counted, and similarly for the total looks. Naturally, the infants did not watch the screens continuously, but this was clearly recognizable.

**Results**

The obtained length of first looks (in seconds) are given in Table 3.1. They are divided by same-sex and opposite-sex. Direction of very first-look is noted, also side of viewing. Subjects Nos. 1 to 7 viewed Pair A first and subjects Nos. 8 to 14, Pair B first.

The time spent looking at same-sex versus opposite-sex (both groups) was statistically compared on a Wilcoxon Matched-Pairs Signed-Rank test. As it was predicted that same-sex first-look would be significantly longer than opposite-sex, a one-tailed test was used.

Obtained $T = 89$, $P < 0.005$ ($N = 28$), enables rejection of the null hypothesis that there would be no difference between same-sex and opposite-sex first-looks.
TABLE 3.1:

LENGTH OF FIRST LOOK (in seconds) (N = 28)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>5.63 L R</td>
<td>3.77 R</td>
</tr>
<tr>
<td>2</td>
<td>2.66 L R</td>
<td>3.53 R</td>
</tr>
<tr>
<td>3</td>
<td>1.09 L R</td>
<td>2.56 R</td>
</tr>
<tr>
<td>4</td>
<td>4.22 L R</td>
<td>1.59 R</td>
</tr>
<tr>
<td>5</td>
<td>2.79 L R</td>
<td>0.61 R</td>
</tr>
<tr>
<td>6</td>
<td>7.95 L R</td>
<td>4.    R</td>
</tr>
<tr>
<td>7</td>
<td>3.66 L R</td>
<td>6.84 R</td>
</tr>
<tr>
<td>8</td>
<td>1.3   ^R</td>
<td>0.86 L</td>
</tr>
<tr>
<td>9</td>
<td>4.16 R L</td>
<td>3.37 R</td>
</tr>
<tr>
<td>10</td>
<td>6.62 ^R</td>
<td>3.66 L</td>
</tr>
<tr>
<td>11</td>
<td>6.19 ^R</td>
<td>6.52 L</td>
</tr>
<tr>
<td>12</td>
<td>5.83 R L</td>
<td>2.95 R</td>
</tr>
<tr>
<td>13</td>
<td>1.59 ^R</td>
<td>1.56 L</td>
</tr>
<tr>
<td>14</td>
<td>7.59 ^R</td>
<td>2.12 L</td>
</tr>
</tbody>
</table>

*SS = Same-sex
**OS = Opposite-Sex

^R/L indicates side of appearance and direction of very first look

N.B. Ss 1-7 were viewing Pair A  Ss 8-14 were viewing Pair B then Pair A.

Then Pair B.
To test for any differences in looking-behaviour to Pair A of Pair B, the first looks to Pair A were compared with those for Pair B on Mann-Whitney U tests respectively. Obtained U for girls nos. 1 to 7 against girls nos. 8 to 14 was 95, and a similar comparison for boys derived a U of 87. As both have a probability of occurrence greater than 0.10, it was not possible to reject the null hypothesis that there would be no differences in the overall looking-behaviour to Pair A and Pair B. In other words, the overall pattern of looking-behaviour did not vary between Pair A and Pair B.

A check on side of preference was also made. For the girls, of the 14 longest looks, 5 were to the left side and 9 to the right side. For boys, 6 were to the left and 8 to the right. Altogether, of 28 longest looks, 17 were to the right and 11 to the left. This suggests a very slight bias to the right side. However, on a sign-test, \( P = 0.395 \) which indicates that there was no significant bias to one side.

Finally, any correspondence between preferred screen and direction of very first look was also checked. This is indicated for each S in Table 3.1. Of 20 Ss who looked longer at same-sex, 7 regarded same-sex first and 13, opposite-sex first. This again is non-significant on a sign test \( (P = 0.132) \).

The mean length of first looks was also calculated and the findings are presented in Tables 3.2 and 3.3.
TABLE 3.2:
MEAN FIRST LOOKS FOR GIRLS, BOYS AND BOTH TOGETHER (in seconds)
(PAIRS A AND B COMBINED)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>4.37</td>
<td>3.14</td>
</tr>
<tr>
<td>Boys</td>
<td>4.73</td>
<td>2.79</td>
</tr>
<tr>
<td>Both</td>
<td>4.5</td>
<td>2.96</td>
</tr>
</tbody>
</table>

TABLE 3.3:
MEAN FIRST LOOKS TO PAIRS A AND B

<table>
<thead>
<tr>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>4</td>
<td>3.27</td>
</tr>
<tr>
<td>4.75</td>
<td>3.01</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex
Table 3.2 gives the mean length of first-look (Pairs A and B collapsed). Table 3.3 presents the derived mean length of first look for those subjects who saw Pair A and those who saw Pair B. From Table 3.2 it can be seen that boys and girls separately (and both together) demonstrate same-sex preference as predicted. Figures 3.2 and 3.3 illustrate the derived mean first looks from Tables 3.2 and 3.3.

Length of total looks were also scored. These are presented in Table 3.4. Ss nos. 1 to 7 saw Pair A followed by Pair B while Ss nos. 8 to 14 saw Pair B followed by Pair A.

From both pairs of actors the total looks to same-sex versus opposite-sex (boys and girls) were compared on a one-tailed Wilcoxon Matched-Pairs Signed-Rank test. Obtained $T = 166.5$ $(N = 28)$, $P > 0.10$. That is, it was not possible to reject the null hypothesis for total-look that there would be no significant preference for either sex. Individually, girls scored a $T$ of 39 and boys, 51. Neither, therefore, demonstrated any significant preference in total looks.

Table 3.5 gives the breakdown of total looks to both pairs of actors separately. Ss nos. 1-7 saw Pair A then Pair B. Ss nos. 8-14 saw Pair B then Pair A. Figure 3.4 illustrates the separate and mean total looks to Pairs A and B.

Order-effects were examined by comparing the pattern of looking-behaviour from those viewing Pair A followed by
FIGURE 3:2. Mean first looks to Pairs A and B combined.
FIGURE 3:3. Mean first looks to Pairs A and B respectively.
TABLE 3.4:
LENGTH OF TOTAL LOOK FROM BOTH PAIRS OF ACTORS (in seconds)  \( (N = 48)\)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th></th>
<th>BOYS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>25.74</td>
<td>37.76</td>
<td>48.73</td>
<td>28.17</td>
</tr>
<tr>
<td>2</td>
<td>51.3</td>
<td>19.22</td>
<td>25.48</td>
<td>52.14</td>
</tr>
<tr>
<td>3</td>
<td>17.68</td>
<td>49.47</td>
<td>20.07</td>
<td>38.51</td>
</tr>
<tr>
<td>4</td>
<td>39.95</td>
<td>16.71</td>
<td>38.75</td>
<td>30.36</td>
</tr>
<tr>
<td>5</td>
<td>28.5</td>
<td>55.67</td>
<td>28.33</td>
<td>60.41</td>
</tr>
<tr>
<td>6</td>
<td>29.38</td>
<td>47.08</td>
<td>29.8</td>
<td>42.48</td>
</tr>
<tr>
<td>7</td>
<td>24.57</td>
<td>33.86</td>
<td>34.48</td>
<td>33.37</td>
</tr>
<tr>
<td>8</td>
<td>26</td>
<td>15.25</td>
<td>37.01</td>
<td>41.15</td>
</tr>
<tr>
<td>9</td>
<td>23.95</td>
<td>43.38</td>
<td>61.72</td>
<td>26.43</td>
</tr>
<tr>
<td>10</td>
<td>27.53</td>
<td>39.3</td>
<td>34.68</td>
<td>23.28</td>
</tr>
<tr>
<td>11</td>
<td>46.09</td>
<td>25.44</td>
<td>49.24</td>
<td>29.27</td>
</tr>
<tr>
<td>12</td>
<td>30.83</td>
<td>51.56</td>
<td>25.3</td>
<td>14.22</td>
</tr>
<tr>
<td>13</td>
<td>32.03</td>
<td>41.6</td>
<td>31.51</td>
<td>28.43</td>
</tr>
<tr>
<td>14</td>
<td>31.58</td>
<td>24.56</td>
<td>29.1</td>
<td>22.22</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

N.B.: Ss 1-7 were viewing Pair A then Pair B;
       Ss 8-14 were viewing Pair B then Pair A.
TABLE 3.5:
LENGTH OF TOTAL LOOK TO BOTH PAIRS OF ACTORS (in seconds)

<table>
<thead>
<tr>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAIR A</td>
<td>PAIR B</td>
</tr>
<tr>
<td>SS</td>
<td>OS</td>
</tr>
<tr>
<td>2</td>
<td>30.95 $^L$</td>
</tr>
<tr>
<td>3</td>
<td>6.02 $^L$</td>
</tr>
<tr>
<td>6</td>
<td>18.18 $^L$</td>
</tr>
<tr>
<td>8</td>
<td>17.59 $^L$</td>
</tr>
<tr>
<td>9</td>
<td>12.04 $^L$</td>
</tr>
<tr>
<td>11</td>
<td>15.44 $^L$</td>
</tr>
<tr>
<td>13</td>
<td>11.88 $^L$</td>
</tr>
<tr>
<td>14</td>
<td>6.78 $^L$</td>
</tr>
</tbody>
</table>
FIGURE 3:4. Mean total looks to Pairs A and B separate and combined.
Pair A. On a Mann-Whitney U test (two-tailed) obtained $U = 93$ for girls and $U = 74$ for boys. As both have a probability of occurrence greater than 0.10, it appears likely that order of actor appearance had no significant effect on looking-behaviour. To test for side-effects, as with first-look, any correspondence between preferred actors and preferred side was examined. For girls, across both pairs of actors, there was a total of 28 possible preferences. Of these 16 were for the right and 12 were for the left. For boys, again out of 28, 14 were for the right and 14 for the left. This suggests that, as with first-look, there was no significant bias to view one side over another.

To check for "model-effects", for both sexes combined, total looks to the girl and total looks to the boy (Pair A seen first) were compared on a two-tailed Mann-Whitney U test. Obtained $U = 95$ (14 x 14 d.f.), $P > 0.10$. Similarly for Pair B (seen first), total looks to the boy versus total looks to the girl, obtained a $U$ of 85.5 (14 x 14 d.f.), $P > 0.10$. From this, it would appear that no one actor was significantly preferred by both sexes combined. This suggests that model-effects were not functional here.

Table 3.6 gives a breakdown of mean totals and significance obtained for looking-behaviour when separated by actor pairs and order of appearance. From this, only Pair B seen second (and overall when seen first and second) favours same-sex actor.
<table>
<thead>
<tr>
<th></th>
<th>GIRLS</th>
<th></th>
<th>BOYS</th>
<th></th>
<th>BOTH</th>
<th></th>
<th>Whether &quot;Both&quot; differs in Predicted Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
<td></td>
</tr>
<tr>
<td>Pair A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seen 1st</td>
<td>18.1</td>
<td>22.84</td>
<td>18.63</td>
<td>23.32</td>
<td>18.36</td>
<td>23.08</td>
<td>No</td>
</tr>
<tr>
<td>seen 2nd</td>
<td>10.42</td>
<td>15.87</td>
<td>10.75</td>
<td>12.41</td>
<td>10.59</td>
<td>14.14</td>
<td>No</td>
</tr>
<tr>
<td>seen 1st + 2nd</td>
<td>14.26</td>
<td>19.36</td>
<td>14.68</td>
<td>17.86</td>
<td>14.48</td>
<td>18.61</td>
<td>No</td>
</tr>
<tr>
<td>Pair B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seen 1st</td>
<td>12.92</td>
<td>14.27</td>
<td>13.61</td>
<td>17.46</td>
<td>13.26</td>
<td>15.86</td>
<td>No</td>
</tr>
<tr>
<td>seen 2nd</td>
<td>20.72</td>
<td>18.57</td>
<td>26.18</td>
<td>14.01</td>
<td>23.43</td>
<td>16.29</td>
<td>Yes</td>
</tr>
<tr>
<td>seen 1st + 2nd</td>
<td>16.82</td>
<td>16.38</td>
<td>19.89</td>
<td>15.74</td>
<td>18.36</td>
<td>16.07</td>
<td>Yes</td>
</tr>
<tr>
<td>Pairs A + B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seen 1st</td>
<td>15.51</td>
<td>18.55</td>
<td>16.12</td>
<td>20.38</td>
<td>15.81</td>
<td>19.47</td>
<td>No</td>
</tr>
<tr>
<td>seen 2nd</td>
<td>15.57</td>
<td>17.22</td>
<td>18.47</td>
<td>13.21</td>
<td>17.02</td>
<td>15.22</td>
<td>Yes</td>
</tr>
<tr>
<td>seen 1st + 2nd</td>
<td>31.08</td>
<td>35.78</td>
<td>35.31</td>
<td>33.59</td>
<td>33.19</td>
<td>34.68</td>
<td>No</td>
</tr>
</tbody>
</table>
DISCUSSION

As the video experiment was intended as a pilot, the theoretical issues will only be briefly discussed here. The underlying assumption behind the experiment is that the infant Ss can perceive the moving groups of dots as walking infants. Adults have no difficulty. Only two were initially unsure whether the actors were adults or infants. No formal affect-scale was used here, but at least half of the infant Ss seemed evidently pleased by the videos. Smiles or laughter, vocalizations, pointing and waving were frequently displayed - one boy even applauded.

The vocalizations alone were encouraging. Three infants who were evidently advanced in speech development said "Ba-ba" or "Baby", and one girl said "Dolly", while pointing to the monitors.

On this basis, it seems reasonable to continue assuming that infants can perceive the walkers wearing the dots. Turning to the obtained looking-behaviour, this seems even more likely. As there was a large variance in looking between infants, non-parametric statistics were always used.

The most striking point about the pilot looking-behaviour is the mis-match between the results of the first-look data and the results of the total-look data.
On first-look, same-sex looks were significantly longer than opposite-sex looks ($P < 0.005$). For total looks, on the other hand, unlike Aitken (1977), there was no significant difference between the time spent on same-sex actors and opposite-sex actors.

Overall in fact, mean total-look preference slightly favours opposite-sex instead (see Table 3.6), although this comes from only one pair of actors (Pair A). In general, the first-look data would appear to support the experimental hypothesis, while total-look does not.

The question is how far can this single result be taken to indicate same-sex preference from movement cues? In terms of the purpose of this experiment, is this enough evidence to pursue this paradigm with more infants?

On balance, the outlook seems promising. The obvious alternative hypothesis is that looking-behaviour is determined by variables in video-content other than the gender of the actors. At least for first-look this does not appear to be the case. If it were, then first looks would not vary across gender of Ss. What would be expected is for both genders alike to be attracted to one video over another. This did not happen. The preference in boys was for boys, and girls for girls. This result was obtained for both pairs of actors (see Table 3.1). From this, at least for the opening scenes, independent variables in video content can be ruled out. Similarly, as side of
appearance, as well as order of appearance, were equally balanced between Ss, there does not seem to be either side-effects or model-effects, at least in first-look. Side-effects were directly examined by comparing the number of longest first looks which were to the right side with the number of longest first looks which were to the left. In Table 3.1, the side of appearance is given in abbreviated form (R and L) in each box. Infant actors Pair A were always shown with the girl on the left and the boy on the right, and vice-versa for Pair B.

For girl Ss, of the total of 14 longest first looks, 5 were to the left and 9 were to the right. For boys, 6 were to the left and 8 were to the right. This makes a total of 17 longest looks to the right and 11 to the left, out of 28. On a sign-test, $P = 0.395$, suggesting that there is little, if any, side preference here.

The other possibility of a model-effect was also directly studied. Half of the Ss saw Pair A first, and half, Pair B. To test whether there was a difference in looking-behaviour to both pairs, the length of looks to Pair A (both opposite- and same-sex) were statistically compared with the length of the looks to Pair B, both between boys and between girls. On a Mann-Whitney U test, female looks to Pair A compared with female looks to Pair B, obtained a U of 95, which has a probability of occurrence greater than 0.10 on a two-tailed test. Similarly, boys seeing Pair A against boys seeing Pair B, obtained a U of
which also has a probability of occurrence which is
greater than 0.10. Neither for females or males,
therefore, does looking-behaviour significantly vary
between Pair A and Pair B actors. As indicated earlier,
therefore, same-sex preference in first-look seems to be
neither a function of side-preference or model-preference.

One final alternative explanation is that the
discrepancy between same-sex and opposite-sex looks is a
function of direction of gaze. For example, all the
monitors which were looked at first could also have been
looked at longer, or vice-versa. In the case of the
former, it is technically possible that, by chance, most
of the girls looked at the girls first and vice-versa for
the boys. If a constant relation holds between direction
of gaze and preference, then it is possible that this is
the true explanation of the results.

To check for this, gaze direction was compared with
preference. Of 20 Ss who looked longer at own sex, 7
regarded own-sex first and 13, own-sex second. This
result seems little more than chance (P = 0.132). In
other words, preference does not appear to be determined
by direction of gaze.

Having ruled out independent variables in video-
content, side-effects, model-effects and direction of gaze
as explanations of the first-look results, the case for
same-sex preference as the explanation of the results seems
stronger. As mentioned in Chapter 2, the simultaneous-preference paradigm is usually employed in infant research to test for an awareness of difference. On a simpler hypothesis that there is discrimination of gender from movement, the present results would be positive. In fact, any significant difference in the time spent looking at one gender over another would support a discrimination hypothesis. The present experimental hypothesis, however, is that 10-13 month olds can not only discriminate but identify the sex of the actors. In the case of the first-look results obtained here, the latter, stronger hypothesis is favoured. As predicted, looking-behaviour is directional - in favour of own sex.

It was also predicted, however, that the total-look data would similarly demonstrate this directional difference. In fact, no significant differences were obtained. How serious are the implications of this for the experimental hypothesis is the next point of discussion.

It is possible that the mis-match between the first-look and the total-look results reflects boredom or fatigue in the Ss. Despite the fact that each session lasted only 91 seconds, there is over this period a drop in time spent looking at the monitors. Table 3.5 is a record of the total-look to each pair of actors and shows a consistent drop in time spent on the second pair. Some, although not many, did become increasingly restless as the session wore on. This could not have been helped by the necessity of
using several walking-sequences more than once. (This was to enable synchronization with the other model.)

Alternatively, there is the possibility of gaze-avoidance. This has been well documented in the literature (e.g. Carpenter, 1975) as a defensive measure against anything strange or untoward. It was mentioned earlier that pleasure in the videos was frequently displayed. This was not the case for all the Ss (naturally, if any S showed distress they were not pressed to watch; two Ss were discounted in this way). It is possible that gaze-avoidance was practised by at least some Ss, and that this could be a source of the discrepancy between the significant total-look results of Aitken and the present results.

Another very important consideration is the considerably enhanced scope for independent variables in video-content to adversely affect looking-behaviour. The original constraints in editing were to effect a match between the pairs, while allowing scope for the natural differences between the genders to show. The difficulty is to control for any significant movement which may especially attract the attention of S. For example, occasionally an infant actor raised his or her arms. While this event may have the potential to convey important gender-specific information, it may also have had an adversely attracting influence on Ss. While independent
variables clearly did not influence first-looks, they may well have affected total-looks.

Two other possibilities are either side-effects or order-effects. Side-effects were tested by examining, as for first-look, for any correspondence between preference and side of appearance. For girls, across both pairs of actors, there was a total of 28 possible preferences from both pairs of actors (see Table 3.5). Of these, 16 preferences were for the right, and 12 for the left. For boys, 14 of the possible preferences were for the right, and 14 the left. In total, 30 out of 56 preferred sides were for the right, and 26 were for the left. This suggests that, even in total-look, there is no significant preference for one side over the other. Indeed, the experimental design was aimed to prevent any possibility of side preference influencing the results.

The other possibility is order-effects. Half of the Ss saw Pair A followed by Pair B, and half saw Pair B followed by Pair A. To test this, the pattern of total looks to Pair A-B were statistically compared with the pattern obtained by Pair B-A, within each gender group. On a Mann-Whitney U test, the total looks from girls (both for same and opposite-sex) viewing sequence A-B against girls viewing B-A obtained a U of 93, which has a probability of occurrence greater than 0.10. For boys, obtained U = 74 which similarly is unable to reject the null hypothesis at level 0.10. In other words, for both
boys and girls, Pair A followed by Pair B obtains a pattern of total looking-behaviour which does not appear to vary from the pattern produced by Pair B followed by A.

From the above, it seems reasonable to rule out side-effects and order-effects for total looking-behaviour. Having done this, however, the problem of explaining the failure of total-look still remains.

An alternative major source for failure is the hardware of the experiment itself. Videotape is not the most suitable medium for fine-editing and extensive play-back. Towards the end of the experiment, the edited joins on the videotapes became subject to "stretching". This resulted in a slight loss of synchrony between the paired models. While this was as carefully monitored as possible during the experiment, it could have occurred enough to throw the total-look results. As the solution of making a master copy, from which new copies could be obtained, resulted in a substantial reduction in resolution, this suggests that alternatives to video should be sought.

So far, two possible sources of the non-significant results have been outlined: gaze-avoidance resulting from fatigue and or fear, as well as independent variables in video content. The added attraction of such explanations is that they are entirely compatible with the first-look positive results. If both measures had failed to attain significance, then as a pilot, the conclusion would
inevitably be that the experiment is a failure. This not being the case, and considering that there are ready explanations in the experimental design itself, suggests that there is a case for developing this paradigm further. Indeed, considering the delicacy of the first-look data, as well as the large variation in infant looking-behaviour itself, it seems advisable on this alone to increase the number of Ss.

It was decided, from this experiment, to attempt a more controlled presentation of infant movement patterns in a second, similar experiment. This time film rather than video was used, as here, more detailed editing and better image-projection could be obtained. In addition, in the second experiment, the design aimed to control for the possibility of subconscious "cueing" from the mother holding the infant on her lap, and further, the sibling status of the infant Ss. This is outlined further in Chapter 5. The next chapter (Chapter 4) discusses the method of filming infant movement patterns as it involved the development of a new technique in film.
CHAPTER 4

METHOD OF FILMING
INTRODUCTION

In light of the difficulties of video for this method of experimentation, it was decided to seek an alternative. Here, the obvious solution is to use film. Although the patch-light (cyclographic) technique is widely used for video, as it is relatively easy to produce, the constraints of the present paradigm proved too stringent for videotape.

The minute, detailed editing necessary for a display which controls for independently attractive movements, is simply not possible on videotape. With film, however, the act of editing is performed on the hardware itself. This makes it easier to manipulate as well as less susceptible to damage through constant use.

A further advantage is the possibility of varying the size of the image. Unlike videotape, where image-size is constrained by the size of display monitors, film images are simply a function of projection distance. To promote the chances of recognition by the infant Ss, it was considered desirable to increase image-size to as near real size as possible. Unlike videotape, this is perfectly possible with film.
FILMING TECHNIQUE

The only known previous use of film for patch-light displays is that of Johansson (Maas and Johansson, 1971a,b). This involved placing point-lights on the main joints of adult Ss. By reducing the length of exposure, it was possible to obtain exposure of the lights, but nothing else.

A variation of this was piloted with infants here in Edinburgh several years ago. It became obvious that the necessary accompaniment of wires and a power-pack were too cumbersome for an infant. The alternative is retro-reflective tape, as used for video. Reflective tape, however, presents a number of difficulties in obtaining the correct balance of light and exposure on film. Altogether, it took several attempts to get the desired result of lights against a dark background.

DEVELOPMENT OF TECHNIQUE

The technique was developed in a series of steps.

(a) Materials

To find the ideal retroreflective tape, tests were conducted on a selection of coloured 3-M tape. The
colours used covered a wide range of silvers as well as yellow, red, white, blue and fluorescent yellow. These were attached to a test card and filmed under a systematic variation of light levels to f-stops. The resulting brightness of each was measured by a light meter. Eventually, a selection was made of 3-M Scotchlite 8910 silver, which displayed a brightness ratio of log 3.5.

As the property of retroreflective tape is to reflect light directly back to the source, the next task was to devise a means of establishing a light source directly adjacent to the camera. It had been found that, with the light as little as one degree off centre, there was a significant loss of reflection.

(b) Light Source

To overcome this problem, it was decided to use a mirror with a hole cut out in its centre as the light source. By placing the camera through the aperture, it became possible to keep the camera at the heart of the light-source.

For this, a "mirror" was specially constructed. It consisted of 100% reflective mylar film, mounted on a wooden frame (50 cms square). In the centre, an oval aperture (7 cms across) was cut out, then framed with rubber. The mylar surface was subsequently tensioned with heat to smooth any wrinkles. This meant the light fell
To film, a lamp was placed near the baby, with

the lamp positioned to ensure the direct sunlight

was filtered out. The lamp was turned on.

The camera

was positioned to capture the scene.

In Figure 4.1, an illustration of the filming arrangement is shown.

FIGURE 4.1. Illustration of filming arrangement.
symmetrically around the aperture.

(c) Equipment

To film, a Super-8 mm Bauer camera was used, with Kodachrome 40 film. The camera was mounted on a tripod, with the lens protruding through the mirror aperture. To reduce the amount of direct light to the lens, the hood was attached after the lens was in position. The camera settings were fixed at artificial light, manual and f-11.

To check whether the light level was sufficient, prior to every session, a light meter reading was taken from a test card of reflective tape. Optimally, the reading should be 14 on the low level scale of a Hycam meter. As each session covered a demarcated area of approximately 10 metres square, it was possible to focus for this beforehand. The zoom lens was always set in the close-up position.

The area of filming itself was kept as dark as possible, in order to prevent extraneous reflection. In addition, a carpet was placed on the floor to cushion any tumbles.
PROCEDURE FOR FILMING

With this technique, a total of 16 infants (8 boys and 8 girls), all aged between 15 and 18 months, were drawn from a volunteer system covering the Edinburgh area. With the exception of one girl, all were efficient walkers. The girl who was not (17 months) had only been walking for a few weeks, and had been recently adopted.

To film, two adults were required. Each mother and infant were welcomed into the room, and the nature of the task was explained. The baby was then decorated with the reflective tape, which had been cut into 1.5 cm discs and mounted onto strips of cloth. These were attached to the infant's clothing by means of double-sided Sellotape. Two were placed around the outside of the shoulders, and two around the hips. The others were simply wrapped right round the relevant places on the limbs: elbows, wrists, knees and ankles. (see Figure 4.2).

![Figure 4:2. Infant wearing retroreflective markers.](image-url)
Mothers of girls had previously been asked to dress their infants in trousers, in case a skirt caused anomalous movement at the hips or covered the knee markers. Most infants did not object initially to being decorated thus, and all eventually lost interest in the markers.

An important part of the procedure was coaxing the infants to run in approximately the same direction. This was in order to keep the filmed activity as homogenous as possible for later, experimental use. This was achieved by placing the mothers at the far corner of the room and one of the adults beside the camera. Mother and adult would then play games with the infants, such as throwing a ball from one to the other and getting the infant to chase it, or bring toys to each one.

**EDITING**

By this method, a total of 15 4-minute films were obtained. As most of the infants hardly ever engaged in continuous walking between A and B, the films tended to break when the infants reached the end of the run. There were also breaks when the infant either ran off course, stopped in mid-run or fell over. The latter was quite frequent, although no infant ever cried and most simply picked themselves up and carried on.
It was decided that presenting the total number of infant actors in simultaneous-presentation would be problematic. In the pilot, it was obvious that the infant observers became restless after only a short presentation. Ideally, presentation should last for approximately one to two minutes. In light of this, it was decided to present only a selection of infant actors from the total presentation. This would ensure a limited length of presentation, as well as avoiding the problem of extensive controls for side- and order-effects incumbent on a large sample of actors. The remainder would be kept for analysis (see Chapter 7).

The criterion used for selecting the actors was subjective. To E, it appeared to be possible to rate the infants on "femininity" and "masculinity". Doubtless, this was with reference to adult patterns, but as a means of selection, it seemed reasonable.

On this criterion, four actors - two boys and two girls - were chosen: one boy and one girl were selected because they appeared to demonstrate typically masculine and feminine patterns of gait respectively. The second boy and girl were chosen because they appeared to be low on measures typical of their own gender. By this means, even if the original criteria were invalid, then at least this would ensure presentation of a wide diversity of gait patterns.

The next problem was to effect a match between the infant films, for the purposes of experimental presentation.
As with video, the object was to control for extraneous variables such as differences in image-size or level of activity, which could attract the infant Ss' attention over and above gender. This could only be achieved by pairing each shot with a partner shot. Naturally, this meant that only one match per shot could be achieved. Each member of a pair, therefore, could only be shown with the other member. The boy and girl who were typically masculine and feminine were matched (henceforth known as Pair A) and, similarly, the atypical boy and girl (Pair B).

To match each shot of the infants traversing from point A to point B, and vice-versa, the films were edited on a professional edit-table. The length of every appropriate shot was counted on a frame-counter, in order to be appropriately matched.

Content of every shot was also checked. To ensure compatibility, the shots which corresponded in length were run simultaneously - one on the table and one on an edit-viewer. Any shots which were not easily paired were discarded.

Once a paired shot had been selected, they were marked with crayon and cut. A final check on length match was made by the simple expedient of holding them against one another. After this, they were attached to two separate Super-8 mm reels (see Figure 4.3). For a smooth finish, they were joined by cement splicer.
Once all the possible paired-shots from Pair A had been spliced onto the reel, the process was repeated for Pair B. Thus, each reel contained film of only one gender. Pair A film lasted 44 seconds while Pair B lasted for 41 seconds.

PRESENTATION

For suitable presentation, the problem of synchrony had to be overcome. There is always a margin of error in projection rate, and this could have proved disastrous for the experiment. It is possible to synchronize Super-8 mm projectors by driving them from the same motor. Such projectors, however, are not easily available for extensive tampering, designed as they are for the amateur.

To overcome this problem, it was decided to make use of a facility provided by Mr Puddyfoot of Colourtone Laboratories, Beaconsfield. By reducing the size of Super-8 mm images, he can copy two simultaneously onto one single 16 mm frame. By this method, exact synchrony can be maintained, as well as enabling use of unspliced film.

One outstanding problem with this method, however, is cost. Simply copying the reels as they were was expensive relative to available resources. In addition to this, there should be controls for side- and order-effects. Although the pilot with video had not demonstrated the
existence of either, it would not have been wise to ignore them. Cost of copying all the necessary permutations, however, was simply too high.

The solution was to make a choice of controls. As looking-preference is such a sensitive measure, it was decided that it was more important to control for side-effects over order-effects. The possibility of deriving order-effects with only two pairs of actors was considered to be less likely than the possibility of obtaining side-effects. (Indeed, without a control for the latter, the paradigm is effectively redundant.) Following this, the films were copied in the following manner (Figure 4.4).

![Figure 4.4: The Two Super-8 mm films.](image-url)
Having obtained suitable versions of the films on 16 mm, they were then presented to a further sample of 1 year olds. This is detailed in the next chapter.
CHAPTER 5

EXPERIMENT 2
The following experiment constitutes a replication of Experiment 1, this time with film instead of video. As the Super-8 mm films were copied onto a single 16 mm film, perfect synchrony was ensured. A further advantage was the possibility of increasing the image-size of the actors in the films to near life-size.

Several other modifications were also incorporated. The first was the sibling status of the infant observers. In Experiment 1, the Ss were not screened for sibling status. It is theoretically possible that having older brothers and/or sisters may affect an infant's interest in one or other gender. To control for any adverse affect on looking-behaviour, the sample in Experiment 2 were all, with the exception of one, only children. Unfortunately, a disadvantage to this was a reduction in the numbers of available volunteers at the time of this experiment. By way of obtaining enough volunteers, the upper age limit of the Ss was raised from 13 months to 14. As the original choice by Lewis and Brooks (1975) was essentially a choice of the one year old, an extra month onto the upper age limit was not considered a significant deviation. Even with this increase, however, the sample size of Experiment 2 was still six infants less than that of Experiment 1.
The second modification introduced was the substitution of a baby-chair for S to sit in, rather than the mother's lap. This was to control for the possibility of subconscious cueing by the mother toward one film over another. Although this is considered unlikely, it was always possible that there was subconscious recognition by the mothers which could have been transmitted to the infant Ss as they sat on their mothers' laps.

Apart from the above, Experiment 2 was essentially a replication of Experiment 1. That is, the same predictions were made as to the pattern of infant looking-behaviour whereby there would be a significant preference for the moving patterns of same-sex actors, both on first-looks and total-looks. In addition, some specific predictions were made with regard to the actors themselves. As mentioned in Chapter 4, one pair of infant actors (Pair A) were chosen because they appeared to E to demonstrate more "feminine" and "masculine" features respectively in walking. Pair B, on the other hand, appeared to be more characteristic of the opposite-sex. From this, it was possible to hypothesize that, if the original, albeit subjective, criteria had any psychological validity for the infant Ss, then Pair A would elicit same-sex preference in looking, while Pair B would elicit opposite-sex preference.
METHOD

Design

Again, the simultaneous-presentation paradigm was used. Each infant saw two synchronized films, during which their faces were recorded on black and white video, served by infra-red light. A digital timer was simultaneously recorded to facilitate later assessment of the looking-behaviour of the Ss.

To balance for side-effects, half of the Ss saw one set of synchronized films whereby the girls appeared on the left, and the boys on the right. The remaining half saw a different set of films with the sides reversed.

Materials

The films were originally Kodachrome 40 Super-8 mm. To avoid extensive problems of synchronizing Super-8 mm projectors (which are highly unsuited to such demands), the films were copied onto a single 16 mm film (see Chapter 4).

Apparatus

The experiment consisted of two apparatus systems. One was for presenting the films, the other for recording looking-behaviour.
(a) **Film System**

The films were projected on an Elf 15 mm projector at silent speed (16 fps). This was slightly lower than the original speed of filming which was 18 fps, but the difference was barely noticeable to the human eye. The screen used was rear projection (1.11 metres square). This was covered to a height of 40 cms by black paper. Cut out in the paper was a 5 x 11 cms rectangle, through which the video system operated. Above 40 cms, the screen was split by black tape measuring 10 cms across. This was to cover the visible join of the Super-8 mm films on the 16 mm film, which may have attracted the infant's attention.

(b) **Video System**

Looking-preference was recorded by a Hitachi CCTV camera (Model HV-17SK). This included a zoom lens for close-ups of Ss faces. The recording was made on Sony black and white videorecorder (Model AV-3520CE). Each recording included a digit read-out, supplied by a Digi-tel electronic timer, which feeds into the videorecording circuit. The recording was displayed on a Sony 9" black and white monitor. As the experiment was run in darkness, the S was lit by an infra-red light, cross-polarized against any visible glow. The subject was placed in a baby-chair with his mother on a chair directly behind. Screens were used to limit the infant's field of vision to the films directly ahead (see Figure 5.1).
Subjects

Twenty-two normal, healthy infants from in and around the Edinburgh area were asked to participate. Of these, two cried and were discounted. The remaining 20 consisted of 10 boys and 10 girls, all aged between 10-14 months. Twenty-one were only children; only one boy had an older sister. This did not appear to vary his looking-behaviour from the others and he was subsequently included in the sample.

FIGURE 5.1. Arrangement for Experiment 2.
Procedure

The mothers and babies were brought to the Lab. by taxi. Each baby received 50p for the visit. Once the infant seemed accustomed to his/her surroundings, he/she was placed in the baby-chair with his/her mother seated directly behind him. (Occasionally, an infant refused the chair and, instead, the mother sat where the chair would normally have been and the infant sat on her knee. To avoid the possibility of parental cueing, the mothers in this case were asked to shut their eyes during the films.) All of the mothers had been told the nature of the experiment and what to expect on the screens. Having settled the infant, E then closed off the viewing area to ensure that only the films occupied the infants' field of vision. The overhead lights were then switched off and E checked that the camera was picking up an appropriate image. After this, the projector was turned on. To accustom the infant to the noise, it was several seconds before the films appeared on the screen. At this point, E indicated (by means of the timer) on the recording that the films had begun and started the clock running. Unless the baby found the films distressing, the films proceeded to the second pair. Before the appearance of the second pair, however, there was a three-second gap. This was also indicated by the timer, and similarly, the end of the films.
Analysis

The videotapes were examined frame-by-frame. The time spent looking (indexed by the pre-recorded timer) to either film was counted to 100th of a second, and the sequence of looks was noted. The results are given in first looks to both sexes, as well as total looks. An affect-scale was also devised after Aitken (1977). Behaviours measured were facial expression and body movement (although this last was more limited because of the facial close-up). These were scored on a negative to positive dimension, from +3 to -3. If an infant laughed and pointed to the screens, this scored +3 on both scales. If he/she cried and put his/her hands before his/her face, then this scored -3 on both. All of the derived measures were additionally scored by an independent observer.
RESULTS

Here, the results are presented firstly for Pair A, followed by those obtained for Pair B. For Pair A, length of first looks is given in Table 5.1. Mean length of first looks is given in Table 5.2 and Figure 5.2 illustrates the derived means.

An independent observer rated all the obtained results in this section. This derived a correlation of E's scores of $r = 1$ for direction and 0.8 for magnitude.

As in Experiment 1, the length of first-look to same-sex was compared with length of first-look to opposite-sex (both groups) on a Wilcoxon Matched-Pairs Signed-Rank test. As it was predicted that same-sex looks would be significantly longer than opposite-sex looks, a one-tailed version was used. Obtained $T = 32$, which has a probability of occurrence less than 0.005. This enabled rejection of the null hypothesis that same-sex looks and opposite-sex looks would not differ.

From Table 5.1 it can be seen that the first girl subject did not look to opposite-sex at all. To check whether this had artificially inflated the results, a further Wilcoxon was performed without her score. Here, obtained $T = 29$, which again is $P < 0.005$. As with Experiment 1, therefore, the first-look results have demonstrated a significant preference for same-sex, on a probability of occurrence of less than 0.05.
TABLE 5.1:
LENGTH OF FIRST LOOKS TO PAIR A (in seconds) (N = 20)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>(1)</td>
<td>30.90</td>
<td>R</td>
</tr>
<tr>
<td>(2)</td>
<td>1.61</td>
<td>R</td>
</tr>
<tr>
<td>SIDE (3) A</td>
<td>2.67</td>
<td>L</td>
</tr>
<tr>
<td>(4)</td>
<td>18.56</td>
<td>L</td>
</tr>
<tr>
<td>(5)</td>
<td>1.30</td>
<td>L</td>
</tr>
<tr>
<td>(6)</td>
<td>7.66</td>
<td>L</td>
</tr>
<tr>
<td>(7)</td>
<td>4.55</td>
<td>R</td>
</tr>
<tr>
<td>SIDE (8) B</td>
<td>1.97</td>
<td>R</td>
</tr>
<tr>
<td>(9)</td>
<td>1.56</td>
<td>R</td>
</tr>
<tr>
<td>(10)</td>
<td>1.75</td>
<td>R</td>
</tr>
</tbody>
</table>

*SS = Same-Sex **OS = Opposite-Sex
^R/L indicates initial look and also side of appearance

TABLE 5.2:
MEAN FIRST LOOKS (in seconds)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>7.25</td>
<td>1.7</td>
</tr>
<tr>
<td>Boys</td>
<td>4.14</td>
<td>2.75</td>
</tr>
<tr>
<td>Both</td>
<td>5.69</td>
<td>2.23</td>
</tr>
</tbody>
</table>
FIGURE 5:2. Mean first looks to Pair A.
Although side of presentation was balanced between Ss, to check for any bias, the relationship between longest first-look and side was examined. Of 20 Ss, 10 looked longer to the left and 10, the right. This suggests that, again, as with Experiment 1, first-look preference is not a function of bias for one side.

To check for a relation between same-sex preference and first film regarded, a sign-test was used. Of 16 infants who preferred same-sex, 7 regarded same-sex initially and 9, the opposite-sex. This is non-significant on a sign-test (P = 0.402).

Total looks to Pair A are presented in Tables 5.3 and 5.4. Figure 5.3 presents the derived mean total-looks.

As with Experiment 1, same-sex versus opposite-sex total-look did not achieve significance on a one-tailed Wilcoxon Matched-Pairs Signed-Rank test. Here, obtained T = 66, which has a P > 0.05.

From mean total-look scores, however, there is a trend favouring same-sex for girls. Boys, alternately, do not differentiate between the sexes in looking. The possible reasons for this could be either bias to the girl actor or bias to one side. On examination of side of preference, while girls appear to show little bias (6 preferred left-side, and 4, right-side), boys do show some bias to the left-side (7 for left and only 3 for right). On a sign-test, however, P = 0.172, suggesting that there was no
TABLE 5.3:
LENGTH OF TOTAL LOOK TO PAIR A (in seconds)  (N = 20)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>(1)</td>
<td>30.90</td>
<td>R</td>
</tr>
<tr>
<td>(2)</td>
<td>4.03</td>
<td>L</td>
</tr>
<tr>
<td>(3)</td>
<td>31.86</td>
<td>L</td>
</tr>
<tr>
<td>(4)</td>
<td>25.04</td>
<td>L</td>
</tr>
<tr>
<td>(5)</td>
<td>22.04</td>
<td>L</td>
</tr>
<tr>
<td>(6)</td>
<td>15.92</td>
<td>R</td>
</tr>
<tr>
<td>(7)</td>
<td>15.93</td>
<td>R</td>
</tr>
<tr>
<td>(8)</td>
<td>23.37</td>
<td>R</td>
</tr>
<tr>
<td>(9)</td>
<td>14.09</td>
<td>R</td>
</tr>
<tr>
<td>(10)</td>
<td>4.23</td>
<td>R</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

TABLE 5.4:
MEAN TOTAL LOOK TO PAIR A (in seconds)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>18.74</td>
<td>11.8</td>
</tr>
<tr>
<td>Boys</td>
<td>19.95</td>
<td>19.1</td>
</tr>
<tr>
<td>Both</td>
<td>19.35</td>
<td>15.47</td>
</tr>
</tbody>
</table>
FIGURE 5:3. Mean total looks to Pair A.
significant bias to one side.

To check whether the boy or girl actor was preferred across both sexes, a two-tailed Mann-Whitney U test compared total-looks to the boy and total-looks to the girl. Obtained \( U = 163 \) (20 x 20 d.f.). This has a probability of occurrence of \( P > 0.10 \), suggesting that neither the boy nor girl was significantly preferred by both sexes.

It was decided (see Discussion) to examine the relationship between first-look and total-look more closely. In the first-look data to Pair A, same looks are very short – indeed, less than one second in some cases. This may cast some doubt upon the reliability of length of look as an index of identification. To counter this, it was decided to examine only the data from infants whose initial looks were longer than 1.16 seconds, which is the average time taken to view two step-cycles from the infant actors. Table 5.5 gives the derived first- and total-looks after this treatment.

As can be seen, after selection for "understanding", the remaining Ss demonstrate a consistent preference for same-sex both in first- and total-look. Statistically, first-look same-sex versus opposite-sex on a Wilcoxon Matched-Pairs Signed-Rank test (one-tailed) derived a \( T \) of 21 (\( P = 0.025 \)). For total-look, obtained \( T = 32 \) which, although greater than 0.05, is not far from significance on a sign-test (\( P = 0.090 \)).
### Table 5.5: First and Total Looks to Pair A After Selection for "Understanding" (in seconds) \((N = 14)\)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th></th>
<th></th>
<th>BOYS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Look</td>
<td>Total Look</td>
<td></td>
<td>First Look</td>
<td>Total Look</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
</tr>
<tr>
<td>2</td>
<td>1.61</td>
<td>1.26</td>
<td>4.03</td>
<td>7.96</td>
<td>5.84</td>
<td>1.67</td>
</tr>
<tr>
<td>3</td>
<td>2.67</td>
<td>1.42</td>
<td>31.86</td>
<td>8.35</td>
<td>4.03</td>
<td>7.98</td>
</tr>
<tr>
<td>5</td>
<td>1.3</td>
<td>1.87</td>
<td>22.04</td>
<td>21.1</td>
<td>2.81</td>
<td>1.58</td>
</tr>
<tr>
<td>6</td>
<td>7.66</td>
<td>4.59</td>
<td>15.92</td>
<td>12.06</td>
<td>1.88</td>
<td>2.32</td>
</tr>
<tr>
<td>7</td>
<td>4.55</td>
<td>2.13</td>
<td>15.93</td>
<td>14.92</td>
<td>2.69</td>
<td>1.36</td>
</tr>
<tr>
<td>8</td>
<td>1.97</td>
<td>2.27</td>
<td>23.37</td>
<td>9.57</td>
<td>14.72</td>
<td>8.67</td>
</tr>
<tr>
<td>10</td>
<td>1.75</td>
<td>1.33</td>
<td>4.23</td>
<td>17.64</td>
<td>2.46</td>
<td>1.79</td>
</tr>
</tbody>
</table>

### Table 5.6: Mean First and Total Looks to Pair A After Selection (in seconds) \((N = 14)\)

<table>
<thead>
<tr>
<th></th>
<th>FIRST LOOK</th>
<th>TOTAL LOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same-Sex</td>
<td>Opposite-Sex</td>
</tr>
<tr>
<td>Girls</td>
<td>3.07</td>
<td>2.12</td>
</tr>
<tr>
<td>Boys</td>
<td>4.91</td>
<td>3.62</td>
</tr>
<tr>
<td>Both</td>
<td>3.99</td>
<td>2.87</td>
</tr>
</tbody>
</table>
Table 5.6 presents the mean length of first- and total-look after selection. Figures 5.4 and 5.5 illustrate the derived mean length of look given in Table 5.6.

For Pair B, length of first-looks and mean length of first-looks are given in Tables 5.7 and 5.8 respectively. Figure 5.6 presents mean first-looks to Pairs A and B.

Length of same-sex first-looks was again compared with length of opposite-sex looks on a one-tailed Wilcoxon Matched-Pairs Signed-Rank test. This time the prediction was that, if Pair B did exemplify opposite-sex characteristics, preference would be for opposite-sex. No significant preference was found, however, with $T = 66$ ($P < 0.05$). This is not sufficient to reject the null hypothesis. Yet again, on examination of Table 5.8, there is a slight indication of a preference for opposite-sex, both from boys and girls.

Again, as with Pair A, there was no significant bias for one side. While 7 girls preferred the left-hand film and 3, right; for boys, 6 preferred the left and 4, the right. On a sign-test, both together derived a $P = 0.132$, which is non-significant (girls on their own derive a $P = 0.172$).

Preference as a function of very first or second look does not appear either to hold across both sexes. Of 20 Ss, 11 looked longest on their very first-look and 10 did not. Girls, however, do show a slight bias, with 7
FIGURE 5:4. Mean first looks to Pair A (after treatment).
FIGURE 5.5. Mean total looks to Pair A (after treatment).
### TABLE 5.7:

LENGTH OF FIRST LOOKS TO PAIR B (N = 20)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>2.50</td>
<td>0.31</td>
</tr>
<tr>
<td>2</td>
<td>0.71</td>
<td>2.22</td>
</tr>
<tr>
<td>3</td>
<td>1.48</td>
<td>3.05</td>
</tr>
<tr>
<td>4</td>
<td>0.36</td>
<td>2.19</td>
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<tr>
<td>5</td>
<td>7.12</td>
<td>4.94</td>
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<tr>
<td>6</td>
<td>1.85</td>
<td>5.88</td>
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<tr>
<td>7</td>
<td>1.31</td>
<td>1.32</td>
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<tr>
<td>8</td>
<td>0.94</td>
<td>1.26</td>
</tr>
<tr>
<td>9</td>
<td>1.14</td>
<td>1.39</td>
</tr>
<tr>
<td>10</td>
<td>0.64</td>
<td>26.63</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

+R/L indicates direction of very first look

### TABLE 5.8:

MEAN FIRST LOOKS TO PAIR B

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>1.81</td>
<td>4.9</td>
</tr>
<tr>
<td>Boys</td>
<td>2.27</td>
<td>3.19</td>
</tr>
<tr>
<td>Both</td>
<td>2.04</td>
<td>4.06</td>
</tr>
</tbody>
</table>
FIGURE 5:6. Mean first looks to Pairs A and B.
looking longest on very first-look and 3, on second. Again, however, this is non-significant on a sign-test ($P = 0.172$).

Length of total looks to Pair B is given in Tables 5.9 and 5.10. Figure 5.7 illustrates mean total-look to both Pairs A and B. On a Wilcoxon Matched-Pairs Signed-Rank test, obtained $T = 98$, $P < 0.05$ (one-tailed). This is not sufficient to reject the null hypothesis that there would be no difference between looks to either sex. The prediction that total-looks to Pair B would favour opposite-sex, therefore, has not been borne out statistically. On examination of Table 5.8, on mean total-look, while this appears to hold for girls, it does not for boys, who instead favour the same-sex actor. Altogether, therefore, the boy of Pair B is fixated longer by both sexes.

To check this statistically, all the looks to the boy (both sexes) were compared with all the looks to the girl (both sexes) on a Mann-Whitney U test. Here, obtained $U = 112$ (20 x 20 d.f.), which has a $P < 0.025$, $> 0.01$ on a one-tailed test. This suggests that the boy actor of Pair B was significantly preferred by both sexes.

Bias to one side does not appear to be functional. For boys, 5 looked longer to the right and 5 to the left. In girls, 7 preferred the left and 3, the right. However, this last is still non-significant ($P = 0.172$ on a sign-test).

Looks to Pair B were also scanned for "understanding" in initial looks. That is, all infants who looked for
### TABLE 5.9:
LENGTH OF TOTAL LOOK TO PAIR B (in seconds) (N = 20)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>17.36</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>12.52</td>
<td>L</td>
</tr>
<tr>
<td>3</td>
<td>1.48</td>
<td>L</td>
</tr>
<tr>
<td>4</td>
<td>16.98</td>
<td>L</td>
</tr>
<tr>
<td>5</td>
<td>9.56</td>
<td>L</td>
</tr>
<tr>
<td>6</td>
<td>3.6</td>
<td>R</td>
</tr>
<tr>
<td>7</td>
<td>6.28</td>
<td>R</td>
</tr>
<tr>
<td>8</td>
<td>7.86</td>
<td>R</td>
</tr>
<tr>
<td>9</td>
<td>3.98</td>
<td>R</td>
</tr>
<tr>
<td>10</td>
<td>1.85</td>
<td>R</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

### TABLE 5.10
MEAN TOTAL LOOK TO PAIR B

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>8.15</td>
<td>14.97</td>
</tr>
<tr>
<td>Boys</td>
<td>14.77</td>
<td>9.95</td>
</tr>
<tr>
<td>Both</td>
<td>11.46</td>
<td>12.46</td>
</tr>
</tbody>
</table>
FIGURE 5.7. Mean total looks to Pairs A and B.
less than 1.16 seconds were dropped and the mean first- and total-looks were calculated for the remainder. The sample size here lowered by a further three for girls, and two for boys against the samples obtained for Pair A. Tables 5.11 and 5.12 give the derived scores. Figures 5.8 and 5.9 illustrate the mean first-looks after treatment (Pairs A and B) and mean total-looks after treatment (Pairs A and B) respectively.

On a one-tailed Wilcoxon Matched-Pairs Signed-Rank test, first-look (same-sex versus opposite-sex) derived a T of 12 which is non-significant. Total-look comparison yielded a T of 14, which again is non-significant.

From Table 5.12 it can be seen that, while the predicted outcome of opposite-sex preference holds for mean first-look (after treatment), in total-look boys still continue to favour same-sex while girls favour opposite-sex.

Finally, the derived mean affect scores for Pairs A and B are given in Table 5.10. Inter-observer reliability here was 0.75 for direction, although magnitude did not achieve consistent agreement.
TABLE 5.11: FIRST AND TOTAL LOOKS TO PAIR B AFTER SELECTION FOR "UNDERSTANDING" (in seconds) (N = 9)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th></th>
<th></th>
<th>BOYS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Subject No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>First Look</td>
<td>Total Look</td>
<td></td>
<td>First Look</td>
<td>Total Look</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
<td>SS</td>
<td>OS</td>
</tr>
<tr>
<td>3</td>
<td>1.48</td>
<td>3.05</td>
<td>1.48</td>
<td>9.25</td>
<td>2.05</td>
<td>8.91</td>
</tr>
<tr>
<td>5</td>
<td>7.12</td>
<td>4.94</td>
<td>9.56</td>
<td>9.51</td>
<td>1.75</td>
<td>1.52</td>
</tr>
<tr>
<td>6</td>
<td>1.85</td>
<td>5.88</td>
<td>3.6</td>
<td>31.28</td>
<td>2.21</td>
<td>1.83</td>
</tr>
<tr>
<td>7</td>
<td>1.31</td>
<td>1.32</td>
<td>6.28</td>
<td>11.98</td>
<td>2.29</td>
<td>3.61</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.67</td>
<td>2.99</td>
</tr>
</tbody>
</table>

TABLE 5.12: MEAN FIRST AND TOTAL LOOKS TO PAIR B AFTER SELECTION FOR "UNDERSTANDING" (in seconds) (N = 9)

<table>
<thead>
<tr>
<th>FIRST LOOK</th>
<th>TOTAL LOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same-Sex</td>
<td>Opposite-Sex</td>
</tr>
<tr>
<td>Girls</td>
<td>2.94</td>
</tr>
<tr>
<td>Boys</td>
<td>1.99</td>
</tr>
<tr>
<td>Both</td>
<td>2.41</td>
</tr>
</tbody>
</table>
FIGURE 5: Mean first looks to Pairs A and B (after treatment).
FIGURE 5:9. Mean total looks to Pairs A and B (after treatment).
FIGURE 5:10. Mean affect scores to Pairs A and B.
DISCUSSION

Taking the results from each pair separately, for Pair A the first-look data appear to replicate the results from Experiment 1. As predicted, same-sex first-looks to Pair A are longer than opposite-sex first-looks \((P < 0.005)\). This was also obtained for same-sex versus opposite-sex first-looks in Experiment 1. There was one girl in Experiment 2 (girl 1, Table 5.1) who failed to look at the opposite-sex. Yet, even without her score, \(P\) is still less than 0.005 \((T = 29)\). For total-looks to Pair A, however, while the overall means do indicate a preference for same-sex, this fails to attain statistical significance \((T = 66, P > 0.05)\).

Taken together, the statistical results in general for Pair A follow the trend indicated in Experiment 1, in that first-look does display a significant preference for same-sex, but total-looks fail to attain significance in the same direction. However, there does seem to have been improvement in the predicted direction for the overall mean total preference for same-sex in Experiment 2. In Experiment 1, the strictly comparable scores of mean total-looks to Pair A seen first and Pair B seen first, were 18.36 seconds for same-sex and 23.08 for opposite-sex (Pair A), and 13.26 for same-sex and 15.86 for opposite-sex (Pair B) (see Table 3.6, Chapter 3). In Experiment 2, however, this has been altered to a
preference for same-sex of 19.35 seconds against 15.47 seconds for opposite-sex.

As with Experiment 1, the first-look data to Pair A seem promising. Again, because the result favours same-sex across both sexes, it is difficult to find an alternative other than gender identification as an explanation. If, under the same treatment, two groups display significantly different behaviour, then the logical conclusion is that the behavioural difference is a function of a psychological difference between the two groups. Taken individually, girls demonstrate a higher mean preference for same-sex than boys (see Figure 5.2), but both sexes still clearly favour own sex.

There are possible alternatives in the design itself, however, which is the next point of discussion. The directional preference for same-sex suggests that the content of the films themselves (at least for the opening scenes) did not contain any extraneous variables. A second alternative is side-effects. Half of the boy subjects and half of the girls saw a different side of presentation from the others. From the 20 Ss, however, no bias toward one side over another was found, with an equal number preferring a left-hand film and a right-hand film. From this, it seems reasonable to rule out side-effects for the first-look results.

Similarly, initial direction of gaze appears to have no relation to preference. Of a total of 16 infants who
preferred same-sex, 7 regarded their own sex initially, and 9 the opposite-sex, which on a sign test, $P = 0.402$. As with Experiment 1, direction of gaze can be ruled out as a dynamic variable in determining preference.

The first-look results to Pair A, therefore, are not readily explained by either extraneous variables in film-content, side-effects or direction of gaze, which was also the case for Experiment 1. As in both cases, the probability of occurrence of the derived same-sex preference on first-look was less than 0.005, and this suggests that there is a reasonable formal correspondence between Experiments 1 and 2.

The differences which were instigated in the latter were, firstly, a larger image-size made possible by the use of film rather than video. Secondly, the substitution of a baby-chair for the mother's lap, and thirdly, a reduced distance between right and left presentations. None of the above, however, appear to have had a significant effect on initial looking-behaviour, as in both experiments the null hypothesis that there would be no difference in first-looks to same and opposite-sex can be rejected at the region of 0.005. In other words, from both experiments, same-sex looks were longer than opposite-sex looks to quite a considerable degree. In terms of the original hypothesis, it would appear from a sample of 48 (Experiments 1 and 2 combined) that 10-14 month olds can demonstrate
same-sex preference from movement information alone - at least in their first-looks.

First looks, however, form only one part of the experimental hypothesis. It was also predicted that total-looks would also demonstrate same-sex preference. For Pair A, unfortunately, while total looks come closer here than in Experiment 1 to the predicted outcome, they ultimately fail to attain significance (on an individual comparison, Wilcoxon $T = 15$ for girls and $T = 27$ for boys). Both are below the 0.05 probability level, and only when they are combined do they come nearer to significance. From Table 5.4 it can be seen that, for mean total looks, there is a trend in total-look to prefer same-sex over opposite-sex, although it is mostly the outcome of female same-sex preference against no male preference. Nevertheless, when combined, there is an overall preference for same-sex which is also an increase over the total-look same-sex mean preference outlined in Table 4.6 of the previous chapter. However, on strict statistical terms, this is still non-significant.

Taking both the positive first-look results and the negative total-look results together, it seems at least plausible that the failure of the latter lies again in the experimental design itself, as was suggested in Experiment 1. It was predicted that, if the fault was of design, then technical improvements in editing and presentation would lead to an increase in total-look same-sex
preference. This in fact did take place (T = 44, N = 14 for first-seen Pairs A and B combined in Experiment 1, and T = 66, N = 20 for Experiment 2). Unfortunately, a more formal comparison is not possible, as the times of presentation vary between the experiments.

Naturally, the models themselves differed between the experiments, which is a further source of improvement. The fact that an improvement did take place, however, whether it was due to technical development or different models, makes it at least possible that the problem is one of design rather than theory. If there had been no change, this would have made it more likely to have been the theoretical explanation which is causing the problem.

In terms of design, one possible explanation is the content of the films themselves. Although this did not show up in first-look, it could be that the total content of the films contained extraneous variables which may have attracted the infants to one actor over another regardless of sex. In both first-look and total-look, the mean same-sex preference was higher in girls. It is possible that, despite the editing, the girl actor in Pair A was more attractive for independent reasons. In neither case, however, was preference significantly biased toward one actor over another (see p.145 of Results section).

The other factors in design suggested previously which could account for failure of significance are fatigue
or gaze-avoidance. Fatigue is a built-in disadvantage of simultaneous presentation, for which the only answer is to use large numbers of Ss. In this experiment, however, only a very small number of Ss overtly demonstrated weariness by the end of Pair A.

On gaze-avoidance, one relevant point is the possible increase in antipathy consequent on the use of the baby-chair rather than the security of the mother's lap. Subjectively, E noted a greater difficulty in settling the babies in the chair. By controlling for subconscious cueing, there may have been a concordant increase in feelings of strangeness with a higher degree of gaze-avoidance. If this was the case, then an increase in gaze-avoidance may have countered any advantages gained from technical improvements. Although the majority of Ss appeared to enjoy the films, it would require only a few timid ones to substantially lower the results.

Having considered the possible effect of gaze-avoidance and total content, the question is how far can one accept the experimental hypothesis from the present results. The underlying hypothesis argues for the presence of an ability to identify gender from movement information alone. Due to the significance of first-looks, it is not possible to accept the null hypothesis that there is no same-sex preference at all. Returning to the original predictions, these were derived from Aitken's demonstration of the primacy of movement cues for
ABOVE PHOTOGRAPHS ARE GIRL LOOKING AT GIRL,
BElOW PHoTOGRAPHs ARE BOY LOOKING AT BOY.
same-sex preference. Unlike the present experiments, Aitken obtained significant preferences on total-look.

Aitken (after Lewis and Brooks) also used an affect-scale to measure differing responses to males and females. For Aitken, however, there were some difficulties in obtaining suitably comparable scores. In the stills versus moving conditions of his second experiment, affect scores were only derived for females for the former and only for males for the latter.

In Experiment 2, it was also decided to measure affect. As mentioned earlier, this took the form of two scales, one for facial expression and one for upper body movement, on the range of +3 to -3. It was predicted that, if the original hypothesis is correct, then there will be discriminatory affective behaviour toward the actors as a function of sex of subject. Figure 5.10 gives the derived measures of affect. As can be seen, there was in fact some discrimination between the actors in affect. Girls demonstrated more positive affect to the girl in Pair A, while for the boy Ss, there was more positive affect to the boy in Pair A. The increase in affect scores to same-sex actors was largely due to smiling, which scored +3 on the facial expression scale. Indeed, there were some smiles to the same-sex actor which gave a striking impression of "Eureka!" on the part of the infant Ss. The page opposite gives some examples of these.
Interestingly enough, there was also more negative affect to same-sex as well. Neither Lewis and Brooks nor Aitken recorded any negative affect, but it was probably obtained here due to the novelty of the films. Although this negative discrimination was not predicted (and is indeed slight). It is perhaps further evidence of some identifying awareness in the Ss.

In light of this, it is possible that the failure of the total looks to vary significantly are not indicative of a failure to identify gender from movement.

In favour of this, a study of fixation as a cognitive measure by Lewis, Kagan and Kalafat (1966) indicates that only first-look is a reliable measure of differential fixation and not total-look. They suggest that total-look fails because it can cover a multitude of differential patterns of looking-behaviour. On this basis, the obtained positive differentiation on first-look for Experiments 1 and 2 is perhaps sufficient indication of the presence of the capacity to identify like-self from movement patterns.

Despite this, it was decided to examine all possible alternatives to the present failure of total-look. One outstanding difference between the moving films of Aitken's and the ones used here is in the quantity of information specified. The former were filmed under normal lightings, where "static" cues such as clothes, hair-length and toys were conveyed, as well as pattern of movement. From Aitken's results, as well as those of
Lewis and Brooks, it is quite clear that static cues are attended to and used by one year. When the latter are subtracted, then perhaps it is logical to expect a resulting reduction in accuracy.

On this line of reasoning, then it is possible that there are infants who cannot identify gender from the total presentation simply as a result of the reduction from normal life in the amount of information available, or even because of the novelty of the films themselves. In the above discussion, all of the infants who sat through the entire presentation without crying have been considered. It is possible, however, that a more stringent selection of Ss may produce a different picture.

If we consider the first-look results in more detail, it is clear from Table 5.1 that some first-looks are very short; indeed, less than one second in some cases. According to Barclay, Cutting and Koslowski (1978), gender recognition in adult Ss for moving patterns of other adults requires presentation of at least two step-cycles (two right and two left steps). For infants, this takes on average 1.16 seconds, as overall mean time to step was 0.29 seconds (see Chapter 8).

As a means of selecting infants from this sample of whom it could be reasonably claimed that there was interest in the films throughout, it was decided to drop all of the infants whose initial looks to either sex were less than
1.16 seconds. It does in fact seem at least unlikely that for those infants whose initial looks were less than one second, enough information has been picked up to enable an effective judgement. Certainly in under a second, only a fraction of the movement of the actors could have been observed.

Using this criterion (see Table 5.1), 3 girl Ss and 3 boy Ss were dropped (girls numbers 1, 4 and 8; boys numbers 3, 4 and 9). The resulting mean first-look preferences still favour same-sex, with girls looking at girls for a mean time of 3.07 seconds against 2.12 seconds at boys. For boy Ss, same-sex look is 4.91 seconds and opposite-sex, 3.62. Combined, this derives an overall preference for same-sex of 3.99 seconds and 2.87 seconds for opposite-sex (see Table 5.6).

Interestingly enough, when only these Ss are also examined on total-look, the trend for same-sex preference continues. Girls looked at the girl for a mean time of 16.77 seconds against 13.09 seconds to the boy, while boys, on the other hand, looked at the boy for an average of 21.94 seconds and only 16.75 seconds at the girl. Furthermore, on the one-tailed version of the Wilcoxon test, first-looks continue to vary significantly and, while total-look still fails to attain significance (P > 0.05), it is very nearly significant (P = 0.90 on a sign-test). In other words, after this treatment,
statistically there is better continuity between the first-look and total-look data, with both yielding a significant preference for same-sex, as originally predicted.

On this criterion of initial "understanding", therefore, there is a correspondence between preference in first-look and preference in total-look. This in fact is in accord with E's subjective impression that, although the majority of Ss did respond positively to the films, some seemed to be puzzled or at least antipathetic to them. Figures 5.4 and 5.5 illustrate the derived mean preferences after this treatment.

It does seem to make sense in light of the novelty of these films to expect a large variance in reaction to them. More importantly, this may clarify the original discrepancy between first-look and total-look preference. If it is acceptable that, for some infants, there is either a lack of comprehension of liking for them, then it is possible that their total response throughout the presentation deviates from the norm enough to pull the entire sample away from significance. Considering the delicacy of differential looking as a cognitive measure, it would only require a few deviant responses to alter the whole pattern. When they are dropped, first-look and total-look become compatible. The answer, of course, for future research is to use large numbers of Ss to combat this possibility.
A further interesting variation for the future would be to correlate age of onset of walking with looking-behaviour. It may be that the infants who did not respond properly right from the beginning were all non-walkers. As mentioned in Chapter 2, Lewis and Brooks and Bower explain the preference for same-sex at this age as a function of a "like-me" judgement. Although all of the infants in this sample were around the age of walking (10-14 months), it is possible that some were still not actually walking and therefore lacked the necessary knowledge to make a "like-me" judgement. Unfortunately, this information was not obtained in the present experiment, which is a regrettable oversight.

Whether this is acceptable or not, it remains that there is evidence here, certainly from first-look and possibly from total-look, of preferential looking for same-sex on the basis of movement alone.

Having considered a number of alternative explanations for the results to Pair A, only the latter appears to fit the obtained pattern. In light of this, as well as the derived differential affective responses, it seems reasonable to accept the original hypothesis that there is same-sex preference here from movement information alone. Additional support for this may be found when the present results are compared with the original results of Lewis and Brooks-Gunn (1979). There, on first fixation, 10-12 month old infants display a mean increase of 1.39 seconds
for same-sex against opposite-sex. Here, in Experiment 1, the discrepancy was raised to 1.54 seconds (see Chapter 3, Table 3.2). For Experiment 2, this has been increased yet again to 3.46 seconds (see Table 5.2). For both Experiments 1 and 2, therefore, there has been an increase in mean preference for first-look compared with that obtained by Lewis and Brooks-Gunn. This perhaps is further evidence that it is reasonable to claim that the present results demonstrate a preference for same-sex from movement cues alone.

Turning to Pair B, the boy and girl here were selected because they appear to demonstrate characteristics which are atypical of their particular gender. This, of course, is unlike Pair A who were selected because they were considered to reflect sex-typical characteristics. It was hypothesized that the looking-behaviour to Pair B would elicit opposite-sex preference, as the actors here appeared to display opposite-sex characteristics in walking. On examination of mean first-looks and total-looks to Pair B (Tables 5.7-5.10), again the hypothesis would appear to be confirmed for first-look but not for total-look. On first-look, girls this time favour opposite-sex by a mean increase of 3.09 seconds against same-sex, while boys favour opposite-sex by a mean increase of 0.92 seconds. On total-look, however, while girls continue to favour opposite-sex by 6.82 seconds, boys do not. Instead, same-sex is preferred by a margin of 1 second.
Yet, overall, on statistical comparison, neither first-look nor total-look vary significantly between same- and opposite-sex ($P > 0.05$ in both instances).

It is tempting to see this last result for the boy actor of Pair B as an indication that he was not recognizably "boyish". One major problem with interpretation, however, remains outstanding. This is the ordering of the pairs wherein Pair A was always seen first. Although there was a three-second gap between the two pairs, it is always possible that some sort of order-effect was functioning here. Certainly, from Experiment 1 it was clear that there was a drop in amount of looking to the second pair of actors. Unlike Experiment 1, it was unfortunately not possible to balance for order-effects here, due to the cost of copying all of the necessary permutations onto 16 mm film. Ideally, with more Ss it would be advisable to either present a control group with Pair A followed by Pair A again; or to present half of Ss with A followed by B, and half with B followed by A. However, it should be stressed that total-look in general has major problems as a reliable cognitive measure, so that any ordering may produce anomalous looking-behaviour as the session progresses.

Order-effects notwithstanding, it was decided to examine the results in more detail. Using the same selective criterion outlined above, the Ss were screened for "understanding" on their initial looks. For Pair B, more Ss than for Pair A gave looks which were less than
1.16 seconds. Indeed, only four girls and five boys remain after screening. From Table 5.11, it can be seen that only one subject (boy 4) was not accepted for Pair A consideration, but was for Pair B. Table 5.12 gives the derived mean scores for first and total-look respectively.

As can be seen, all but boys' total-look do in fact present a same-sex preference. Statistically, however, neither significantly vary (T = 12 for first-look, T = 14 for total-look). From this, although the mean preference in first-look does favour same-sex, there is no statistical confirmation of this result, suggesting that it is not possible to reject the null hypothesis that there is no difference between looks to same-sex and looks to opposite-sex, either before or after selection for "understanding". Nevertheless, it is interesting that, for first-look at least, there is a reversal of preference as predicted to opposite-sex rather than same-sex. The possibility of order-effects, however, makes interpretation of these results only very tentative.

A further means of testing behavioural differences to Pairs A and B is to compare the measure of affect taken from all 20 Ss. Figure 5.10 shows the mean affect scores obtained from the two pairs of actors. Here it is clear that there is a degree of qualitative change in affect. For girls, there is an overall reduction in amount displayed and now the boy actor elicits a greater amount of positive
affect than the girl actor. For boys, on the other hand, a greater amount of positive affect continues to be displayed to the boy. Interestingly enough, if we compare this with mean length of look, it is also the boy who elicits the longest total amount of looks from boys, both before and after treatment. A further notable point is that the overall positive affect to the boy actor (both sexes) is supported by an overall significant preference in total-look obtained by both sexes for the boy actor versus the girl actor (see p.152 of Results section). As stressed before, however, any interpretation of the results to Pair B must be tentative in view of the possibility of order-effects. This is extremely regrettable, but with the available resources for the present experiment, unfortunately necessary.

Taken together, the overall results here do suggest that infants can demonstrate same-sex preference from movement cues alone. This is very clear from the initial results from both Experiments 1 and 2, and even in total-look to Pair A, a slight mean preference for same-sex was found. As further support, Lewis, Kagan and Kalafat (1966) have indicated that first-look is more reliable than total-look as an index of differential fixation. In this context, the obtained discrepancy between the first and total-looks here is perhaps not surprising at all. However, an alternative explanation was considered.
It was suggested that the failure of the total-look results to attain significance for Pair A may have been the outcome of a varying attitude to the films by the infant Ss. Subjectively, it was noticed that some infants did not appear to be very interested in them. In light of the novelty of the films, whereby there is a substantial reduction from real life in the amount of information specified, it is probably hardly surprising that some infants did not respond well to them.

In an attempt to screen those who were not responding appropriately, it was decided to examine only those infants whose initial looks were longer than 1.16 seconds, which is the equivalent of two step-cycles in infant walking. By this method, for Pair A, three girls and three boys were dropped. When this was done, a clear preference for same-sex on both first-look and total-look emerged. Statistically, first-look demonstrated a significant preference for same-sex and even total-look very nearly attains significance ($P = 0.090$ on a sign-test). Furthermore, this last result corresponds to the obtained affect scores which show a differential response as a function of gender of subject X actor. Same-sex elicited more positive as well as negative affect in Pair A.

Overall, therefore, it appears that, for Pair A, as predicted there is a preference for same-sex on the basis of movement patterns alone. A comparison of a gender-typical pair and an atypical pair was also attempted. The
possibility of order-effects, however, makes interpretation very difficult. An overall trend was found in first-look of a preference for opposite-sex. However, on total-look, an overall (significant) preference for the boy actor of the atypical pair was obtained. In addition, more positive affect to the boy actor was displayed by both sexes. Unfortunately, the potential of order-effects makes any interpretation of the results to the atypical pair problematic.

The next chapter considers the theoretical implications of the obtained same-sex preferences for movement patterns.
CHAPTER 6

DISCUSSION OF EXPERIMENTS 1 AND 2
If it is acceptable that Experiments 1 and 2 have demonstrated the existence of same-sex preference on the basis of movement patterns, the important question is, what are the theoretical implications of this? In essence, while same-sex preferential looking was obtained from first-look for both Experiments 1 and 2 \( (P < 0.005) \), this was not generally found for total-look.

Indeed, overall total-look failed to show any significant discrimination between the boy actors and girl actors. While same-sex total-looks differed from opposite-sex looks at the region of \( P > 0.05 \) for both experiments, so too were no significant differences obtained, across both sexes, to any one actor over another. That is, in neither experiment, did total-look (across both sexes) favour the boy or the girl \( (P > 0.10 \) for Pairs A and B seen first, Experiment 1; and \( P > 0.10 \), Pair A of Experiment 2). This suggests that the overall total-look measure failed to demonstrate either a preference as a function of observers' own sex, or preference as a function of discrimination between the actors' sex. Yet from first-look, both experiments yielded a significant difference as a function of sex.

In favour of a positive interpretation of this last measure, Lewis, Kagan and Kalafat (1966) have noted that, while first-look is a sensitive measure of differential fixation, total-look is not. They argue that total-look
can cover a multitude of looking patterns within the same obtained value. First-look, alternatively, is not subject to this possibility. (A second measure considered by Lewis et al. is longest overall fixation. However, there is a sex difference here, in that it appears to function for girls but not for boys. For this reason, it was not used here.)

It should also be noted that, for Pair A (Experiment 2), after selection of Ss for "understanding", an overall (significant) preference was obtained for same-sex, both on first and total-look. It is possible that this is a further indication that, while first-look is a reliable measure of differential fixation, total-look, alternatively, can be subject to extraneous factors. In other words, the consistent preference for same-sex found here on first-look can perhaps be taken as sufficient confirmation of the experimental hypothesis.

In addition, discrimination on the basis of affect was also obtained in Experiment 2. While girl Ss demonstrated more positive, as well as more negative affect to the girl actor in Pair A, boy Ss, alternatively, demonstrated a greater positive and negative response to the boy actor.

The above, therefore, constitutes support for the validity of same-sex preference based on the first-look results alone. Furthermore, the suggested unreliability
of total-look makes it more likely that the derived results on Pair B of Experiment 2 are the outcome of an order-effect. As mentioned before, Pair B was always seen subsequent to Pair A. The former was included as a tentative test of the noted differences in gait pattern between boys and girls. While Pair A seemed to be "typical" of their gender, Pair B appeared to be "atypical". It was originally hypothesized that, if the selection criteria had any validity, then Pair B would obtain significant opposite-sex preference. However, the necessity of presenting them second encounters the possibility of order-effects. In light of Lewis et al.'s dissatisfaction with total-look, this suggests that interpretation of the results to Pair B should be very cautious. For the rest of this discussion, therefore, only Experiment 1 and Pair A of Experiment 2 will be considered.

Returning to first-look, as both experiments have yielded a significant preference in the predicted direction, and as this is in accordance with other work suggesting the validity of the measure, it would appear that the experimental hypothesis has been confirmed. That is, same-sex preference has been elicited from infants watching movement patterns of other infants.

It was mentioned earlier that same-sex preference is difficult to explain on any basis other than as a capacity to perceive a similarity between self, and others of the
same-gender. If the infant Ss were capable of simply detecting a difference between the boy and the girl presentations, then a significant difference between looks to one over the other would be expected. However, preference is as a function of own sex, suggesting instead that looking-behaviour is in relation to self. In other words, there is not just discrimination but identification.

Further support for the identity hypothesis can be found in the report of Lewis and Brooks (1975). Here, presentation of photographs of the same- and opposite-sex included presentation of a self photograph. While fixation of same-sex and self did not differ significantly, both were significantly longer than opposite-sex fixation. This effectively constitutes support for the contention that same-sex fixation is the result of a perception of the similarity to self in same-sex other infants. To all intents and purposes, the infants are demonstrating a capacity to identify gender in other infants.

Having thus argued for gender identity based on self-similarity, the next point is to consider the implications of the indicated capacity to perceive similarity on the basis of movement. While Lewis and Brooks(-Gunn) have demonstrated that this can be judged from static presentations, which include superficial, featural cues such as clothes, hair-length and facial configuration, Aitken (1977) has extended this. Here, he demonstrated that, when conflicting featural cues are presented,
perceived similarity can still be accurately judged from moving films. Bower (1982) has argued from this that movement is in some sense primary for judging like-self in infancy, in that it appears to override conflict of information caused by cross-dressing.

On Bower's theory, movement information alone should give rise to a judgement of like-self. This is because development, both in the physical and social world, is considered to proceed from an initial representation and computation of abstract (higher-order) variables to a mediation of the specific. Thus, self and others are also considered to be apprehended in an abstract sense prior to the use of more specific, featural cues.

The obtained results here, therefore, appear to support Bower's theory of self-other representation in infancy. That is, infants seem to have the ability to judge like-self from abstract presentations of other infants. Altogether, the present results constitute support of at least two aspects of Bower's theory of development. First of all, the obtained indication that infants can perceive the moving patterns of dots as persons contradicts traditional theories of perceptual development in line with the alternative account proposed by Bower. Secondly, the suggested capacity of infants in identifying gender from these movement patterns contradicts the constructivist position of Lewis and Brooks(-Gunn) regarding the infantile self-concept, and instead supports the differentiation theory of Bower.
INFANT PERCEPTION OF MOVEMENT PATTERNS

With regard to the first point, what was particularly gratifying here was the general positive response to the films by the infant Ss. Most seemed quite happy to sit through at least a short presentation of them (around 2 minutes). More importantly, in Experiment 1, a number of infants clearly said "Baby" or "Dolly", whilst pointing to the monitors. Altogether, it was clearly evident that infants at this age can perceive the moving dots as human, and even more importantly, as infants. For developmental theories of event perception, the present results are of some consequence.

In the area of motion perception, studies of biological movement have been used to promote "flow models" of perception as opposed to "image models". That is, after J.J. Gibson (1950) and Johansson (1950), theories have predicated change of stimulation over time as the primary sensation necessary for the perception of motion. Rather than the "image-and-cue" models of the classical mode, wherein motion is defined in terms of seriated discrete images, Gibson alternately argues that the array of light undergoes continual change as it impinges on both a stationary and moving observer. Perception of motion in depth is reformulated by Gibson as a process of abstracting invariances from this array, based on the principles of perspective transformation.
Similarly, Johansson (1973, 1976) has demonstrated that the perception of complex motion is coherent only within a stimulus analysis based on the principles of projective geometry. That is, analysis of the image with absolute metrics cannot specify the perception of complex motions where there is change within change. Rather, the stimulus becomes defineable only as a system of relations maintaining an invariant relation to each other, and a common background.

To demonstrate this, Johansson (Maas and Johansson, 1971a,b) uses films of human movement of the type employed here. In a paper (1976), he discusses the compelling nature of the perception of adults as wearers of the dots of light. In fact, the perception of adult movement requires a minimum presentation time of 200 msecs. From this evidence on biological motion perception, Johansson argues against the "image-and-cue" model of perception, wherein the association of cue and image are learned through experience. As prior to viewing the cyclographic films there could have been no chance for learning, Johansson's demonstration constitutes strong evidence for spontaneous perception as a function of invariances extracted from change over time.

With regard to developmental theories of perception, some authors have argued that perceptual development begins with an innate capacity to extract invariance from
continuously changing stimulation. In particular, Bower (1974), as with E.J. Gibson (1969), Gibson et al. (1978), describes the developmental task as one of specifying the details of the visual world, as opposed to constructing the world from sensory data.

The newborn does not respond to sensory experience as such, indeed is probably unaware of the sensory qualities of stimulation; instead I would maintain, the newborn responds to the formal abstract properties of stimulation, properties which are independent of any specific sense, what Gibson (1950) called higher-order variables .... the newborn's perceptual world is form without content, a structure of places and events, without the rich sensory bloom that so characterises our own perceptual world. (Bower, 1982)

The present indication that infants appear to respond to the moving dots as persons can, therefore, be taken as support for Bower's differentiation theory of perceptual development. Unlike "image-and-cue" models of perceptual development, which predicate learning through association, here it is suggested that the present demonstration that infants can perceive the walkers wearing the dots of light, contradicts such assumptions. This is because infants are even less likely than adults to have had any prior experience of persons represented by dots of light. Instead, it is suggested that the present results constitute support for a developmental theory of perception based on the principles of E.J. Gibson and Bower.
IDENTIFICATION OF "LIKE-SELF":
THE CASE FOR ABSTRACT REPRESENTATION

The obtained results from looking-behaviour are suggested to be support for a differentiation theory of social development. A constructivist, Piagetian theory, such as that of Kohlberg, and Lewis and Brooks(-Gunn) would not predict an infant capacity to perceive the moving groups of dots as other infants. This is because the films convey only higher-order variables which are not considered to be represented in infancy on such theories.

Instead, Lewis and Brooks(-Gunn), for example, propose that social (self-other) knowledge is initially represented as superficial, featural forms. Just as the object is initially defined in Piaget's theory in terms of immediate, perceptual reality; so too are the categories of persons, including self.

Bower, on the other hand, would predict both the rejection of inappropriate cues in Aitken's films as well as the efficacy of pure movement cues, in a judgement of like-self. In this sense, the present results appear to support Bower's position on the developing representation of self and others. For Bower, the results of Lewis and Brooks(-Gunn) and Aitken's replication constitute evidence that self-similarity can be perceived from featural cues.
at this age, just as objects are also perceivable at the level of features in older infants (1979). However, for Bower, the perception of self-similarity is considered to arise from an initial, abstract representation of self and others (such as in the representation of movement), which only later becomes fully specifiable at the level of features.

On closer examination of the first-look results, it is interesting to note that other studies maintain a formal identity with regard to the obtained values of "preference". That is, girls consistently demonstrate a stronger preference for same-sex, over the preference shown by boys for same-sex. Lewis and Brooks-Gunn (1979) obtained a mean first-look preference for same-sex from girls of 5.74 seconds, against 3.98 seconds for opposite-sex. The equivalent in boys was 4.48 seconds for same-sex, against 3.96 seconds for opposite-sex. Also Aitken (1977), on total-look (first-look was not measured), in the cross-dressing movie condition, derived a mean female same-sex number of 295 frames fixated, against mean opposite-sex number of 115 frames fixated. Boys, alternately, fixated same-sex for a mean of 250 frames, against a mean number of 135 frames to opposite-sex.

From both authors, therefore, it is clear that the girl Ss demonstrate a stronger preference for same-sex than boys.

Here, although this was not found for Experiment 1, in Experiment 2 at least, girls' mean first-look to
same-sex was 7.25 seconds, against 1.7 seconds to opposite-sex. For boy Ss, this has been lowered to 4.14 seconds for same-sex against 2.75 seconds for opposite-sex.

One interpretation of these results is that they demonstrate a functional identity between the derived judgements of like-self to appropriate-dress stills, inappropriate-dress movies and patch-light movies. In other words, this unity may be further indication that representation of self and others in infants can take place on a number of levels, of which featural cues are only one. Furthermore, Aitken's demonstration of the primacy of movement information, as well as the present results from pure movement representations, suggest that even with the capacity to judge from features, computation for the judgement of like-self can still proceed on abstract variables and, indeed, takes precedence over more specific variables. This is in accordance with Bower's theory of social development.

If it can be argued that movement constitutes a more reliable index of perceived self-similarity for infants, the next task is to consider the parameters of this hypothesized self-other representation. A priori, this type of representation necessarily involves a number of factors.

First of all, the ability to perceive similarity with others at the level of movement suggests that there
must be a capacity to represent self in movement. This point has been taken for granted in the preceding discussions, but it is now time to consider this in detail.

In order for a comparison with others to be effected, there has to be a knowledge of self within the terms of comparison. That is, in order for others to be perceived as similar from pure movement cues, there must be some description of self at the level of movement. This, of course, must also apply to featural criteria such as that in Lewis and Brooks(-Gunn)'s experiments, and Aitken's. Thus, for self-similarity to be perceivable here, self must also be described at 10-13 months by features, as well as movement. However, Aitken's results and those obtained here, suggest that a movement-based representation is in some sense primary to a featural type of representation.

Furthermore, it can also be said that, in order for an effective comparison to take place from movement, self and others must be described in a form which can give rise to perceived similarity. That is, in order for the movement created by self to be comparable with the movement created by other, the two forms must be specified at some level of representation in a similar "code". For example, it can be argued that, knowledge of self in movement must be initially derived from the proprioceptive sensors. Knowledge of the other in movement, however, must be derived from the visual sense. Yet, in order for
the two types of information to be effectively compared, there must be some level of internal description which specifies them in a form common to both. Without this, comparison would simply not be possible.

This last is similar to the argument put forward by Meltzoff and Moore (1977) in their account of neonatal imitation. Here, it is argued that imitation can only occur through a capacity to represent transformations of own body and transformations of the other's body in a common (supramodel) form. Again here, the basis of imitation is considered to rest with an ability to perceive similarity between proprioceptively-generated information and that derived from the visual sense. Importantly, Meltzoff and Moore (1983) argue that this ability to represent differing sensory information in a supramodel form is present from birth, and indeed constitutes the starting-point of psychological development rather than an end-point, as was suggested by Piaget (1951/1962). The present indication, therefore, that this may exist in the one year old is perhaps not surprising at all within this context. For Meltzoff and Moore and others (e.g. Bower, 1979), specification of information from the senses at the abstract level initiates development, as opposed to being constructed as a result of development.

In the absence of any alternative explanation for the indicated ability to perceive self-similarity from
movement patterns, it is suggested that this is a function of the same capacity which allows for imitation, as formulated by Meltzoff and Moore (1977, 1983) and Bower (1979). That is, information regarding self and others must be specified or represented in a form which is abstract enough to describe both.

It should be noted that Meltzoff and Moore (1983) themselves draw a distinction between imitative behaviour at birth and in the one-year-olds, as, for example, a function of different motoric capacities, or meaning to the infants. However, ultimately, the imitative capacity predicates the existence of an ability to co-ordinate differential sensory information which seems only explained by the existence of a representative capacity for abstract or formally-specified information. In the present case, a similar capacity is also predicated.

The above has been argued on a priori grounds. However, it is possible to conceive an alternative explanation for preferential same-sex fixation as a function, not of perceived similarity to self, but rather of sibling exposure. Here, the logistics might run something like this. The obtained figures on a tendency to fixate same-sex could arise from a chance selection of infants who all have same-sex siblings. Through associative learning, the infant Ss may simply have a capacity to perceive similarity between same-sex siblings and same-sex person. On this argument, self is not
inserted into this matrix.

In Experiment 1, sibling-status was not controlled for, which suggests that the above cannot be ruled out for this experiment. However, in Experiment 2, this was controlled for in that only one boy S had an older brother. For the rest, all were only children. This suggests that the sibling-related argument can be ruled out for at least Experiment 2. Yet again, within this line of reasoning, it is possible to argue from a more general peer exposure. Here, little can be offered from the empirical data which could contradict this position. Bower (1982), however, has already addressed this issue, noting that communal day-care is very rare for infants in Scotland. The possibilities of infants becoming acquainted with others to the degree that an associative learning argument would require, is, in fact, highly unlikely with the sample used here. In addition, this sort of explanation would still not account for a consistent preference for same-sex, as individual variations within this context would be necessarily large.

Altogether, the indicated preference for same-sex from movement information seems to be explainable only within the context of a capacity to represent information from the senses in a form which can allow for effective matching or comparison. This form must be sufficiently abstract, in the sense that a description of one must readily map onto a description of another class of sensory data.
Taking both the results obtained here, and those obtained by Aitken (1977), it would appear that Bower's theory of social development has been supported. That is, self-other representation in infancy appears to be organized in an abstract form.

Having argued for self-other representation at the level of movement in infancy, the next point is to consider the present application of the term "movement" in more detail. It was mentioned earlier (Chapter 3, Introduction, p.94) that movement in the films is defined as walking movement, as all of the infant actors in the present films were walking. In addition, all of the infant actors were of walking age. The derived preferences, therefore, suggest that movement-as-walking may have constituted the basis of perceived similarity.

From the above, at least two points can be made. Firstly, if this is correct, then this suggests that there are differential walking-patterns in infants as a function of gender. This will be taken up in more detail in Chapter 8.

The second point effectively constitutes a means of testing Bower's explanation of same-sex preference as perceived similarity judged from movement. It can be argued that, if similarity is judged in relation to self, then younger infants, who are still well below the age of walking, will not be able to judge like-self from the same
films of infants walking. That is, in the absence of the knowledge of self-as-walking, on Bower's theory, it should not be possible for infants in this category to perceive a similarity between self and others-as-walkers. This last is the concern of the next chapter.
CHAPTER 7

EXPERIMENTS 3 AND 4
Until now, gender identification from simultaneous-presentation paradigms have focused on one year olds. Lewis and Brooks, Aitken and Experiment 1 used 10-13 month olds, while Experiment 2 used 10-14 month olds. In an attempt to examine the mechanism of identification, the following experiment uses the same materials in the same paradigm, but with a younger sample.

This is effectively designed to test whether "walking" is a salient dimension for a judgement of perceived similarity. The predictions are that, if walking is represented by 10-14 month olds, and functions for the perception of similarity, then younger pre-walking infants will not demonstrate a same-sex preference in looking-behaviour to the films of infant walkers. In other words, if as Bower (1982) predicts, movement is the basis for the perception of similarity, then younger infants who do not walk will not judge similarity-to-self from the present films.

Experiment 2 was repeated with two groups of younger babies, aged 8 months (Experiment 3) and 4 months (Experiment 4).

All Ss again were only children. The only difference was the subtraction of Pair B from the test films, partly because it reduced the time-span for the younger babies
and partly because of the problems in interpretation of the results from Pair B.

EXPERIMENT 3

Method

Subjects: 8 infants, all aged 8 months (4 boys and 4 girls).

Design: As Experiment 2. Side-effects were balanced by presenting half of each group with a different R-L presentation. This meant that 4 Ss saw the boy on the right and the girl on the left, and 4, the reverse.

Materials: As Experiment 2, except that Pair B was not included.

Apparatus: The only alteration here was heavier padding in the baby-chair.

Results: The results obtained from the looking-behaviour of 8 month old infants are given below. Table 7.1 presents the length of first-looks and Table 7.2 presents the obtained mean length of first-looks. Inter-observer reliability for the above scores was 1 for direction and 0.75 for magnitude.

On a one-tailed Wilcoxon Matched-Pairs Signed-Rank test, same-sex versus opposite-sex looks derived a T of 12, N = 8 (P > 0.05). That is, no significant differences were obtained between length of same-sex first looks and length
TABLE 7.1:
LENGTH OF FIRST LOOK (in seconds) (N = 8)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>5.13</td>
<td>1.03</td>
</tr>
<tr>
<td>2</td>
<td>13.17</td>
<td>1.74</td>
</tr>
<tr>
<td>3</td>
<td>1.56</td>
<td>5.06</td>
</tr>
<tr>
<td>4</td>
<td>5.00</td>
<td>0.99</td>
</tr>
</tbody>
</table>

*SS = Same-Sex    **OS = Opposite-Sex

*R/L indicates direction of very first look

TABLE 7.2:
MEAN LENGTH OF FIRST LOOK (in seconds) (N = 8)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>6.21</td>
<td>2.2</td>
</tr>
<tr>
<td>Boys</td>
<td>3.66</td>
<td>4.63</td>
</tr>
<tr>
<td>Both</td>
<td>4.02</td>
<td>2.26</td>
</tr>
</tbody>
</table>
of opposite-sex first-looks (both sexes). Figure 7.1 illustrates the derived mean scores for first-look.

Total-look results are presented in Tables 7.3 and 7.4. On a one-tailed Wilcoxon Matched-Pairs Signed-Rank test comparing same-sex with opposite-sex total-looks, $T = 12$, $P > 0.05$. As with first-look, this was insufficient to reject the null hypothesis that there would be no difference between length of same-sex total-look and length of opposite-sex total-look. Figure 7.2 illustrates the derived mean total-looks.

To check whether the boy or girl actor of Pair A were significantly fixated more by both sexes, two Mann-Whitney U tests were performed on first-look and total-look respectively (both sexes combined).

For first-look, comparing length of look to the boy actor versus length of look to the girl actor, obtained $U = 19$, $P = 0.097$. This falls just short of significantly longer fixation to the girl actor. On total-look, however, obtained $U = 11$, $P = 0.014$, which does indicate a significant preference for the girl actor here, by both sexes.

The derived affect scores for Experiment 2 are given in Figure 7.3.
FIGURE 7:1. Mean first-looks from 8 month olds.
### TABLE 7.3:

**LENGTH OF TOTAL LOOK (in seconds) (N = 8)**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>33.09</td>
<td>5.79</td>
</tr>
<tr>
<td>2</td>
<td>34.64</td>
<td>14.82</td>
</tr>
<tr>
<td>3</td>
<td>12.96</td>
<td>10.21</td>
</tr>
<tr>
<td>4</td>
<td>24.48</td>
<td>7.87</td>
</tr>
</tbody>
</table>

*SS* = Same-Sex  
**OS** = Opposite-Sex

### TABLE 7.4:

**MEAN LENGTH OF TOTAL LOOK (in seconds) (N = 8)**

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>26.29</td>
<td>9.67</td>
</tr>
<tr>
<td>Boys</td>
<td>12.44</td>
<td>17.61</td>
</tr>
<tr>
<td>Both</td>
<td>19.37</td>
<td>13.64</td>
</tr>
</tbody>
</table>
FIGURE 7:2. Mean total looks from 8 month olds.
FIGURE 7.3. Mean affect scores from 8 month olds.
DISCUSSION

As predicted, neither the first-look results or total-looks displayed any significant difference in preference. That is, 8 month olds do not appear to be able to identify gender from walking information alone. For first-look, both sexes differed to a $P > 0.05$, and similarly for total-look. It was not possible on such a small sample to test boys and girls individually; but from Figure 7.1 it is clear that girls on first-look did, in fact, prefer own sex by approximately 4 seconds, and boys, the reverse — although only by a small margin. On one interpretation this could be taken as indicating that girls have developed, in advance of boys, the ability for gender identification. Although only one girl is largely responsible for the success of female same-sex preference (Subject 2), there was no reason to consider her as unrepresentative of the other girls.

Taking both boys and girls together, however, an obvious alternative explanation is that they both simply found the girl actor of Pair A more attractive for reasons other than gender-awareness. Unlike the 10-14 month olds of Experiment 2, who consistently preferred own-sex, certainly in first-look; from Table 7.1, it is clear that more 8 month olds looked longer initially at the girl. It is always possible that the 8 month olds were attending to different cues in the films, choosing the girl actor on a
different basis from the older infants. (Although one cautionary note is that, individually, the boys' choice was two out of four preferred same-sex, and two, opposite-sex, suggesting that male preference was possibly the result of chance.) However, on a Mann-Whitney U test, comparing first-looks to the boy actor versus first-looks to the girl actor (all subjects), obtains U = 19, P = 0.097. This is close enough to significance to suggest that there was a trend by both sexes to prefer the girl actor in first-look.

Other possibilities for the first-look results are either side of presentation or direction of gaze. Side of presentation, as mentioned earlier, was balanced by presenting half of Ss with one R-L film, and half with the reverse. If side did figure significantly, then a functional relationship should emerge between preferred side and longer look. This did not occur. From eight Ss, five preferred the right-hand film, and three, the left. This is so close to chance that it appears unlikely that side of presentation bore any functional relationship to preference. Indeed, on a sign-test, P = 0.363.

Direction of gaze as an alternative is less easy to rule out for the 8 month olds. Three out of three girls who preferred same-sex also looked there initially, and two out of two boys. In the case of boys, two out of two who did not prefer same-sex also looked there first. This suggests that, for boys, direction of gaze does not appear
to function in preference, but for 8 month old girls, it is a possibility. Three out of three who favoured their own sex, regarded the girl initially and the fourth, who did not, looked first at the opposite-sex. For girls, therefore, there is a correspondence between actor initially regarded and preference. The numbers are so small, however, that any interpretation can only be tentative. One puzzling aspect is why should something occur for girls and not for boys, and suggests caution to any claim.

Taken together, the first-look results here do not demonstrate a significant same-sex preference, which is in accord with the original prediction. Taken individually, however, girls do demonstrate a trend toward girl preference, whereas boys do not. On one interpretation, this could mean that girls are more advanced at 8 months than boys in gender-differentiation, although as an explanation this would appear to lack internal cohesion.

Other alternatives are either that the girl film was simply more attractive to 8 month olds, or that the girls here simply preferred the first film they looked at. Side of presentation does not seem a likely explanation.

What seems clear is that, at 8 months, on the same presentation, both sexes do not demonstrate the same-sex preference obtained from first-look in 10-14 month olds. If either variables in opening content, or direction of
gaze do affect choice of preference in female 8 month olds, then the original hypothesis remains. The only possible contravention is that girls are able at an earlier age than boys to identify gender. This rather unlikely explanation would need to be tested on a larger sample, and as it stands, it is still not significant. In general, the most likely explanation is that both sexes preferred the girl actor, unlike the preference for same-sex obtained from older infants on first-look.

For total-look, again the probability of the obtained difference between same-sex and opposite sex was \( P > 0.05 \). Individually, however, again the trend differs between boys and girls in that girls do display mean same-sex preference, whereas boys do not (see Figure 7.2). If this is compared with the mean total looks from Experiment 2, 8 month old girls spent an average of around 8 seconds longer on own sex than older girls, and approximately 3 seconds longer on opposite-sex. From Experiment 2 to 3, same-sex looks drop by almost 10 seconds, while opposite-sex looks remain the same. When both sexes are combined, the high female same-sex mean and the low male same-sex mean score cancel each other out, so that the combined results approximate the combined scores of the 10-14 month olds. Individually, however, as both girls and boys in this experiment prefer the same actor, it is not possible from this to advance the contention that there is a
preference for same-sex. Instead, what has occurred in
total-look is preference for one actor. This was, in
fact, statistically confirmed by a Mann Whitney U test
comparing total-looks to the girl actor and total-looks
to the boy actor (all subjects). Here, obtained $U = 11,$
$p = 0.014,$ suggesting that the overall preference for the
girl actor was indeed significant.

Interestingly enough, there is a certain correspon-
dence here with the results obtained from Experiment 2,
in that the girl actor here also appeared to be overall
regarded the most. (In Experiment 2, the girl actor
received an overall mean looking-time from all Ss of
18.92 seconds, while the boy received an overall mean of
15.88 seconds (derived from Table 5.4, Chapter 5). It
is possible that there were independent variables at
work both in Experiments 2 and 3. In Experiment 2,
however, the boy actor for boys is at least equally
attractive, whereas, in Experiment 3, the girl actor is
consistently preferred both in first and total-look.

It is always possible that what was happening for 8
month olds is that, in the absence of the requisite knowledge
for a "like-me" judgement, the (unknown) variables which
rendered the girl actor overall more attractive for 10-
14 month olds assumed more importance for the 8 month olds.

On this line of reasoning, the results from both
Experiments 2 and 3 for Pair A seem to fit readily into
the same theory. That is, in Experiment 2, while there
is also some evidence of an overall attraction to the
girl actor in Pair A. In Experiment 3, both in first-
look and in total-look, this attraction appears on both
measures while there is an absence of any same-sex
preference. The original prediction for 8 month olds
was simply that there would be no same-sex preference.
No specific predictions were made as to what the
alternative pattern of looking would be. However, it
does appear to make sense that, in the absence of same-
sex preference, one actor is consistently preferred.
As there is also evidence for this in 10-14 month olds,
this result for 8 month olds could be demonstrating a
certain coherence between the two experiments.

It is perhaps reasonable to suggest, therefore, that
the results from Experiment 3 provide support for the
notion that same-sex preference from movement patterns
are the result of a "like-me" judgement in the older
infants. This is because, in the younger infants tested
here, what has emerged is an overall preference for one
actor rather than a same-sex preference. Unlike the
older infants, all of the infants in this sample were,
of course, pre-walking.

Remaining alternative explanations for total-look in
the design itself are that they are a function of either
direction of gaze or side of presentation. The latter,
as with first-look, seems unlikely. Of eight Ss, three
demonstrated a right-hand preference and five, left-hand.
This suggests that no one side was preferred (at least significantly).

Preference as a function of direction of initial gaze also seems highly unlikely here. It was suggested that the first-looks of 8 month old girls could have been the result of looking longer at the first actor apprehended, regardless of gender. This relation in the case of total-look, however, is slightly weakened. For first-look there was a correlation of one between initial direction of gaze and preference for girls. For total-look this drops to three out of four for girls and remains at two out of four for boys. Combined, this means only four out of eight looked longer at initial actor regarded.

On considering the logistics of this argument, there are considerable flaws. It seems highly implausible that initial direction of gaze has much effect on total preference considering that, over the total presentation, an infant can be expected to look an average of eight or more times to an actor. While it seems possible that first-looks could be affected by initial direction of gaze, as an explanation of total-look, it lacks credibility.*

* In Experiment 2, the Ss were also screened for "understanding" in their initial looks. That is, all of the Ss who looked less than 1.16 seconds in their initial looks were excluded from the sample and the rest examined. In this experiment, however, as can be seen from Table 7.1, this would only leave a sample of four (two boys and two girls), which seems hardly sufficient for analysis. It was decided, therefore, not to attempt a similar treatment for the 8 month olds.
In the absence of any correspondence between direction of gaze or side of presentation, and preference, this perhaps could be a further indication that 8 month olds are responding to the girl actor in Pair A for reasons which attract them, independent of an interest in like-self.

Additional support for this tentative hypothesis can be seen in the results derived from the affect scales from both samples. A measure of affect, as in Experiment 2, was taken from the 8 month olds and compared with that derived from the 10-14 month olds (see Figure 7.3). What is immediately clear here is the lack of positive differentiation in affect by 8 month olds between the boy and girl actors. Both girls and boys display an equal amount of positive behaviour (body behaviour and facial expression) to the actors. This is unlike the affective measures derived from the 10-14 month olds, who clearly did differentiate on both negative and positive measures.

The 10-14 month olds displayed a greater positive affect score for their own sex and, interestingly enough, a greater same-sex negative affect. On the other hand, 8 month olds remain constant on positive measures between the sexes, with only the boys displaying a rather puzzling high negative score to the girl. This result notwithstanding, what seems clear is that there is a substantial difference in behavioural attitude between 10-14 month olds and 8 month olds, which again supports the above
hypothesis.

In conclusion, it is apparent that 8 month olds do differ from 10-14 month olds' responses to the films. On both first- and total-look, no significant differences emerge between same-sex and opposite-sex looks. Rather, the derived preference in 8 month olds is for the girl actor from both boys and girls. It is suggested that, in the absence of the ability to effect a "like-me" judgement (due to the lack of relevant knowledge of walking), 8 month olds were responding to a different set of cues in the films. On this, due to these other cues, the girl actor was the overall preferred actor. What makes this especially interesting is that, in 10-14 month olds, there is some evidence that the same girl actor was also overall preferred, although here it was overridden by a significant same-sex preference. From this, a certain continuity between the responses of the 8 month olds and those of the 10-14 month olds can be discerned. As predicted, therefore, it seems highly likely that 8 month olds have a substantially different attitude to the films. Additional support for this can be seen in the measure of affect, which displayed substantial differences between the one year olds and the 8 month olds. Overall, it is suggested that evidence has been found on comparing 8 month olds and 10-14 month olds that supports Bower's (1982) theory that same-sex preference in 10-14 month olds is a function of a "like-me" judgement from movement.
**EXPERIMENT 4**

**Introduction**: A separate sample of 4 month olds was also tested in the same way. While 8 month olds are pre-walking, they are still fairly close in age to onset (around 9 months onwards). Four month olds, on the other hand, are still well below the age of onset. Following the original prediction for Experiment 3, it was hypothesized that 4 month olds would not demonstrate same-sex preference from movement cues. Indeed, as 4 month olds are even further from walking than 8 month olds, their looking choices would resemble chance more than 8 month olds.

**Method**: As Experiments 2 and 3.

**Subjects**: 8 normal, healthy infants (4 boys and 4 girls).

**Results**: The length of first-looks for Experiment 4 are given in Table 7.5, mean first-looks in Table 7.6. Figure 7.4 illustrates the derived mean first-looks.

On a one-tailed Wilcoxon Matched-Pairs Signed-Rank test comparing same-sex versus opposite-sex looks, T = 19, P > 0.05. This does not enable rejection of the null hypothesis that there would be no difference between same-sex and opposite-sex looks.
TABLE 7.5:
LENGTH OF FIRST LOOK (in seconds)  \((N = 8)\)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th></th>
<th></th>
<th>BOYS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
<td>SS*</td>
<td>OS**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.56</td>
<td>R</td>
<td>L</td>
<td>0.36</td>
<td>1.26</td>
<td>R</td>
</tr>
<tr>
<td>2</td>
<td>3.38</td>
<td>R</td>
<td>L</td>
<td>4.52</td>
<td>12.27</td>
<td>L</td>
</tr>
<tr>
<td>3</td>
<td>0.99</td>
<td>L</td>
<td>R</td>
<td>11.49</td>
<td>45.16</td>
<td>R</td>
</tr>
<tr>
<td>4</td>
<td>21.81</td>
<td>L</td>
<td>R</td>
<td>1.12</td>
<td>9.48</td>
<td>R</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

\(^+\)R/L indicates direction of very first look

TABLE 7.6:
MEAN LENGTH OF FIRST LOOK (in seconds)  \((N = 8)\)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>6.65</td>
<td>4.37</td>
</tr>
<tr>
<td>Boys</td>
<td>17.04</td>
<td>16.37</td>
</tr>
<tr>
<td>Both</td>
<td>11.86</td>
<td>10.37</td>
</tr>
</tbody>
</table>
FIGURE 7:4. Mean first-looks from 4 month olds.
Total-look results are given in Tables 7.7 and 7.8. On a Wilcoxon Matched-Pairs Signed-Rank test, same-sex versus opposite-sex total-looks obtained a T of 12, $P > 0.05$. Again, as with first-look, this is insufficient to reject the null hypothesis that there would be no difference between same-sex and opposite-sex total looks. Figure 7.5 illustrates the derived mean total-looks.

As first-look and total-look demonstrate a reversal of preferences, no comparison of looks to one actor over the other was performed. This is because no consistent preference for one actor has emerged here.

In addition, an affect measure was taken. Here, only the girls displayed any quantifiable affective responses, as Figure 7.6 illustrates. This makes interpretation difficult; suffice to say that the affect scores obtained from the 4 month olds differed from the 8 month olds, and again from the 10-14 month olds.
TABLE 7.7:
LENGTH OF TOTAL LOOK (in seconds) (N = 8)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS*</td>
<td>OS**</td>
</tr>
<tr>
<td>1</td>
<td>11.8</td>
<td>R</td>
</tr>
<tr>
<td>2</td>
<td>12.38</td>
<td>R</td>
</tr>
<tr>
<td>3</td>
<td>13.11</td>
<td>L</td>
</tr>
<tr>
<td>4</td>
<td>32.02</td>
<td>L</td>
</tr>
</tbody>
</table>

*SS = Same-Sex  **OS = Opposite-Sex

TABLE 7.8:
MEAN LENGTH OF TOTAL LOOK (in seconds) (N = 8)

<table>
<thead>
<tr>
<th></th>
<th>Same-Sex</th>
<th>Opposite-Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>17.33</td>
<td>23.69</td>
</tr>
<tr>
<td>Boys</td>
<td>17.04</td>
<td>23.48</td>
</tr>
<tr>
<td>Both</td>
<td>17.18</td>
<td>23.59</td>
</tr>
</tbody>
</table>
FIGURE 7:5. Mean total looks from 4 month olds.
FIGURE 7.6. Mean affect scores from 4 month olds.
DISCUSSION

On first-looks and total-looks from 4 month olds, no significant preferences were found. Again as with 8 month olds, this was in accordance with the original prediction. Indeed, 4 month olds display a different pattern of looking from 8 month olds and again from 10-14 month olds. This suggests that the younger babies have their own, alternative attitude to the films.

One immediately striking factor about this younger group is the increase in length of individual looks, which were noticeably longer than those obtained in Experiments 2 and 3. Subjectively, the impression is that the 4 month olds lack the motivation of older babies to compare the two actors on the screen. Instead of darting from one to the other, 4 month olds seem content to let their gaze rest on one film. Indeed, the youngest boy only regarded one film. (Despite the possible consequent artificial inflation of the results, it was decided to include him in the sample as his behaviour was not dissimilar to the general pattern of looking displayed by 4 month olds.)

On considering mean first-looks (see Figure 7.4), the increase in length of look is quite apparent, especially from the boys. In fact, 4 month old boys demonstrated an outstanding increase on 8 month olds of nearly 17 seconds.
for same-sex first-look. Opposite-sex look too is increased by approximately 14 seconds. From Table 7.5, it is clear that three boys produced at least one first-look which was over 28 seconds. The fact that the mean age of boys is lower than that of girls is further support of the suggested "youth effect" on looking.

Turning to preference, as predicted for both boy and girl 4 month olds, there is still less of a difference between looks to same-sex and opposite-sex. For 8 month olds, same-sex first-look was 4.02 seconds, and 2.26 for opposite-sex. Four month olds reduce the gap with 11.86 seconds to same-sex and 10.37 seconds to opposite-sex. Statistically, a reduction in difference is also clear. The obtained T for 8 month olds is 12, and 19 for 4 month olds. In other words, the difference between same-sex and opposite-sex first-looks is closer to chance.

On a first-look boy-girl comparison, certain intriguing differences between Experiments 2, 3 and 4 emerge. In Experiment 2, the preference both for boys and girls is clearly for own sex. In Experiment 3, an overall preference for the girl actor was found. In Experiment 4, the trend for both sexes again becomes same-sex, although for boys, only just.

The preference in Experiment 3 for the girl actor was suggested to be the result of independent variables acting in the absence of the relevant gender-specific knowledge
of walking. This does not appear to be the case for 4 month olds. No actor-specific preference emerged, nor does initial direction of gaze bear any functional relation to preference. Of the seven infants who looked at both models, four looked longest at their initial choice and three, the reverse—suggesting little more than a chance relationship. Side of presentation figures little as well. Of eight Ss, four preferred the right-hand actor and four, the left-hand.

If the slight preference for same-sex from 4 month olds had been statistically significant, then this would have refuted the prediction for this age group. They were not, and considering the lack of available explanations from independent variables, the first-look results seem little more than the product of chance.

Total-look measures also displayed no significant preference. Continuing the point made earlier on the relative prolonged looking in 4 month olds, this becomes even clearer on total-look. Three of the boys looked only once to the boy model, so that their first-looks are also total-looks (see Tables 7.5 and 7.7). One of them, as mentioned before, did not even look across to the other model. This alone indicates a substantial difference in the attitude of 4 month olds to the films.

Interestingly enough, a reversal of preference takes place between first- and total-look, with both boys and
girls now preferring opposite-sex. Nor does this either appear to be a function of independent variables. Firstly, content of films can be ruled out because no one actor is preferred. Secondly, direction of gaze, because only four out of seven looked longer at their initial choice, and three the reverse. Finally, side of presentation does not appear to figure, with four preferring the right-hand actor and four, the left-hand.

In view of this, it seems likely that the total-looks of 4 month olds, as with first-look, are the product of chance. This seems even more likely in face of the reversal of preference between first- and total-look. This did not happen with the older babies, for whom choice of preference remained consistent. To all intents and purposes, this indicates that there is no one factor governing the preference of 4 month olds and rather that they are outcomes of chance.

The affect-scale for 4 month olds again illustrates a clear difference in attitude from 8 and 10-14 month olds. Only one affective measure was obtained, namely, those from the girl Ss to the boy actor (see Figure 7.6). In the absence of comparable scores from boy Ss, and from girl Ss to the girl actor, no clear interpretation can be made. What is definite, however, is that they vary from the older babies, suggesting that the original prediction of a substantial difference in attitude in 4 month olds is correct.
GENERAL DISCUSSION

Altogether, the results obtained from Experiments 3 and 4 appear to support the experimental hypothesis, namely, that infants of a younger, pre-walking age-group will not demonstrate same-sex preferential fixation. As predicted, a different pattern of looking was obtained from 8 month olds, and again from 4 month olds.

For the former, an overall preference for the girl actor of Pair A was established across both sexes, this time both in first-look and for total-look. Indeed, on the Mann-Whitney U test, first-looks approached a significant preference for the girl actor (all subjects) and total-looks did significantly favour the girl actor.

In general, therefore, for the 8 month olds, preference tends to favour the girl actor. While girls fixated the girl actor longer as in Experiment 2, boys differed from the older group in that they also looked more at the girl. On this point, an interesting analogy can be drawn with both Experiment 2, and other work. This is the tendency for girl infants to show a stronger preference for same-sex than the equivalent in boys. Altogether, this pattern has been continued for Experiment 3, where girls, this time both in first-look and total-look, show quite a clear preference for same-sex.

It was suggested above that there may be a general tendency to look at the girl actor for reasons other than
a judgement of like-self. It is possible that the trend indicated in Chapter 5 for the girl actor to be fixated more overall by both sexes, has been continued in the case of the younger infants, this time without any additional tendency to preferentially fixate same-sex actor.

On consideration of the 4 month olds, however, this has not been continued. Instead, it was argued that the fixation times of younger infants are the result of chance looking. Particularly noticeable in this instance is the lack of looks between the screens which could be indicative of the act of comparing on the part of the infant.

Overall, the present results appear to support the contention that younger, pre-walking infants do not demonstrate the preference for same-sex obtained from 10-14 month olds. However, it should be noted here that the sample sizes for Experiments 3 and 4 are smaller than those for Experiments 1 and 2. Any interpretations based on a comparison, therefore, should be treated with caution. Ideally, a future research programme would compare age-related changes with an equivalent sample size.

Yet, as an indication, the present results suggest tentative support for Bower’s hypothesis that the same-sex preference of older infants is with reference to self-in-movement. In this case, "movement" has been defined as walking versus not-walking. When pre-walking infants were tested with the experimental films, no same-sex (like-self) preference was obtained, unlike the
positive results from older infants, who are of the age of walking.

This, of course, does not rule out the possibility of a capacity to perceive like-self in younger infants from presentations of same-age other infants. The difference in this case would be over the definition of "movement", as obviously "walking" would not be applicable for 8 month olds. It is always possible that like-self identity may be derived from films portraying same-age other infants engaged in a different type of movement, such as crawling. Again, here, the underlying assumption would be the prevalence of movement in the infant representation of self and others.

The above experimental suggestion would constitute a stronger test of Bower's theory of the developing self-other concept, as would a direct comparison of older and younger infants from walking films with comparable sample sizes. As far as can be ascertained here, there is at least an indication this early social representation does in fact include movement, as Bower suggests. Exploring the parameters of the self defined as movement, therefore, may prove to be a very interesting line of research in the future. It is suggested that this functions in infancy, and indeed takes precedence for infants over featural, static cues. In this sense, Bower's conception of the abstract nature of early representation appears to
be applicable to the social world.

The results of the last four experiments can be generally interpreted in the following manner. Firstly, infants appear to be able to perceive pure movement patterns as persons, and indeed as infants. Secondly, when movement is defined as walking, like-self appears to be judged by infants who are of walking age, but not by infants too young for this. Altogether, both the above points can be explained by a theory which predicates the capacity for abstract representation of self and others, at the level of movement, in infancy.

For this sort of interpretation to be possible, however, there is one point outstanding. If movement constitutes an effective means of judging like-self in terms of gender, then this suggests that there are gender differences in the movement patterns of infants. As a further test of the present suggested interpretation, the next chapter is an analysis of the patterns obtained from seven girls and eight boys. So far, all that can be said with any certainty is that the female movement presented by the girl actor of Pair A was generally more attractive to the infant Ss.
CHAPTER 8

ANALYSIS OF INFANT MOVEMENT PATTERNS
INTRODUCTION

It was mentioned earlier that preference for same-sex implies two things: that there are sex-differences in infant gait and, secondly, that they are perceived by infants. The latter was the concern of the previous chapters. In this chapter, an attempt will be made to provide some insight into differential movement patterns in infants.

HUMAN LOCOMOTION

The complex process of human locomotion has been variously described in detail (for example, Inman, 1966; Bernstein, 1967). To initiate stepping, the body is moved forward slightly, then the rear leg is lifted off the ground and swung through to the forward position on the ground. Weight is then transferred to this front leg, and the pattern repeated.

To achieve this motion, various components of the body undergo highly specific, rhythmic patterns of displacement. The shoulders roll in opposition to the hips and the upper limbs swing in opposition to the lower limbs. In addition to this horizontal displacement, there is general movement in the vertical plane from step to step.
Inman (1966) sees in the various, opposing movements, mechanisms which aim to achieve bodily displacement with the least expenditure of energy. Probably the most significant of these is pelvic rotation, both in the horizontal and vertical plane. As Inman states: "If there were no pelvic rotation we would step forward like the opening blades of a pair of scissors." (p.1049).

There is also knee and ankle flexion, which combined with pelvic rotation and pelvic list serve to maintain the centre of gravity (the point around which all mass is distributed) as level as possible.

All bodily displacement is in reference, naturally enough, to the force of gravity. The opposition to gravity in walking, however, is not entirely derived from the action of the muscles. In walking, considerable kinetic energy is created as a result of limb swing, as, for example, in the forward swing of the leg. Here kinetic energy is created in the move forward, which, as the leg is decelerated, is transmitted upward to the torso to assist in forward displacement of the body (Inman, 1966).

The above serves to give some idea of the complexity of human locomotion. That there are individual differences within this structure is quite plain. Witness the surprising ease with which we can identify friends walking, across some not inconsiderable distances (Inman, 1966; Cutting and Koslowski, 1977). Even taking into
account individual variation in adult locomotion, however, some clear gender differences have been outlined.

GENDER DIFFERENCES IN ADULT GAIT

That there are differences in the walking patterns of adults is widely accepted. Indeed, several authors have demonstrated that it is possible to identify gender from patch-light displays of adult gait (Koslowski and Cutting, 1977; Runeson and Frykholm, 1982a,b). In addition, they have attempted to outline the particular features which differentiate males and females in adult movement.

The starting point for James Cutting and co-workers was a phrase in a handbook accompanying Johansson’s patch-light film displays of adults (Maas and Johansson, 1971a,b). There they indicated that it was probably possible to identify gender from patch-light displays. Subsequently, Koslowski and Cutting (1977) positively confirmed this. From a total of 30 Ss observing three male and three female walkers, they obtained a mean correct identification of 63%. Additionally, they suggest a number of interesting insights into potential parameters of difference between male and female walking patterns.

An increase in walking speed was observed in females as well as more arm-swing. According to Koslowski and
Cutting, however, neither of these appear to singularly function for gender recognition. Instead, they believe the salient information to be derived from the body as a whole.

In Barclay, Cutting and Koslowski (1978) and Cutting, Profitt and Koslowski (1978), this idea is developed further. Here they suggest that the whole movement can be described in terms of one specific locus. This point generates the movement of the torso and, more indirectly, the movement of the limbs. Correspondingly, the total movement of the body bears a lawful relation to this locus and can be mathematically described as such. They term this invariant the "center of moment". For Cutting et al., this "center" is located differently in adult males and females, and is the basis for differential perception.

Although Cutting and Koslowski's main concern is with event perception, their analysis also provides an interesting account of adult sex differences in walking. Whether or not it is applicable to infants, however, remains to be seen.

They derive the "center of moment" for adults as an abstract point which is a function of torso length, hip and shoulder width; where straight lines (stress lines) from these four points cross is the location of the "center". This is not to be confused with the centre of gravity which is an alternate point about which all mass is distributed.
Although the two centres can coincide as, for example, in simple moving bodies such as the wheel, in complex movement these points can differ quite considerably as Figure 8.1 illustrates.

![Diagram of centre of gravity and centre of moment for male and female bodies.](image)

**FIGURE 8.1.** Centre of gravity versus centre of moment.

As shoulders in males tend to be slightly wider than hips, and the reverse for females, the locale of the "center of moment" will be lower in males than it is for females. Centre of gravity, on the other hand, tends to be lower for females as there is greater mass in the thighs.
For Cutting et al., as the "center of moment" is the point from which the movement of the torso and limbs is derived, it is sufficient to describe the differential movement of the adult males and females. Indeed, Cutting (1978) bases a computer simulation of males and females walking on this concept. Using the criterion of viewer recognition, the program appears, to all intents and purposes, to be successful.

On considering infants, however, matters would appear to be a little different. With adults, sex differences in body proportions such as the shoulder:hip ratio, are clear and unambiguous. Infants, on the other hand, are less available to anatomical differentiation. A review of the available literature on sex differences in infant proportions produced little in the way of grossly differing features.

At birth, boys tend to be bigger than girls on all body measurements (Thompson, 1954). Yet girls grow faster and at all times are nearer to their final mature status than boys (Tanner, 1970). One well-documented difference is on the relatively longer forearm of boys, which remains constant throughout the lifespan (Thompson, 1954; Sinclair, 1969). A further, slightly mysterious invariant is the relatively longer female index finger, which is often nearly the same length or longer than the ring finger (Sinclair, 1969). In males, the ring finger is consistently longer.
Unfortunately, many of the differences cited are derived from child rather than infant studies. These include the female advantage in size of thigh from three years (Thompson, 1954), and the relatively longer legs of females (Davenport, 1944). As these are not mentioned as infant characteristics, they will not be considered any further here.

On Cutting's analysis, the relevant structural differences, which are the basis for differential "centers of moment" are differing shoulder:hip ratios. From the literature, these do not appear to be evident in infancy.

The shoulder-hip width dimorphism has long been used as a measure of bodily androgyne, that is, of the degree to which a male resembles a female and vice-versa .... Before puberty little discrimination is possible; separation increases as puberty progresses. (Tanner, 1970, p.102)

Also, Krogman (1962) points out the difficulty of classifying pre-pubertal skeletons on gender.

In fact, the only distinct pelvic difference is width of pelvic inlet, which is located at the bottom of the bony pelvis. Somewhat remarkably, females at birth already have a wider inlet - a feature obviously related to child-bearing.

In infancy .... boys are larger in measurements relating to the overall structure of the pelvis while girls tend to be either absolutely or relatively larger in measurements relating to the inner structure of the pelvis including inlet. (Thompson, 1954, p.304)

A further difference in infancy noted by Davenport (1944) is on the distribution of the gluteal mass. Of the
infants sampled here, girls appeared to have a slight increase of mass relative to stature, over boys. Davenport himself considers this may be an artefact of sampling and, further, that this difference does not become properly evident until puberty.

Overall, there seems little to suggest that there is little, if any, correspondence between adult and infant structural differences. This would make Cutting's analysis inapplicable to infants and Cutting himself would agree with this. In a personal communication he states:

I have fiddled with various parameters [of the program] changing limb lengths to be appropriate for infants and the algorithm simply does not look like an infant. Lurchiness is not captured at all. (1981)

As well as Cutting et al., two other workers predicate structural differences for sex differences in adult movement. For Runeson and Frykholm (1982a,b), the information which enables perception of gender in movement is a direct product of anatomical and physiological features. Again, this would suggest that this analysis is not available to infants.

Runeson and Frykholm (1982a) replicated Koslowski and Cutting's experiment on gender recognition of adults with patch-light displays. Their results demonstrated an increase in mean correct identification, from 63% (obtained by Koslowski and Cutting) to 75%. They attribute this improvement to their improvement in approximation to real
life conditions. Unlike Koslowski and Cutting, who used only side-views of their actors and also matched their actors for height and weight, Runeson and Frykholm did not control for size, used displays of actors moving in depth and, additionally, directed their actors to engage in a variety of activities such as lifting weights, interact with others and so on.

To them, their obtained increase in recognition supported their hypothesis that the information relevant for gender identification is derived from kinematic properties, which in turn are determined by the "laws of mechanics and the structure of human anatomy and physiology" (1982a, p.14).

One slightly puzzling point in their interpretation, however, is to do with the results they derived from child actors. In addition to ten adult actors, they used ten child actors (aged 11-12 years). Rather to Runeson and Frykholm's surprise, correct recognition for both groups was the same. As they themselves point out, the pre-pubertal skeleton does not carry the differing characteristics of adults. They then go on to suggest that the only real difference between children and adults is one of length and state that "obviously, length has not been a cue for gender identification" (1982a, p.29). In other words, while setting up a theory of structurally-based movement differences, they ignore the challenge posed by their results on gender recognition of pre-adolescent
children.

Leaving this aside for the moment, the important contention of both Cutting et al. and Runeson and Frykholm is that gender-differentiated movement in adults is ultimately a function of gender-specific structural differences. In light of little in the way of gross corresponding structural differences for infants, it seems unlikely that either of the two above accounts could have any application to infancy.

INFANT GENDER DIFFERENCES IN MOVEMENT

One thing is clear, if, as the previous experiments indicate, there are gender differences in infant movement, a major question is whether they bear any formal similarity to adult gender differences. If they do, then they would appear to be functioning in the absence of any corresponding structural differences.

In an attempt to investigate for differing features, the films of infants walking were subject here to frame-by-frame analysis. As mentioned in Chapter 4, a total of seven girls and eight boys had been originally filmed. Of these, only four (two boys and two girls) had been used for experimental presentation.
The latter selection had been made according to subjective notions of "femininity" and "masculinity". The first boy and girl pair (Pair A) were considered to exemplify feminine and masculine features respectively. Pair B were selected as they appeared to demonstrate features more common to the opposite-sex. It was hypothesized that, if the criteria had any validity for infants, then Pair A would elicit same-sex preference, unlike Pair B.

Tentative support for this was obtained in Experiment 2, although any interpretation of this is problematic. This is because the constraints of cost made it impossible to control for order-effects so that Pair B was always seen last. The lack of same-sex preference to Pair B, therefore, may be a result of order-effects and not because the infant actors lacked the gender-appropriate features.

In view of this, it was decided to use the entire pool of infant walkers in the present investigation for broad, differing features between the walking patterns of boy and girl infants. In the analysis outlined later in the chapter, Pairs A and B are marked throughout, and a comparison of these infants relative to the entire pool will be discussed at the end.
Without doubt, the development of locomotion is exceedingly complex, involving a delicate interplay between the brain, the body and the environment. According to the literature, the evidence is that much of the structures for walking are present at birth. Neonates, when adequately supported, can display an early type of walking behaviour. McGraw (1943) describes the features of this:

Usually the neck is flexed so that the chin is held near the chest; the upper extremities are flexed at the elbow and adducted toward the midline of the body; and there is marked flexion at the two major foci in the lower extremities. The manner in which the feet may be in contact with the underlying surface is variable: sometimes the side of the foot touches the surface; sometimes only the toes; and sometimes the entire sole. Ordinarily there is little space for the feet, which are usually in juxtaposition or even crossed. (p.76)

According to McGraw, this activity reaches a peak in the first few weeks of life, and thereafter by a few months has disappeared altogether. Others dispute this, claiming that exercise can maintain this behaviour in infants. One study demonstrated that exercise can lead to an accelerated appearance of later walking (André-Thomas and St. A. Dargissies, 1952). As Bower (1979) points out, the factor of acceleration suggests that there is a formal connection between neonatal walking and later walking, and that it is not simply a reflex as suggested by McGraw.
It is clear, however, that neonatal walking is only an embryonic form of later walking. Although newborns can demonstrate a certain degree of coordination, only about a third of the body-weight is supported (Forssberg and Wallach, 1980). A vast development in the maintenance of balance and coordination still has to take place.

One major feature of balanced bipedal walking has yet to emerge. This is the heel-toe progression in walking (plantigrade), whereby the back foot is raised on its toes as the heel of the forward foot strikes the surface. As can be seen from McGraw's description, neonatal walking is wholly lacking in this refinement. Trevarthen (1984) states that while:

the fundamental neural program for standing and walking on two feet is present in a newborn and the spinal core of it is largely functional .... calibration of more efficient higher level controls takes a number of years, by a process which presumably involves active growth and differentiation of .... specific parts of the central nervous system. (p.234)

According to McGraw, the next phase is the onset of "independent stepping" which emerges around 9 months.

At this time he holds the upper extremities in extension and abduction; even the fingers are extended; the space between the feet is wide; there is marked flexion at the knees and hips; the legs are lifted high as he steps; and the movements are staccato and isolated. At the beginning of independent locomotion some infants compensate for a lag in equilibratory development by taking a few quick running steps before they topple; others, in whom the balancing mechanism appears to be advanced beyond the propulsive mechanisms, take slow steps with noticeably long
pauses between each forward movement of the foot. The movements of such toddlers are staccato or isolated, and often the child has been observed to swing one whole side of his trunk forward as he steps. In other words, at the beginning of independent locomotion the stepping movements are not 'individuated' from the total body movements. (pp. 80-81)

McGraw notes that the extension of the arms at this stage seems to be for the purpose of anticipating a fall rather than as an aid to balance.

Thereafter, development becomes a process of refinement with coordination improving, the limbs relaxing from exaggerated positions and plantigrade stepping emerging.

Possibly the most important work on the development of locomotion is that of N. Bernstein whose observations to this day inspire research into human movement. His method of study was to film human subjects in motion in order to derive a detailed time-course either of one single movement or several together. This enabled him to identify the various forces functioning at each joint, both externally produced ("reactive") and internally produced ("innervative"). Although much of the discussion on Bernstein is contained in the next chapter, it may be pertinent to record here some of his observations on early locomotion.

According to Bernstein (1967), the total adult inventory of dynamic waves at the joints is only attained
by a long process of development. As late as ten years, the entire structure common to adults is still incomplete.

The first year of walking (which is the period under study here), is called the "innervationally primitive" stage. This is because:

in the first months of the development of his walk we may observe only one pair of independent muscle impulses .... the identical simplest reciprocal pair which .... were believed by physiologists of the last century to explain the entire muscular dynamics of walking in adults. (1984, p.189)

From this, Bernstein deduces that the numerous elements in the adult inventory are related, not to basic coordination or the maintenance of equilibrium, but rather to more refined aspects of coordination. In the first year, balance and displacement have evidently been mastered, but there are many differences in the play of forces at the joints. In other words, the walking patterns of infants differ from adults in terms of fine coordination.

One very interesting feature noted by Bernstein is the lack of divergence between running and walking at this early stage. Unlike later walking, there are no "double-support" periods in the step-cycle (that is, the point at which both feet are on the ground in the shift from left to right foot). Adult running is characterized by the absence of this feature, but for infants, neither in walking or running is this feature present, making it impossible to distinguish between running and walking in the first year of locomotion.
It would appear from the above descriptions that infant locomotion is in many ways quite different phenomenologically from its adult equivalent. Coordination and balance are relatively poor, requiring many years of refinement. The arms are frequently held at exaggerated angles, the legs far apart and often the whole body "reflects" the act of stepping. The overwhelming impression is one of conscious regulation, very different from the careless, automatic adult form which appears to be so easily effected but is in fact, the product of a very long, extremely complex developmental process.
ANALYSIS OF INFANT GAIT

Given that infant gait would appear to differ considerably from adult, nevertheless, the experimental evidence presented here indicates that there may be sex differences even at this early age. To investigate this, the total film sample of seven girls and eight boys (described in Chapter 4) were subject to detailed analysis.

Of particular interest is the question of similarity between infant sex differences in movement and adult. As mentioned earlier, studies of adult sex differences in gait ultimately recourse to structural differences between adult males and females (in particular, the differing shoulder-pelvic ratios). Infants, on the other hand, do not readily display gross structural sex differences. It follows that any sex differences found in infant movement may imply that there is an alternative, non-anatomical basis for gender-specific movement.

In this case, the obvious alternative source is environmental. In theory, there would appear to be two possible sources of environmental influence on movement. One is "shaping", whereby the parent (or significant adult) is assumed to be instrumental in increasing certain behaviours and decreasing others through the processes of positive and negative reinforcement. A second alternative is imitation. It is possible that the patterns of
movement exhibited from an early age are functions of the infant's capacity to imitate those around him. Alternately, it could be that any differences are the result of biomechanical factors as yet unknown, or indeed, are a function of the slight difference already noted such as height, weight, gluteal mass and pelvic outlet.

Method

Subjects

Subjects were eight girls and eight boys (aged between 15 and 18 months), all drawn from a volunteer scheme covering the Edinburgh area. One girl, aged 18 months, was dropped from the sample as she had only just begun to walk and was still exceedingly poor at balance maintenance.

Design

The films were subject to two types of analysis. These were "qualitative" and "quantitative". For the former, the raw films were used. The aim here was analysis of changes measured in space. For the latter, the films were videotaped via a digital timer. This enabled analysis of changes against real time.

Materials

Films: The films were all Kodachrome 40, having been recorded by means of the patch-light technique (see Chapter 4 for a detailed description). As they were originally
intended for the purposes of experimental presentation, they were less than ideal for detailed analyses. This was compounded by the difficulty of coaxing the infants to cross the room in a specified manner, as is so easy with adults.

**Videotape:** The films were transferred onto high-density black and white Sony V60H videotapes. Although the differing speeds of film and video resulted in a certain amount of flicker on the tapes, by boosting the contrast and reducing the brightness on the monitor, this became virtually unnoticeable.

**Equipment:** To analyse the films, a Goko Editor-Viewer (Model GM-5005) was used. This afforded frame-by-frame analysis where required. For one part of the qualitative analysis, tracing-paper was laid over the screen and records taken of relevant frames. This was one means of examining changes in form.

For analysis of the videotapes, they were played on a Sony edit-machine and Sony black-and-white monitor. Real time had been pre-recorded during the transfer from film to video, by means of a Digi-tel electronic timer. This enabled frame-by-frame analysis relative to real time. In all of the results tables, Pair A and Pair B of Experiment 2 are denoted \((A\varphi, A\theta, B\varphi, B\theta)\).
I. QUALITATIVE ANALYSIS

(a) Angle Change

The following was undertaken for the purpose of examining possible parameters of difference between boy and girl infants. It had been noted by E that girls appeared to display greater overall "fluidity" in movement.*

Procedure

To test for this, it was decided to measure the degree of variance exhibited in walking by the limbs and torso. It was predicted that, if girls do in fact display more movement, then they will correspondingly display greater variance in the angles created by the limbs relative to torso and vice-versa. Although this measure is far from ideal, as angles are relative measures and are therefore not strictly available for statistical analysis, it was felt that, at the least, this measure could provide some indication of direction in existing formal differences. This could then be followed up in later analyses.

To measure changes in limbs relative to torso, and vice-versa, each infant was analysed throughout one

* For this insight, I am grateful to Professor C.B. Trevarthen.
EXAMPLE OF "STICK FIGURE" TAKEN FROM GIRL S. IN THE "LEFT-UP" AND "LEFT-FORWARD" POSITIONS
step-cycle. Although this is far from ideal as a sampling technique, the measurements involved were extremely
detailed. A point in each film was selected wherein the
following requirements were satisfied; the infants had
to be close to the camera, and in a position of roughly 45
degrees. In addition, at all times, the lights reflected
from the joints had to be in view.

Having selected a suitable step-cycle, tracing-paper
was laid over the screen to obtain a record of the position
of the reflected dots. Within each step-cycle, seven
discrete stages were decided upon. The first was "left
up" which was when the left foot had just lifted off the
floor. The next was "left forward" where the left leg
had just been brought forward of the stationary right leg.
The third, "left down", ideally should have represented
the double-support position but this is rarely produced in
infant gait (Bernstein, 1967) and more often than not, the
left foot here had not quite attained the supportive
function. The same three components were also defined
for the right foot, finishing with a repetition of the
"left up" position to complete the cycle.

Across these seven components of the step-cycle,
tracings were made of every point of light. These points
were subsequently joined to make "stick figures" from which
the angle measurements were derived.

To measure the relation of arms to torso, the angles
made by the arms relative to the near side of the torso
were calculated. For legs, again the line of shoulder to hip was taken as zero to derive the relative projections of the lower limbs. Occasionally, a leg projected below zero (that is, inwards from the shoulder-hip line), but as it was only ever slight, this was counted as zero. The last two measures were the angles created by the line of shoulder point-to-point relative to the left side, and similarly for hip.

For these six angles (left arm and leg, right arm and leg, shoulder and hip), each infant was scored seven times throughout the entire step-cycle.

Results

Table 8.1 records the range of angles occurring for all six measures across the seven components of the step-cycle. To examine the hypothesis that girls display more flexibility in movement, range of angles occurring across the step-cycle were compared between boys and girls for each of the six measures. It was predicted that girls would score a significantly higher range than boys. This was tested statistically by a series of one-tailed Mann-Whitney U tests. Although this is not strictly speaking correct, as angles are relative rather than absolute measures, it was felt sufficient for the present purposes, namely to explore for any areas of possible formal difference which could be followed up in more detail later.
TABLE 8.1:
RANGE OF ANGLES DERIVED FROM SEVEN COMPONENTS OF THE STEP-CYCLE
(N = 15, 7 girls + 8 boys)

<table>
<thead>
<tr>
<th></th>
<th>Left Arm</th>
<th>Right Arm</th>
<th>Left Leg</th>
<th>Right Leg</th>
<th>Shoulder</th>
<th>Hip</th>
</tr>
</thead>
<tbody>
<tr>
<td>A[‡]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>38</td>
<td>79</td>
<td>30</td>
<td>15</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>9</td>
<td>25</td>
<td>13</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>30</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
<td>26</td>
<td>31</td>
<td>7</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>24</td>
<td>28</td>
<td>64</td>
<td>12</td>
<td>57</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>25</td>
<td>36</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B[‡]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>41</td>
<td>29</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Left Arm</th>
<th>Right Arm</th>
<th>Left Leg</th>
<th>Right Leg</th>
<th>Shoulder</th>
<th>Hip</th>
</tr>
</thead>
<tbody>
<tr>
<td>A[‡]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>28</td>
<td>20</td>
<td>20</td>
<td>18</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>5</td>
<td>17</td>
<td>11</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>10</td>
<td>26</td>
<td>14</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>28</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>20</td>
<td>32</td>
<td>20</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>10</td>
<td>20</td>
<td>14</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>B[‡]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td>10</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>16</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: The above data represent the value obtained after subtracting the smallest angle measured from the largest.
For upper limbs, right-arm angle variance was compared between boys and girls, and similarly left-arm. For the latter, obtained $U = 16.5$, which is non-significant (7 x 8 degrees of freedom). For right-arm, however, $U = 10$, which has a probability of 0.025 on a one-tailed test. In other words, while the change of angle derived from left-arm displacement did not differ significantly between boys and girls, on right-arm, girls demonstrated significantly higher variance than boys.

Lower limb displacement was similarly analysed. Left leg produced a $U$ of 12, which has a $P < 0.05$. Right leg, however, was non-significant, only scoring a $U$ of 25.5. Unlike upper limb displacement where girls' right significantly varies from boys', lower limb angle range varied significantly for left, with girls again demonstrating higher variance.

Taken together, the two results suggest an interesting picture. On both right arm and left leg, girls demonstrate greater change in angle than boys throughout the step-cycle. Although this particular analysis is far from adequate, it is at least likely that greater change in upper limb angles reflect more variable arm-swing, while lower limb change reflects more variable stepping-behaviour. On this analysis then, girls appear to display more varied right arm-swing and left stepping.

This would appear to offer some tentative support for the original hypothesis that girls display overall
flexibility in movement. The suggested asymmetry, however, was not expected. It is not possible from these data to ascertain whether there is any one-to-one correspondence between right arm and left leg stepping. From studies on the biomechanics of human movement, however, walking is frequently described as an alternating cycle of movements, with arms moving in opposition to the legs (for example, Murray, 1967). From this, it is possible that there is a correspondence between the right arm-left leg movements in infant gait.

On shoulder and hip comparisons between boys and girls, no significant differences were found in the derived ranges of angles. Obtained U for shoulder was 19.5 and 23 for hip (P for both > 0.05). This was not in accord with subjective impressions that girls at least moved their hips more than boys. It is possible that measuring extent of angle change in hips and shoulders relative to the left side of the torso is simply not appropriate. One outstanding difficulty here is that movement in the hips and shoulders will necessarily be the zero line from left shoulder through to left hip, and may therefore obscure any real differences.

Table 8.2 summarises the values of U derived from comparing all six measures of angle change between boys and girls.
TABLE 8.2:
RESULTS FROM ONE-TAILED MANN-WHITNEY U TESTS, COMPARING MALE AND FEMALE VARIANCE DERIVED FROM THE SIX MEASURES USED THROUGHOUT THE STEP-CYCLE (SEVEN COMPONENTS)

<table>
<thead>
<tr>
<th>Angle</th>
<th>Obtained U</th>
<th>Probability</th>
<th>Whether significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Arm</td>
<td>16.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Right Arm</td>
<td>10</td>
<td>0.025</td>
<td>Yes</td>
</tr>
<tr>
<td>Left Leg</td>
<td>12</td>
<td>&lt; 0.05</td>
<td>Yes</td>
</tr>
<tr>
<td>Right Leg</td>
<td>21.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Shoulder</td>
<td>19.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Hip</td>
<td>23</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
</tbody>
</table>
TABLE 8.2:
RESULTS FROM ONE-TAILED MANN-WHITNEY U TESTS, COMPARING MALE AND FEMALE VARIANCE DERIVED FROM THE SIX MEASURES USED THROUGHOUT THE STEP-CYCLE (SEVEN COMPONENTS)

<table>
<thead>
<tr>
<th>Angle</th>
<th>Obtained U</th>
<th>Probability</th>
<th>Whether significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Arm</td>
<td>16.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Right Arm</td>
<td>10</td>
<td>0.025</td>
<td>Yes</td>
</tr>
<tr>
<td>Left Leg</td>
<td>12</td>
<td>&lt; 0.05</td>
<td>Yes</td>
</tr>
<tr>
<td>Right Leg</td>
<td>21.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Shoulder</td>
<td>19.5</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
<tr>
<td>Hip</td>
<td>23</td>
<td>&gt; 0.05</td>
<td>No</td>
</tr>
</tbody>
</table>
(b) **Shoulder versus Hip Displacement**

To investigate E's own impression that there was greater hip movement in girls, two independent observers were asked to rate shoulder versus hip displacement by boys and girls. It is well known that adults tend to differ on shoulder-hip movement ratios, with females tending to display greater hip movement and males, shoulder (Cutting and Koslowski, 1978; Runeson and Frykholm, 1982b). As a result of this, it was considered important to examine this possibility in infants. The latter analysis of angle variance had not found any significant differences, but this may have been due to the inadequacy of the measure.

**Procedure**

The measure used here relied entirely on subjective impressions. The two adult observers, one male and one female were independently shown the entire film collection of eight boys and seven girls. They were asked to rate each infant as to whether they displayed either more shoulder movement relative to hip, or more hip movement relative to shoulder. Neither of them were given the gender labels of the infants until they had seen them all (see Table 8.3).
From Table 8.3, it is clear that there is a trend in favour of more hip movement relative to shoulder to be perceived in girls, and more shoulder movement for boys. Of seven girls, four were unanimously rated for hip movement, and two for shoulder. Only one showed conflict of decision, with the male observer rating shoulder and the female rating hip. Of the eight boys, only three are unambiguously assigned on shoulder, and two on hip. For three infants, there is disagreement and one received a "don't know". Clearly, for the boys it was less easy to decide whether there was more shoulder movement or more hip movement. Overall, however, of a total of 16 ratings for the boys, nine favoured shoulder, six favoured hip and one was a "don't know". For the girls, from 14 ratings, nine were for hip and five for shoulder.
This was all in the absence of gender label. E's subjective impression that there was quite a clear difference with more hip movement in girls and more shoulder movement in boys may have been subject to bias as a result of knowing their gender labels. In the absence of this, however, a trend in this direction can still be discerned. On later questioning of the observers, they stated that the relative shoulder-hip movement was rarely pronounced as it can be in adults, although it was usually possible to make a decision. From the results here, then, it seems that there is a trend in the adult direction but it is by no means unambiguous and, indeed, on a sign test, neither the shoulder ratings for boys nor the hip ratings for girls were significant.

(c) Upper Limb Displacement

Procedure

To follow-up the previous indication that there may be greater upper limb displacement (asymmetrical or not) in girls than in boys, again subjective ratings were employed. Over four step-cycles (eight steps) the arm-swing from each infant was rated by both E and an independent observer in the following manner: For every step, both right and left arm were scored on three categories of displacement - forward, back and side. A move from the side to either the forward position or back
### TABLE 8.4:

**SCORING PROCEDURE FOR ARM-SWING**

<table>
<thead>
<tr>
<th>CATEGORY OF DISPLACEMENT</th>
<th>CORRESPONDING VALUE OF DISPLACEMENT OCCURRING WITHIN ONE STEP FOR EITHER RIGHT/LEFT ARM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FORWARD</td>
</tr>
<tr>
<td>1 Move from Forward to Side</td>
<td></td>
</tr>
<tr>
<td>2 Move from Back to Side</td>
<td></td>
</tr>
<tr>
<td>3 Move from Side to Forward</td>
<td>0.5</td>
</tr>
<tr>
<td>4 Move from Side to Back</td>
<td></td>
</tr>
<tr>
<td>5 Remains at Side/Forward/Back position but moves Outwards/Inwards</td>
<td>0.5</td>
</tr>
<tr>
<td>6 Move from Forward to Back</td>
<td></td>
</tr>
<tr>
<td>7 Move from Back to Forward</td>
<td>1</td>
</tr>
<tr>
<td>8 Move from Side through Forward to Side</td>
<td></td>
</tr>
<tr>
<td>9 Move from Side through Back to Side</td>
<td></td>
</tr>
<tr>
<td>10 Move from Side through Back through Side to Forward</td>
<td></td>
</tr>
<tr>
<td>11 Move from Side through Forward through Side to Forward</td>
<td></td>
</tr>
<tr>
<td>12 Remains in Side/Forward/Back position</td>
<td>0</td>
</tr>
</tbody>
</table>
### TABLE 8.5:

**TOTAL VALUES OF ARM-SWING DERIVED FROM FOUR STEP-CYCLES IN SEVEN GIRLS AND EIGHT BOYS**

<table>
<thead>
<tr>
<th>GIRLS (N = 7)</th>
<th>BOYS (N = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
</tr>
<tr>
<td><strong>Aq</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>Bq</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>5</td>
<td>3.5</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
</tr>
</tbody>
</table>
position was counted as 0.5. If the arm, in one step, moved to either the forward or rear and back again, this was counted as 1. If this was completed and included a shift to the opposite position, this was rated as 1.5. If the arm remained in the same position, this scored 0. Occasionally, the arm might remain at the side but move outwards. In this case, a score of 0.5 would be given. Table 8.4 summarizes the scoring procedure for arm-swing. In addition, an example of the derived rating is given in Appendix A.

By this method, a score on the extent of arm-swing was obtained for the left and right arms of both boys and girls. Table 8.5 gives the total scores derived from the seven girls and eight boys. A second observer also rated arm-swing and inter-observer reliability was \( r = 1 \) for direction, \( r = 0.7 \) for magnitude.

Results

To compare girls with boys, again the Mann-Whitney U test was used. Following on from the findings derived from angle change, it was predicted that girls would score higher than boys. This entailed the use of one-tailed tests.

Mean scores of girls' left arms were compared with mean scores of boys' left arm movement, and similarly for right. For left, obtained \( U = 9.5 \) (\( P < 0.025 \)) and for right, \( U = 5.5 \) (\( P < 0.005 \)). Both, therefore, were
significantly different in the predicted direction. That is, girls scored higher for arm movement both on left and right.

Unlike the scores derived from angle variance, both right and left arms in girls appear to have more pronounced displacement than in boys. This discrepancy may, as with shoulder and hip measures, reflect the inadequacy of the earlier measures of angle change. This suggests that there is indeed evidence here of a marked increase in arm movement in girls. To directly compare overall arm-swing (left and right together) from girls against boys, a non-parametric analysis of variance was used (Kruskal-Wallis test). It was predicted that girls would score higher than boys, therefore a one-tailed version was used. Obtained Chi = 11.22, which with 1 d.f. obtained a P < 0.001. From this, it would appear that girls do in fact display more pronounced arm-swing than boys, on both right and left arms.*

Interestingly enough, the two measures of angle change and subjective ratings appear to correspond on one point. Right arm displacement for girls, on both measures, scores higher than left arm movement, suggesting that there is some enhanced "asymmetry" in the upper limb movement of girls. Unfortunately, when right arm is tested against left arm in girls (and in boys), on a Wilcoxon Matched-Pairs Signed-Rank test, neither show any difference of

* I am grateful to the Statistics Department, University of Edinburgh, for their help with this analysis.
significance ($N = 5, T = 2$ for girls and $N = 7, T = 16$ for boys). It remains, however, that while left versus right does not vary significantly for either girls or boys, the right arms of girls differ to a greater extent from boys, than on a left arm comparison. In addition, right versus left in girls is closer to significance than in boys. This suggests that there is at least some degree of increased "asymmetry" in girls in upper limb displacement. The obtained probabilities from the various tests on arm-swing are summarized in Table 8.6.
### TABLE 8.6:

**RESULTS OF STATISTICAL COMPARISON BETWEEN BOYS AND GIRLS FOR ARM-SWING**

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Statistical Test</th>
<th>Obtained P</th>
<th>Whether Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Girls' Left vs Boys' Left</td>
<td>Mann-Whitney U (one-tailed)</td>
<td>P &lt; 0.025</td>
<td>Yes</td>
</tr>
<tr>
<td>2 Girls' Right vs Boys' Right</td>
<td>Mann-Whitney U (one-tailed)</td>
<td>P &lt; 0.005</td>
<td>Yes</td>
</tr>
<tr>
<td>3 Girls' Left vs Girls' Right</td>
<td>Wilcoxon Matched-Pairs Signed-Rank Test (one-tailed)</td>
<td>P &gt; 0.10</td>
<td>No</td>
</tr>
<tr>
<td>4 Boys' Left vs Boys' Right</td>
<td>Wilcoxon Matched-Pairs Signed-Rank Test (one-tailed)</td>
<td>P &gt; 0.10</td>
<td>No</td>
</tr>
<tr>
<td>5 Girls' Right + Left vs Boys' Right + Left</td>
<td>Kruskall-Wallis Test</td>
<td>P &lt; 0.001</td>
<td>Yes</td>
</tr>
</tbody>
</table>
II. QUANTITATIVE ANALYSIS

From this analysis, the videotapes, which included pre-recorded real time were used rather than the films.

(a) Time to Step

Procedure

To examine for differences in stepping-behaviour, 25 step-cycles were timed from each infant. As real time was too fast for accurate measurement, the tapes were slowed to frame-by-frame speed as the pre-recorded timing still enabled measurement in real time. Table 8.7 gives the mean time to step. Here, inter-observer reliability was $r = 0.8$.

**TABLE 8.7: MEAN TIMES TO STEP (in seconds)**

<table>
<thead>
<tr>
<th></th>
<th>GIRLS (N = 7)</th>
<th></th>
<th>BOYS (N = 8)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>AQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.28</td>
<td>0.29</td>
<td>AØ</td>
<td>0.27</td>
</tr>
<tr>
<td>2</td>
<td>0.32</td>
<td>0.36</td>
<td>0.31</td>
<td>0.34</td>
</tr>
<tr>
<td>BØ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.28</td>
<td>0.27</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>4</td>
<td>0.34</td>
<td>0.28</td>
<td>0.42</td>
<td>0.48</td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>0.29</td>
<td>BØ</td>
<td>0.26</td>
</tr>
<tr>
<td>6</td>
<td>0.31</td>
<td>0.36</td>
<td>0.33</td>
<td>0.28</td>
</tr>
<tr>
<td>7</td>
<td>0.25</td>
<td>0.28</td>
<td>0.31</td>
<td>0.3</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0.28</td>
<td></td>
<td>0.26</td>
</tr>
</tbody>
</table>
Results

From straightforward observation of the above data, it is clear that there are no striking differences in mean times to step either between boys and girls, or between right and left. This was confirmed by statistical analysis. Using two-tailed Mann-Whitney U tests, mean time to step from boys was compared with girls, and no significant difference was found. Table 8.8 summarizes the statistical results.

TABLE 8.8:
RESULTS OF STATISTICAL COMPARISON ON MEAN TIME TO STEP BETWEEN BOYS AND GIRLS (derived from 25 step-cycles)

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Statistical Test</th>
<th>Obtained Value</th>
<th>Sig.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Girls' Left</strong></td>
<td>Mann-Whitney U test (two-tailed)</td>
<td>U = 27.5</td>
<td>No</td>
</tr>
<tr>
<td>vs <strong>Boys' Left</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>Girls' Right</strong></td>
<td>Mann-Whitney U test (two-tailed)</td>
<td>U = 24</td>
<td>No</td>
</tr>
<tr>
<td>vs <strong>Boys' Right</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. <strong>Girls' Left + Right</strong> vs <strong>Boys' Left + Right</strong></td>
<td>Mann-Whitney U test (two-tailed)</td>
<td>U = 101.5</td>
<td>No</td>
</tr>
<tr>
<td>4. <strong>Girls' Left</strong></td>
<td>Wilcoxon Matched-Pairs Signed-Rank test (one-tailed)</td>
<td>T = 10</td>
<td>No</td>
</tr>
<tr>
<td>vs <strong>Girls' Right</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. <strong>Boys' Left</strong></td>
<td>Wilcoxon Matched-Pairs Signed-Rank test (two-tailed)</td>
<td>T = 17</td>
<td>No</td>
</tr>
<tr>
<td>vs <strong>Boys' Right</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Whether or not significant.
The last two tests were conducted to see if any "asymmetry" existed between right and left stepping-times. In the analysis of angle change, there had been an indication that girls' left-hand steps were more variable. For this reason, a one-tailed test was used for girls, but not for boys. However, there is a possibility that use of means here is too insensitive in that summing may obscure real differences, and indeed, no differences of significance were observed here. As an alternative, it was decided to subtract right-step from left-step within every step-cycle. Sign of difference was ignored as it was unimportant for the present purposes to note direction of difference; rather what was important was magnitude. If girls were taking more variable steps, then the differences between right and left steps would be further from zero than boys. Sign of difference, therefore, was ignored. Table 8.9 gives the total differences obtained by subtracting right-step from left-step from 25 step-cycles in each infant.*

From the means, no striking difference in values of "asymmetry" emerges. Both are virtually equidistant from zero. This was statistically confirmed on an F-Test comparing boys with girls. Obtained F = 1.92 which with 1-13 degrees of freedom is non-significant. However, on

* I am grateful to the Statistics Department, University of Edinburgh, for their help with this analysis.
a Mann-Whitney U test, obtained \( U = 14.5 \) which almost attains significance at alpha level 0.05 on a one-tailed test (significance is 13). This suggests that there is a trend toward a larger discrepancy in female right-left steps, as was originally indicated in the analysis of angle change.

**TABLE 8.9:**

<table>
<thead>
<tr>
<th></th>
<th>Girls (N = 7)</th>
<th>Boys (N = 8 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( A_{\varphi} )</td>
<td>( A_{\sigma} )</td>
</tr>
<tr>
<td>1.</td>
<td>2.7</td>
<td>2.4</td>
</tr>
<tr>
<td>2.</td>
<td>3</td>
<td>2.1</td>
</tr>
<tr>
<td>3.</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>4.</td>
<td>3.2</td>
<td>1.4</td>
</tr>
<tr>
<td>5.</td>
<td>2.8</td>
<td>2.7</td>
</tr>
<tr>
<td>6.</td>
<td>1.9</td>
<td>2.6</td>
</tr>
<tr>
<td>7.</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td>18.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Mean</td>
<td>2.6</td>
<td>2.21</td>
</tr>
</tbody>
</table>
(b) Stepping Frequency

One well-documented adult difference is that females tend to take smaller steps than males (Molen et al., 1972). Testing this from the films, however, was far from simple due to the difficulty of obtaining a distance constant from a non-existent background. One alternative is to examine time to step as indicative of size of step, but as the preceding section showed, there is no significant difference between overall stepping mean times to step. Time also requires a distance constant, however, as the same time to step may cover a variety of distances.

Procedure

As one means of overcoming this problem, it was decided to impose a slightly ad hoc constant and allow for some margin of error. During the infants' run across the floor from their mothers to E, there was a high incidence of toy use. The mother often gave the infant a toy to take to the experimenter and vice-versa, and this is quite clear to perceive on the films. As both the mother and E were in fixed positions (both kneeling on cushions with the mothers always in the far corner of the room), it was decided to demarcate a constant by using a run from each infant which began with an obvious toy receipt from the mother, and ended with the infant coming right to the camera where E was. Of course, this is not ideal. Error could occur if, for
example, the mother had leant forward to give the toy over. Any gross change, however, would be quite easy to perceive as the camera also was in a fixed position.

Results

Having established such a point for each infant, number of steps to cross the room was counted and checked by an independent observer \( r = 0.75 \). Only one boy failed to yield any obvious points of mother interaction. For the others, it was quite frequent as the most effective means of getting the infant to cross the floor was to give him toys to give over. Table 8.10 gives the total number of steps obtained from seven boys and seven girls crossing at least approximately the same distance.

**TABLE 8.10:**

**FREQUENCY OF STEPS DERIVED FROM ONE TRAVERSE FROM MOTHER TO EXPERIMENTER**

<table>
<thead>
<tr>
<th></th>
<th>Girls ((N = 7))</th>
<th>Boys ((N = 7))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AQ 13</td>
<td>AQ 15</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>BQ 14</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>Be 14</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Mean</td>
<td>15.7</td>
<td>13</td>
</tr>
</tbody>
</table>
As predicted, girls did in fact take significantly more steps to cross the floor than boys. On a one-tailed Mann-Whitney U test, obtained $U = 5$ which with $7 \times 7$ degrees of freedom is significant at alpha level 0.01. From frequency measures, therefore, it would at least appear likely that girls do take smaller steps than boys as they take significantly more steps to cross (roughly) the same distance. This result is compatible with findings on adults, where women tend to take smaller steps than men.

(c) Speed of Walking

Procedure

The other sex difference in adult walking noted by Molen et al. (1972) was in speed. Adult males tend to walk faster than adult females. To test for this in infants, the same chosen points in the films used to calculate frequency of stepping were used to measure speed. Table 8.11 gives the derived times to cross the same distance from seven boys and seven girls. Here, inter-observer reliability was $r = 0.8$.

Results

Comparing the obtained times again on a Mann-Whitney U test, $U = 12.5$, which just misses significance at alpha level 0.05 for a one-tailed test, it is not possible to
reject the null hypothesis here that boys and girls walk at approximately the same speed.

**TABLE 8.11:**

**TIME (IN SECONDS) TAKEN TO CROSS THE SAME DISTANCE**

<table>
<thead>
<tr>
<th></th>
<th>Girls (N = 7)</th>
<th>Boys (N = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aφ</td>
<td>Ac</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>3.3</td>
</tr>
<tr>
<td>2.</td>
<td>6.1</td>
<td>4.6</td>
</tr>
<tr>
<td>3.</td>
<td>Bφ</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>3.9</td>
<td>2.9</td>
</tr>
<tr>
<td>5.</td>
<td>4.8</td>
<td>4.4</td>
</tr>
<tr>
<td>6.</td>
<td>8.8</td>
<td>Bφ</td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>3.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>
GENERAL DISCUSSION

Taken all together, the results of the analysis on gender differences in infant movement have demonstrated some areas of significance. A major question here is whether they display any correspondence to adult differences or whether they are unique to infants.

The first analysis was on angle variance. The original aim here was to explore for any differences in limb movement and/or shoulder-pelvic relative movement. It had been noted that girls appeared to display an overall increase in "flexibility". From this it was predicted that girls would produce greater change in angles created by the limbs relative to the torso and by the horizontal lines across the torso relative to the left side—throughout the course of the step-cycle.

The rather surprising result was obtained wherein girls displayed significantly higher right arm variance than boys and higher left leg variance. This appeared to partly confirm the original hypothesis (based on subjective impressions) that girls tend to be less rigid in their movements. In addition, it also suggests that girls might display an enhanced "asymmetry" of limb displacement in gait.

It is generally accepted that there is a functional correspondence between opposing upper and lower limb displacement, with the torso acting like a flat spring,
where the upper region moves with the arms and the lower with the legs. For every step forward, there is a corresponding displacement of the opposing arm which helps to throw the centre of gravity forward in preparation for the next step (Inman, 1966).

The result here would appear to reflect this correspondence with girls exhibiting a significantly larger range of angles both from the right arm and left leg. Why there is a sex difference in this direction is not absolutely clear. As far as can be ascertained from the literature, there is no known difference like this in adults. Compounding any interpretation of these results, the use of angle measures is far from adequate, partly because angles are a relative rather than absolute measure and are therefore not readily available for statistical analysis.

To follow through the analysis begun by angle change, several other measures were taken. The second was a subjective rating by two independent observers on the movement from the shoulders relative to the hips. Although no difference of any significance was found from measuring angle change in the shoulders and hips, this may have been due to the inadequacy of the analysis. In adults certainly it is well known that there tends to be more hip movement relative to the shoulder in females and vice-versa for males.

The results demonstrated that, as with adults, females tend to display more hip movement relative to shoulder, and
males more shoulder movement relative to hip (although with the latter there was more inter-rater disagreement). The results were not significant on a sign-test, but there was a trend in this direction.

It is possible that the enhanced "asymmetry" in girls is related to greater hip movement and may actually occur in adults. As far as can be ascertained, however, it has not been studied. The most interesting point in the shoulder-hip ratings is that, if there is a differing shoulder-pelvic ratio as there clearly is in adults, in the absence of skeletal dimorphism, how does it arise? This will be considered in more detail in the following chapter.

The next area of analysis was subjective ratings of arm-swing. The results demonstrated quite clearly that girls swing their arms more in gait than boys. Comparing right and left displacement both together between girls and boys was significant at alpha level 0.001. Right versus right obtained a $P < 0.005$ and left versus left obtained a $P < 0.025$. In addition, as right arm produced a higher value of significance, this at least suggests that there may well be some bias toward right arm-swing in the girls tested here. Direct comparison of right versus left within gender groups, however, did not produce any significance, although girls were closer to significance than boys. Taken together, the two results from angle change and arm-swing ratings may be at least a tentative indication of right-arm bias which may at least be interesting to follow
up in the future, both in infancy and adulthood.

There is some correspondence between the present results on arm-swing and those from adults. It was noted by Koslowski and Cutting (1978) that their adult female Ss tended to swing their arms more than males, although they did not find that it contributed significantly to gender recognition. The important point here is whether increased arm displacement in females arises out of biomechanical necessity, or whether it is the result of socialization. Given that infants do not display the physical differences of adults, it is tempting to suggest that it is the outcome of the latter.

The next area for analysis was stepping-behaviour. A total of 25 step-cycles from each infant were measured against time. To test for asymmetry in stepping, right was subtracted from left within each step-cycle. By ignoring sign, a value of "asymmetry" was calculated for each infant. The underlying assumption here is that the greater the mismatch between right and left stepping, the further from zero will be the obtained value. It was predicted that girls, as indicated from the measure of angle change, would show a larger value than boys. On a Mann-Whitney U test, this just missed significance.

Certainly it is possible from this to suggest that there is a trend for girls to show a greater discrepancy between right and left stepping. Perhaps an increase in
sample size would yield significance as infants at this age tend to display overall greater inconsistency in stepping rhythm (Bernstein, 1967). Again, the suggestion here is that the angle change measures were reflecting a genuine increase in asymmetry in girls. Although it was not significant, it is extremely close and it is worth at least considering for future research, both in infants and adults.

A further noted gender difference in adult stepping is that females tend to take smaller steps than males (Molen et al., 1972). To test this in the infants here, the number of steps taken by girl infants were statistically compared with the number of steps taken by boy infants. The result supported the hypothesis that girls tend to take more steps to cross the same distance, suggesting that again, as with adults, females do take smaller steps. In Molen et al., smaller steps in adults are assumed to be a function of shorter leg length in females. However, this is not the case in infants. In fact, there is an indication that, at least in childhood, girls have longer legs relative to stature than boys (Davenport, 1944). If this is true, then the case for biomechanical necessity is considerably weakened for this particular area of difference.

Another difference in adult gait noted by the same authors was speed, although it is interesting to note that this contradicts an observation by Koslowski and Cutting (1978) that women, in fact, walk faster than men. Here, over the same distances used for measuring frequency of
steps, time to cross was also calculated. The obtained result just missed significance \((U = 12.5, \text{d.f.} = 7 \times 7)\), suggesting that there may well be some difference in speed between boys and girls, although more rigorous testing is required. In light of the contradictory findings on adults, it is impossible to state whether the indicated trend here corresponds to an adult difference or not.

In summary, the results here suggest, at least tentatively, that there is some correspondence between adult and infant differences in movement. The most significant result was on arm-swing, with girl infants displaying a considerable increase on boys, both for right and left arms. This has also been noted in female adults.

Hip movement relative to shoulder movement tended to be more readily perceived in girl infants, even in the absence of gender knowledge. Again, there is some correspondence here with adult females, although there is a much greater discrepancy in adulthood. Males tend to display more shoulder movement relative to hip and again there was a corresponding perceived difference (albeit slight) in boy infants.

Step-size, as indicated by stepping frequency, also shows a difference in the adult direction with female infants tending to take more (therefore smaller) steps than males to cross the same distance. Speed did not show up as significant, although any interpreted correspondence
with adults would be difficult as contradictory reports on adults were found in the literature.

The most surprising result was the indication of greater "asymmetry" in infant female limb displacement. From angle change measures, there was a suggestion that right arm and left leg movement in girls showed more variance than in boys. Possible further support for this can be seen in the results from arm-swing, where girls' right against boys' right showed a larger difference than left against left.

Stepping asymmetry was also tested by subtracting right step from left step for 25 step-cycles. The resulting values of "discrepancy" were compared between boys and girls. Although girls displayed slightly higher derived values, the results just missed significance. This at least suggests there is a trend favouring greater discrepancy in stepping rhythm in girls.

Taking them altogether, it seems reasonable to state that there is at least some indication of a certain enhanced "asymmetry" in girl infant gait. No known comparable difference has been found in the literature on adult gait. This could be the result of proper study or more simply, it does not exist. A suggested explanation is that it is a function of enhanced hip movement in females. From descriptions of walking, it is held that there is an opposing correspondence between upper and lower
limb displacement, which can also be seen in bodily torque, with the upper torso moving with the arms and the lower with the legs. It is possible that enhanced movement of one upper limb (right-hand in the girls here) and the opposite lower limb is, in some way, a function of more hip movement. As adult females have noticeably stronger hip swing, it is possible that there is some corresponding asymmetry in limb movement. E did informally question some male and female friends on shoe wear. There was a slight indication from this that females do tend to wear down one heel more than the other, while this was less so in males.

A second alternative is that this asymmetry is unique in infancy and is simply not found in adults. This being the case, the question of origins becomes immediately important. No ready answer can be offered here.

In general, the overall picture from the various analyses carried out here does suggest a certain degree of correspondence with adult gender differences in walking. The theoretical issues this raises will be the focus of the next chapter.
ANALYSIS OF INFANT ACTORS (PAIRS A AND B)

This is the final point to consider. In Experiment 2, a selection of two boy and girl pairs were shown to the infant Ss. While Pair A elicited significantly differentiated looking-behaviour, at least on first-look, Pair B did not. Given that this may have been confounded by order-effects (Pair B was always seen second), it was considered to be important to compare Pairs A and B on the measures selected here.

They were originally selected on subjective criterion of "femininity" and "masculinity". Pair A were felt to exemplify the characteristics of their own gender, while Pair B were selected because they appeared to reflect more features of the opposite-sex. It was felt to be not so important whether or not this was strictly correct, rather the aim of the selection was to represent the total pool of infant walkers as broadly as possible in Experiment 2. Given this, it may be of interest to examine how well Pairs A and B reflect the overall directions of difference found here between boys and girls.

By way of comparison, Pairs A and B were individually examined on the seven measures used here which had indicated some differences of significance. These include the two angle measures, right arm and left leg, shoulder versus pelvic movement ratings, right and left arm-swing,
stepping discrepancy and stepping frequency. Shoulder and hip angle measurements were not used here as they had been non-significant, similarly for speed of walking. Shoulder versus hip movement was used, as a trend favouring males for the former, and females for the latter, had been indicated.

Pair A and Pair B girls were examined on all seven measures to see if they differed from each other in accordance with the overall female group pattern, and similarly for boys. It was predicted that, if E's subjective impressions of "femininity" and "masculinity" had any validity, then Pair A's individual scores would correspond with the group direction of difference from the opposite-sex group, while Pair B's scores would correspond more with the group direction of the opposite-sex.

If Pair A infants differed from their Pair B counterparts in accordance with their group direction of difference from the opposite-sex, they scored a YES, or NO if they did not. Similarly, for Pair B, who scored a YES if they differed from Pair A infants in the direction of the opposite-sex. Table 8.12 summarizes the correspondence with the differences between Pair A and Pair B and the differences between the two groups of boys and girls.

Pair A and B girls differed in the group direction a total of five out of seven measures, while Pair A and B
<table>
<thead>
<tr>
<th>Measure of Sex Difference in Movement</th>
<th>Girls' Group Mean Score</th>
<th>Pair A Girls' Mean Score</th>
<th>Pair B Girls' Mean Score</th>
<th>Whether A+B differ in Predicted Direction</th>
<th>Boys' Group Mean Score</th>
<th>Pair A Boys' Mean Score</th>
<th>Pair B Boys' Mean Score</th>
<th>Whether A+B differ in Predicted Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Arm Angle Variance</td>
<td>33.4°</td>
<td>79°</td>
<td>41°</td>
<td>Yes</td>
<td>14.9°</td>
<td>20°</td>
<td>10°</td>
<td>No</td>
</tr>
<tr>
<td>Left Leg Angle Variance</td>
<td>27.2°</td>
<td>30°</td>
<td>29°</td>
<td>Yes</td>
<td>17.6°</td>
<td>20°</td>
<td>20°</td>
<td>No</td>
</tr>
<tr>
<td>Shoulder vs. Hip Movement</td>
<td>Hip more than Hip</td>
<td>Hip</td>
<td>Shoulder</td>
<td>Yes</td>
<td>Shoulder more than Hip</td>
<td>Shoulder</td>
<td>Hip</td>
<td>Yes</td>
</tr>
<tr>
<td>Arm-Swing Value</td>
<td></td>
<td>a) Left</td>
<td>4.6</td>
<td>8</td>
<td>5.5</td>
<td>Yes</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>5.5</td>
<td>6</td>
<td>5.5</td>
<td>No</td>
<td>2.9</td>
<td>2</td>
</tr>
<tr>
<td>Right vs. Left Stepping Discrepancy</td>
<td>2.6</td>
<td>2.7</td>
<td>1.8</td>
<td>Yes</td>
<td>2.2</td>
<td>2.4</td>
<td>2.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Frequency of Stepping</td>
<td>15.7</td>
<td>13</td>
<td>14</td>
<td>No</td>
<td>13</td>
<td>15</td>
<td>14</td>
<td>No</td>
</tr>
<tr>
<td>Total No. of Correspondences</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
boys differed a total of four out of seven times. Girls differed in the direction of between-group differences on the two angle measures, with A showing more change than B on both right-arm and left-leg angles. On shoulder versus hip, A had been unambiguously rated as showing more hip movement than shoulder, and B, the opposite. For left arm-swing, A showed more, again corresponding to the overall finding that girls demonstrated more arm-swing than boys. For right arm-swing, however, both A and B attained similar values, which did not correspond to the group finding that right arm-swing in girls differed even more than left relative to boys. There was also a greater right versus left discrepancy for Pair A girl relative to Pair B girl; but on stepping frequency, the difference between A and B did not correspond to the finding that girls take more steps.

For boys, no correspondence was found for right-arm and left-leg angle changes. In fact, Pair A boy showed more change of angle than Pair B boy on right-arm, although they both scored the same for left-leg. On shoulder versus hip, A boy was unanimously rated as demonstrating more shoulder movement than hip, and B, the opposite; which is in accordance with overall between group differences. For arm-swing, as predicted, A boy showed less movement here than B boy both for right and left. A boy also showed less right-left stepping discrepancy than B, which again corresponds to the finding that girls show more of a
discrepancy than boys. Finally, frequency of stepping did not seem to vary between A and B boys, as with A and B girls also.

Overall, there is a slight indication that Pair A infants are reasonably representative of their own gender, and Pair B, more of the opposite. From this, one could tentatively suggest that the first-look results from Experiment 2, which demonstrated a trend for opposite-sex preference may have some reference to the areas of gender differences in gait used here. That is, it could be that the Ss were responding to the Pair B infants as if they were members of the opposite-gender category, as had been predicted. However, it must be stressed that any interpretation of the looking results from Pair B must also take into account the possibility of order-effects.

In conclusion, there does seem to be a certain degree of correspondence between E's subjective criteria of "femininity" and "masculinity", and the measures of difference used here. This perhaps is further evidence that there is some similarity between gender differences in infant and adult movement. The issue is continued in the next chapter.
CHAPTER 9

POSSIBLE ORIGINS OF DIFFERENTIAL MOVEMENT IN INFANTS
INTRODUCTION

Given that the results of the preceding analysis, in addition to the results of Experiments 1 and 2, do indicate that there are gender-specific features in infant movement, an important question would be, how do they arise?

As with most developmental issues, the answer appears to divide into two possibilities. Either gender-differentiated movement is a function of innate, biomechanical factors; or it is a function of differential socialization. Naturally, an interactive position of the two would count as a third alternative.

It was a major concern of the last chapter to test for a correspondence between adult and infant gender-specific movement. Overall, there does appear to be a functional similarity. Both girl infants and female adults take smaller steps, have more pronounced arm-swing, and greater hip movement relative to the shoulder. On the other hand, there was no apparent difference in speed of gait in the infants, unlike adults, where males tend to walk faster than females.

For adults, theories which consider the generation of differential movement generally predicate differential biomechanical structure. For infants, alternately, there is no equivalent explanation readily available. In the last chapter's review of the literature on physical
differences in infancy, little of obvious significance was found. For example, on the oft-quoted shoulder-pelvis dimorphism in adults, this does not seem to become apparent until puberty.

The alternative hypothesis of differentiation through socialization, however, requires considerable qualification. There are at least two conceivable sources from the environment. One is "shaping", whereby the significant adults in the infant's world could be reinforcing specific patterns of movement. A second means is imitation, whereby the infant could be emulating others, either parent or peer.

The above, however, are fairly radical alternatives to the prevailing tendency to ascribe differential movement in adults to underlying biomechanical factors. In light of this, it is necessary to consider briefly theories on the relation of structure to function in human movement. It can be safely supposed that, if this is a relation of necessity, then it would not be possible to accept the reality of environmental factors in the generation of infant differential movement.
"DEGREES OF FREEDOM PROBLEM"

A major preoccupation of theories on the generation of movement is what Bernstein (1967/1984) called the "degrees of freedom problem". Despite subsequent elaboration and modification, it is essentially the question of how much constraint on movement exists within the system itself. Or alternately, it can be put as the question of the extent by which movement is a function of structure. If it is clear that there is a necessary relationship between structure and resulting movement, then naturally it would not be possible to consider alternatives to biomechanical differences for differential infant movement. The fact that no striking structural differences between infants have been observed would instead suggest that this is the result of a lack of appropriate research.

Bernstein himself originally formulated the question in terms of the correspondence between innervative impulses and resultant motor activity. Unlike his contemporaries, Bernstein perceived that this could not be a one-to-one relation and that, instead, there are numerous sources of indeterminacy within the motoric process.

By acknowledging the complexity of motor activity, the issue of how control of the process is achieved correspondingly becomes more complex. If, as Bernstein
originally suggested, the process is subject to numerous "degrees of freedom", the question then becomes how does the system cope as efficiently as it does?

To answer this, Bernstein and his followers have assumed that there must be some means of constraint within the system which enables it to master the whole complex process. Today, this is still a major issue for students of human movement, and to outline the available theories would be an unnecessary, not to mention impossible, exercise here. Instead, only those constraints potential for gender-specific movement will be considered here.

The constraints put forward by Bernstein were tentative and undeveloped. Predominantly, he was concerned with constraints within the central nervous system itself. For Bernstein, a major preoccupation was accounting for the accuracy of the delivery at the periphery of the system of the "right impulse at the right moment" (1967, Ch. 3). For this, he proposed agencies within the CNS itself, the function of which is to establish anticipatory regimes within which particular tasks are accomplished.

Since Bernstein, a greater interest has been taken in the possibility of anatomical constraints. Bernstein himself did not deny these, although the following quote is illustrative.

The fact of the presence of a large number of degrees of freedom of movement at the joints, and
more so in the complex kinematic chains found in the make-up of the organism, provides very many conditions for indeterminacy. Among these we may count the impossibility of existence of fixed anatomical antagonists at many joints; the variation in the function of one and the same muscle group at a multiaxial joint in relation to the disposition of the limb segments; the multiplicity of action of muscles .... where they act on more than single joint, and so forth. Amongst anatomical sources we must also mention the fact of multiplicity of innervation of the skeletal muscles, resulting in their convergent motor dependence on a whole series of conduction pathways both in the central and autonomic nervous systems. (1984, p.214)

More recently, however, research has indicated that, to a certain extent, the joints are constrained to move in reference to other joints, forming what is known as "co-ordinative structures" (Easton, 1972; Kugler et al., 1980). Furthermore, through analogy with mechanical devices, such as damped mass-spring systems, some authors have argued (beginning with Fel'dman, 1966a,b) that limb activity arises through initial storage of potential energy in the musculature, which is then released through relaxation to equilibrium "endpoints", as in a mass-spring system.

It emerges that the brain and the muscles do not produce our movements in the sense of commanding and pushing the limbs point-for-point through specific kinematic trajectories .... A more appropriate way to conceptualize is that the "executive" and the muscles set conditions for a movement by activating and tuning certain co-ordinative structures and then let go. The detailed kinematic shape of the movement then unfolds in a mass-spring-like fashion. Thus arises the detailed prominent role of the anatomical make-up in the shaping of our movements. (Runeson and Frykholm, 1982, p.131)
From the above summary, the issue of the determinacy of movement would appear to be answered. However, the mass-spring analogy has not gone unquestioned. There is evidence that there is sometimes monitoring of conditions during motor tasks and further that endpoint control cannot explain many aspects of even simple tasks (see Boylls and Greene, 1984). In other words, there is no general acceptance of the massed-spring analogy, as suggested by Runeson and Frykholm.

That there is some anatomical constraint on movement, however, is generally accepted. What is not clear is the extent to which anatomy determines type of movement, contrary to Runeson and Frykholm's claim. Instead, the degrees of freedom problem is still very much a live issue. As Rozedal (1984) states: "factual knowledge of length-force relations in non-isometric submaximal functioning of muscles is very scarce, and speculative considerations are abundant" (p.283).

In other words, the relation of structure and function in human movement is still a matter of controversy. For the present purposes, the existence of gender-specific movement in infants is by no means readily explained by biomechanical factors. This at least allows for a consideration of environmental factors although the possibility of structural differences can not, and indeed should not, be ignored.
THE CASE FOR ENVIRONMENTAL INFLUENCE

In favour of an environmentalist hypothesis, there are indications that many forms of bodily movement are subject to external influence, and are not entirely a function of given structure in action. In particular, there is the evidence from non-verbal communication (for example, see Argyle, 1982), which demonstrates that intentions are readily communicated through fine posture changes. Additionally, Runeson and Frykholm (1982b) consider the communicative aspect of gender-differentiated movement.

In interaction between the sexes expression may be important because of its communicative function. Emphasis on own sex-typical movements may communicate that the person is aware that an observer attends to him or her, or that the person expects to be treated according to sex role demands. (pp.18-19)

Given the communicative aspect of movement, it is perhaps not unreasonable to consider that the social environment of the infant may exert some influence on type of displayed movement patterns. For example, Trevarthen (1983)*discusses the patterns of interaction between mothers and infants, and notes differential infant-directed patterns of movement by mothers of different cultures.

There is also some evidence with regard to gender-specific motor routines in children which suggest the

reality of cultural influence. One author (Williams, 1983), notes that children from as early as 4 years show differential motor skills, with boys tending to perform better at throwing, catching, running and kicking; while girls are better at hopping, skipping and galloping.

In general, there is a wealth of evidence which suggests that there is a cultural influence on the generation of movement, and indeed may be applicable to gender-differentiated motor-performance. Taken together with the suggested indeterminacy between biomechanical structure and function, it seems at least plausible to consider the role of the environment in the ontogeny of gender-differentiated movement in infants.
Having established that it is at least possible to ask this question of gender-specific movement, the next point is to consider the available explanations in more detail. They can be outlined in the following manner:

Gender differences in infant movement arise from:

(a) structural differences between boy and girl infants which may include as yet unknown factors;

(b) selective imitation by the infants themselves of the appropriate adult or peer model;

(c) differential "shaping" of gender-appropriate movement patterns by significant adults in the infant's world.

Naturally, the above hypothetical processes could assume an interactive influence.

Of them all, the first hypothesis probably achieves the greatest descriptive adequacy. Although no striking differences have been noted for boy and girl infants, there are some indications of a differing shoulder-pelvic ratio, which are probably in preparation for childbirth. In addition, there is a possibility that future research may produce more differences which are as yet unknown.

Of the available differences, as mentioned in the previous chapter, there is some evidence that girls from
birth have a larger pelvic inlet, as well as a slight increase in gluteal mass. Although this is a far cry from the gross differences which emerge during puberty, it would be unwise to rule out these indications in infancy completely. In addition to this, differences in relative height and weight appear to be well documented, with girls overall maintaining a smaller stature relative to boys. It is conceivable that this type of structural difference could lead to a different type of gait, although it does not readily explain factors such as the greater arm-swing noted in girl infants.

The above, of course, is not the domain of psychological testing. It is suggested that one important means of delimiting the range of possible explanations for differential infant movement is to examine the alternative source of the environment. If any evidence for the latter can be found, then this at least suggests that biochemical factors are not the only available source.

A major difficulty facing any attempt to consider the environment in the generation of movement differences is the lack of available data on differential movement patterns. In fact, as far as is known, there is only one study which could be of relevance here. This is an experiment by Dunkeld (1979) on smiling differences in 6-12 week old infants. Here, across four different conditions for eliciting smiles, Dunkeld noted both
qualitative and quantitative differences between the smiles of boy and girl infants. Most interesting of all in this study is the lack of known corresponding differences in facial structure at this age. In this sense, there is a similarity between the indicated differential movement in infants noted by Dunkeld, and those noted here. However, it should, of course, be stressed that smiling is clearly a communicative movement, while more gross forms of bodily movement are less available to such description.

From observations of 14 girls and 10 boys, all aged between 6 and 12 weeks, Dunkeld found that consistent differences emerged in smiling to both mother and a stranger, as well as smiling to dots on a white card, and smiling on detection of contingency. Overall, boy infants tended to smile more frequently and for longer than girls. In addition, boys differed from girls in the form of smiling where generally they tended to smile more intensely than girls. For example, boys tended to curl their mouths more on both sides of the face, and to crinkle their eyes more. A higher incidence of head movement was also noted, with boys throwing their heads back more than girls in the course of a smile, as well as raising the hand to the mouth.

These differences appear to exist in the absence of any corresponding structural differences in boy and girl infants. In an attempt to evaluate the role of imitation
in smiling. Dunkeld also examined the smiles of six blind or visually-impaired infants. Here she found a general lowering of "intensity" in the smiles of these infants. In the blind infants, eye crinkling had all but disappeared, as well as head and eye movements. Alternately, in those infants suffering a severe visual impairment, there was a closer resemblance to normal infant smiling. From this, Dunkeld argues for an effectance of imitation in smiling, as those infants who could see, however slightly, demonstrated a closer approximation to normal smiles.

In this sense, it is possible that there is some corresponding role of imitation in the generation of grosser types of movement by infants, such as walking (arm swing, hip swing, etc.) If this can be shown to be effective in the generation of formal differences in infant smiles, then by analogy, it may also be applicable to other types of movement differences.

It is suggested from the above that there is scope for a possible role of imitation in the generation of formal differences in infant movement. However, in the absence of any further experimentation, this can only be a highly speculative point here. Having discussed imitation, the next potential source for consideration is differential reinforcement. Here, unlike imitation, no relevant studies could be found.
Considered on a priori grounds, as a possible mechanism, shaping appears to be at least feasible. It is not inconceivable that differential movement is the outcome of differential treatment. The real difficulty lies in designing an adequate test for the reality of this in parent-infant interactive patterns.

Here, an obvious source for experimental manipulation are the smiling differences between boys and girls noted by Dunkeld (1979). Although the age gap between the walking infants who served as actors (15-18 months), and the infants observed by Dunkeld (6-12 weeks) is large, the attraction here is over the absence of notable correspondence between the observed differences in movement and existing generative structure. For this reason, it was decided to examine empirically the potential of differential reinforcement for smiling behaviour, as one means of delimiting the role of the environment in the ontogeny of differential movement patterns. An added attraction here is that, if shaping can be shown to be effective at 6 weeks, then at least this may increase the adequacy of reinforcement as a suggested ontogenetic mechanism.

For this, it was decided to use the "deception" paradigm used elsewhere (see Chapter 2) as a test for the efficacy of gender label. That is, the aim is to compare parental response when gender label is altered. If responses differ to the same infants who are labelled
differently, then this is taken as an indication that shaping as a function of perceived gender label is occurring. In this case, the particular behaviour is, of course, smiling in early infancy.

The next chapter is concerned with such a test of the reality of parental shaping in the ontogeny of differential smiling. This, of course, constitutes an exploration of potential generative mechanisms for differential movement, of which at least two others (biomechanical factors and imitation) are also suggested. If differential reinforcement can be shown to exist, this does not rule out the efficacy of the other mechanisms, and indeed, may presuppose interaction between a number of factors.
INTRODUCTION

To investigate for the reality of differential reinforcement for gender-specific infant smiling, it was decided to use a variation of the "deception" paradigm whereby adults are deceived as to the gender of infants, and any resulting differences in their behaviour to the infants are noted. Here the rationale is that, if infant-directed behaviour can be shown to alter as a function of gender-label, then it is assumed that shaping is functional in the ontogeny of differential smiling.

That parental behaviour is in response to gender-label is accepted in many respects. This was discussed in detail in Chapter 2. Additional studies which demonstrate this include one by Rubin, Provenzano and Luria (1974) where parents were asked to describe their newborns only 24 hours after birth. Daughters tended to be characterized as weaker, smaller, prettier, more delicate, inattentive, awkward, softer and finer-featured. Sons, on the other hand, were seen as bigger, stronger, tougher, firmer, better co-ordinated and more alert.

As all of the infants did not differ on length, weight or Apgar scores, the differences in ratings seem to have been entirely a function of expectation presumably derived from stereotyped notions of feminity and masculinity. Often, in fact, expectations can contradict
reality.

There is a greater vulnerability in the male sex than there is in the female sex. There are more conceptions that are male. There are more accidents for young boys than for girls. There are more diseases that kill off boys than girls. Nonetheless the stereotyping related to the male role is that boys are less vulnerable and girls are more vulnerable. This flies in the face of biological reality; nonetheless, the stereotype holds. (Luria commenting, 1980)

From this, it is clear that adult behaviour does alter as a function of perceived gender of infant. In addition, it seems reasonable to accept that much gender-specific differential reinforcement is not consciously directed. For example, in the study by Will, Self and Datan (1976), discussed in Chapter 3, all of the Ss specifically denied that they differentiated between boy and girl infants. In fact, this was contradicted by their subsequent behaviour. Mothers who thought the infant was a boy offered "him" a train, and mothers who thought the same infant was a girl tended to offer a doll.

Further evidence may be seen in the "failure" of the feminist influence to significantly alter stereotyping in children. Some mothers I know have been greatly perplexed to discover that their little girls can actually want pink, frilly dresses and dolls, and that their sons can be even more sexist than their fathers. Despite all their strivings to rear modern boys and girls, stereotyped behaviour is still rife in today's children. One explanation of this could be the reality of differential
treatment arising from differential (and probably subconscious) treatment

It was decided, therefore, to examine for this by presenting film-clips of infant smiles to parents, and examining for any change in perception of these smiles as a function of ascribed gender-label. Here the underlying assumption is that, if change in perception of smiles alters through change of gender-label, then this is evidence that differential treatment is effective in the ontogeny of gender-specific smiling by infants. If there is no change in perception, then this would suggest that shaping is not functional. It should be stressed here, however, that even a positive demonstration of differential treatment does not rule out the effectance of other factors, such as imitation. Indeed, Dunkeld (1979) has already presented evidence for the latter.

For this experimental rationale, two assumptions are necessary. One is that infants do produce a range of smiles in the earliest days which are not necessarily specific to their gender, and the second, that feedback is important for the act of smiling. For the latter, several decades ago (and indeed, quite recently) the contention that the smile is a social response and therefore dependent on others for its appearance in infancy, would have been hotly contested. There have been many attempts to ascribe the origins of the smile to non-social
factors such as contingency detection (Watson, 1977), innate preferences for person-like stimuli such as high-contrast dots (Ahrens, 1954), or more basically, to maintain the presence of people due to their association with relief from discomfort (Bowlby, 1969). More recently, Dunkeld (1979) has shown that smiles to people are formally distinct from smiles for either contingency feedback or high-contrast dots. From this, she suggests that smiling to people is an autonomous activity and is in every sense a proper, social response which is conducted for its own pleasures. That is, it is very likely that others are extremely important for smiling.

The second assumption underlying the present argument is that infants will produce a range of smiles in the earliest days. That is, if shaping is considered to occur, it must be functional in selecting appropriate smiles from inappropriate smiles. There has been some work on the smiles in newborns which has not found any sex differences and may therefore indicate that, in the initial stages at least, infants may well produce a broad range of smiles (Bower and Kujawski, in prep.).

To examine for differential perceptions of smiling, it was decided to show the same film collection of infant smiles to two groups of mothers. One group would be told the correct gender label of all the infants. One group would be deceived. Both of them would be asked to rate
the infants' behaviour according to whether they smiled or not. It was hypothesized that if perception of smiles is as a function of perceived gender, then the two groups' responses would significantly vary. If gender label does not affect perception, then the two groups would act as if they belonged to the same population. Although fathers are known to be more extreme in encouraging stereotyped activity in their children (Maccoby, 1980), it was more convenient to use mothers as subjects here. As a possibility for future research, however, it is believed that it would be extremely interesting to directly compare fathers with mothers on the same experiment. A further interesting variation, of course, would be to use non-parent adults. It was felt for the present purposes, however, that mothers would be more motivated to respond in this experiment.
METHOD

Subjects

All were primiparous mothers \((N = 40)\), half of boys, half of girls, and drawn from a volunteer system covering the Edinburgh area.

Design

Ss were randomly assigned to either the Informed or Misinformed group \((20\ Ss \ in \ each)\). They were all shown the same collection of infant smiles on film, and asked for their ratings of each individual smile according to a prearranged scale. This ranged from "smile" - "wind or practice smile" - "no smile" - "something else".

No mother was told the real purpose of the experiment until it was over. Instead, they were simply told that the aim was to obtain a rating of each infant's behaviour. All of them were cued as to gender by the simple expedient of introducing each infant by name as they appeared on the screen. The Informed group were given the true sex-appropriate name, the Misinformed, a fictional opposite-sex name. Their ratings were subsequently compared for any significant differences.

The possibility of order-effects was balanced by presenting half of each group with a different order of infant appearance from the other half. These were later collapsed for purposes of analysis.
Materials

(a) **Film:** The subjects all viewed a Super-8 mm colour film (Kodak Ektachrome 40) of 22 infants appearing consecutively. The film had been made on a Super-8 mm camera at 18 fps, under normal lighting conditions. It consisted of 11 boys and 11 girls (all aged between 6-12 weeks). The infants had been filmed individually while sitting in an infant chair and interacting with their mothers. All of the mothers had been seated to the right of the infant (just out of sight, to the left of the camera). They were asked to try and get their babies to smile. Most succeeded on the first visit, and if any did not, they were asked to return the following week. By this method, at least one smile was obtained from 22 infants. All of the babies were dressed in white to avoid gender identification by colour cueing.

The obtained film of infants smiling was subsequently edited into 22 consecutive pieces of film per infant, each lasting 15 seconds. The order in which they appeared was as a result of randomization. They were joined by white leader lasting 8 seconds. This was then copied by a professional film laboratory onto one single Super-8 mm film. A second random order of infants was then chosen, and again this was copied onto a single Super-8 mm colour film.

(b) **Criteria:** The original clips of the infants smiling were chosen by E. The functioning criteria were that all
of the infants had to display horizontal and vertical movements of the mouth, as well as some eye crinkle (after Dunkeld, 1979). Here Dunkeld uses the following definition of the smile. It is:

an elongation of the mouth upward and outward, a deepening of the naso-labial folds from the corners of the mouth to the wings of the nose [lines], mouth may be open, wrinkles may form at the outer corners of the eyes as the eyes narrow, and the cheeks may bulge under the eyes.

(Etzel and Gewirtz, 1967)

Naturally, there was a large variation between infants, but all of the chosen clips ultimately met these conditions satisfactorily. The only exception to this were four infants who were in the sample purely as a check on the reliability of the obtained ratings. Two were obvious smilers and two produced no approximation of a smile whatsoever. It was felt that they could be used to spot any Ss who were responding unusually. If an S rated any of the four "anchor" infants incorrectly, then this cast doubt on the reliability of their other Rs and they were dropped from the sample.

Equipment

(a) Projector: The films were projected on a Eumig Super-8 mm projector at 18 fps.

(b) Screen: They were projected onto a frontal-projection screen at a distance of 3 metres.
(c) **Score-sheets:** For each S, E used a separate score-sheet numbered 1-22, with blank beside each number. E also had a note of the first names of every infant in order of appearance, although, for the Misinformed group, these were false names.

**Procedure**

S was made comfortable in a chair just to the left of the projector, facing the screen. E then read out the following instructions: "This is a study on the origins of smiling. A number of people claim that babies' first smiles are in fact not real smiles but are due to something else, for example, wind. You are going to see on the screen a number of babies who are just at the age when real smiles begin to emerge (around 6-12 weeks), and I want to find out which babies (if any) give genuine smiles. After each baby on the film, I'll stop the projector and I'd like you to tell me whether you thought the baby had given either a real smile, a "wind" or "practice" smile, no smile at all or, finally, if you can think of any other way to describe his or her behaviour."

If S was still unsure what to do, an example was given. They were further assured that there was no right or wrong answer, rather that a simple assessment of the infants was all that was required. This sometimes proved necessary where mothers thought that it was they who were being
tested. E also made a point of explaining the real aim of the experiment after it was over and showing S her score-sheet with the recorded responses. In this way, the Ss acted as a reliability check on E's observations.

Having read the instructions, E then switched off the main lights and started the projector. Just before each infant appeared on the screen, they were introduced to S by name as a means of cueing gender without making it obvious. The Informed group were given the correct names and the Misinformed, fictional names.

After each infant had disappeared from the screen, S was asked to state their rating of the infant's behaviour according to the prearranged categories. This was recorded more or less verbatim by E. Initially, the projector was stopped between each shot. As the experiment progressed, however, the 8 second gap of leader tape between each shot often proved to be more than sufficient to obtain a rating. Nevertheless, no attempt was made to rush S.

When finished, as mentioned earlier, E then explained the real purpose of the experiment. No mother had guessed what it was beforehand.

Analysis

The first task was to ascertain whether any Ss had responded unusually to the "anchor" infants. It had been
decided that if any had rated the very obvious "smilers" as not smiling, or the "non-smilers" as smiling, then it was possible that they had not understood what was required, in which case they were dropped from the sample. Only two out of 40 mothers had responded incorrectly, which left a total of 38 Ss.

Before proper analysis, however, it was noticed that a few infants had received very low "smile" ratings. In light of this, it was decided to obtain an overall check on "smileability". The films were shown to 45 psychology undergraduates who were asked to rate the infants as to whether they smiled or not. In addition, they were asked to state believed gender of the infants. Table 10.1 in the Results section displays the obtained ratings from the undergraduates. Of the total of 18 "test" infants, three received no positive ratings at all, and one was only seen to smile by three undergraduates. It was decided, therefore, to drop these infants from the test sample, leaving a total of 14, seven boys and seven girls. The obtained ratings to these infants from the "informed" were subsequently compared with those derived from the "misinformed" group.

Results

Tables 10.1-10.3 present the obtained ratings by 45 psychology undergraduates of the 22 infant smilers.
TABLE 10.1:
RATINGS BY UNDERGRADUATES (N = 45) AS TO WHETHER THE INFANTS WERE SMILING.  (ORDER A OF THE FILM COLLECTION WAS USED).

<table>
<thead>
<tr>
<th>Gender of Infant</th>
<th>Male Undergraduate Ratings (N = 11)</th>
<th>Female Undergraduate Ratings (N=34)</th>
<th>Total Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 1 Boy</td>
<td>9</td>
<td>34</td>
<td>43</td>
</tr>
<tr>
<td>* 2 Girl</td>
<td>9</td>
<td>23</td>
<td>32</td>
</tr>
<tr>
<td>3 Girl</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 Girl</td>
<td>7</td>
<td>13</td>
<td>20</td>
</tr>
<tr>
<td>5 Boy</td>
<td>4</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>6 Girl</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7 Girl</td>
<td>6</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>8 Boy</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9 Girl</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>10 Boy</td>
<td>11</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>11 Boy</td>
<td>3</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>12 Girl</td>
<td>3</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>↑ 13 Girl</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14 Girl</td>
<td>3</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>15 Boy</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>↑ 16 Boy</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>17 Boy</td>
<td>11</td>
<td>32</td>
<td>43</td>
</tr>
<tr>
<td>18 Boy</td>
<td>8</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>19 Boy</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20 Girl</td>
<td>5</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>21 Boy</td>
<td>6</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>22 Girl</td>
<td>5</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

* indicates positive anchors (infants who were broadly smiling).
↑ indicates negative anchors (infants who definitely did not smile).
TABLE 10.2:

NUMBER OF SMILE RATINGS TO 14 REMAINING INFANTS
BY 45 UNDERGRADUATES

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Girl Infants</th>
<th>Boy Infants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>43</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>177</td>
</tr>
</tbody>
</table>
TABLE 10.3:
RATINGS BY UNDERGRADUATES (NON-PARENTS) OF SEX OF SMILING INFANTS *
(includes anchors and non-scored infants)

<table>
<thead>
<tr>
<th>Sex of Infant Model</th>
<th>Males (N = 11)</th>
<th>Females (N = 34)</th>
<th>Both (N = 45)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8 *</td>
<td>19 *</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>24 *</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7 *</td>
<td>22 *</td>
<td>*</td>
</tr>
<tr>
<td>4</td>
<td>9 *</td>
<td>28 *</td>
<td>*</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>19 *</td>
<td>*</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>18 *</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>17 *</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3 *</td>
<td>16 *</td>
<td>*</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>25 *</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>8 *</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>8 *</td>
<td>32 *</td>
<td>*</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>8 *</td>
<td>19 *</td>
<td>*</td>
</tr>
<tr>
<td>18</td>
<td>9 *</td>
<td>22 *</td>
<td>*</td>
</tr>
<tr>
<td>19</td>
<td>8 *</td>
<td>23 *</td>
<td>*</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>9 *</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>5</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>8 *</td>
<td>25 *</td>
<td>*</td>
</tr>
<tr>
<td>% Correct</td>
<td>54.5</td>
<td>53.3</td>
<td>40.9</td>
</tr>
</tbody>
</table>

* Denotes whether rating is correct.
The four infants who were dropped as a result of this were numbers 3, 6, 8 and 15 who all received a score of less than three smile ratings from 45 Ss. The four anchors were also dropped, leaving a total of 14 infants in the sample for analysis. They are henceforth denoted by gender and by order of appearance from above. Table 10.2 clarifies this and includes the total number of smiles rated by the undergraduates. From this, it is clear that in the absence of gender label, more smiles were seen in boys than in girls, suggesting that the sample of infants here contained a slight difference in "smileability" without reference to gender.

The undergraduates were also asked whether the infants were boys or girls, and to note down their answers on a sheet of paper. These were later collected and compared against the real gender of the infants. Table 10.3 gives a breakdown of the obtained ratings. As can be seen, both males and females scored marginally above chance in the correct perception of gender of the infants. Of the 22 infants, 10 were rated correctly by more than 50% of the female undergraduates. When both males and females scored together, only 9 out of 22 infants were correctly labelled by more than 50%. This suggests that correct labelling of gender is not easily achieved.
The next section presents the number of smiles perceived by the two groups of Ss, Informed and Misinformed, for the 14 infant "actors" (Tables 10.4-10.11). Initially, each category is presented individually, followed by the combined scores and statistical results (Tables 10.10 and 10.11).

With regard to Table 10.10, in order to statistically test the effects of mislabelling, the categories of "wind smile", "no smile" and "something else" were collapsed into one broad category of "no smile". On the ratings obtained from the girl models and those obtained from the boy models, 2 x 2 chi-squares were individually performed. Two-tailed tests were used as no specific direction was predicted.

For boys, obtained chi = 7, which on a two-tailed test $P < 0.01$, $> 0.001$. For girls, obtained chi = 3.866 ($P < 0.05$, $> 0.02$).
### TABLE 10.4:

NUMBER OF SMILES PERCEIVED FROM BOTH GROUPS OF Ss, INFORMED AND MISINFORMED (N = 38)

<table>
<thead>
<tr>
<th></th>
<th>GIRLS</th>
<th></th>
<th>BOYS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Informed</td>
<td>Misinformed</td>
<td>Informed</td>
<td>Misinformed</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>14</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>3</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>7</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

### TABLE 10.5:

TOTAL NUMBER OF SMILES PERCEIVED

<table>
<thead>
<tr>
<th></th>
<th>Informed</th>
<th>Misinformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>51</td>
<td>35</td>
</tr>
<tr>
<td>Boys</td>
<td>62</td>
<td>40</td>
</tr>
</tbody>
</table>
**TABLE 10.6:**

NUMBER OF "WIND" SMILES PERCEIVED

<table>
<thead>
<tr>
<th></th>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Informed</td>
<td>Misinformed</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**TABLE 10.7:**

TOTAL NUMBER OF "WIND" SMILES PERCEIVED

<table>
<thead>
<tr>
<th></th>
<th>Informed</th>
<th>Misinformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Boys</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>
TABLE 10.8:
NUMBER OF "NO SMILES" RATED

<table>
<thead>
<tr>
<th>GIRLS</th>
<th>BOYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Informed</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

TABLE 10.9:
TOTAL NUMBER OF "NO SMILES" RATED

<table>
<thead>
<tr>
<th></th>
<th>Informed</th>
<th>Misinformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>52</td>
<td>65</td>
</tr>
<tr>
<td>Boys</td>
<td>46</td>
<td>65</td>
</tr>
</tbody>
</table>
TABLE 10.10:
TOTAL DISTRIBUTION OF RATINGS TO FOUR CATEGORIES: SMILE, "WIND SMILE", "NO SMILE", AND SOMETHING ELSE

<table>
<thead>
<tr>
<th></th>
<th>Smile</th>
<th>Wind Smile</th>
<th>No Smile</th>
<th>Something Else</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>51</td>
<td>21</td>
<td>52</td>
<td>9</td>
</tr>
<tr>
<td>Girls seen as</td>
<td>35</td>
<td>18</td>
<td>65</td>
<td>15</td>
</tr>
<tr>
<td>Boys</td>
<td>62</td>
<td>20</td>
<td>46</td>
<td>5</td>
</tr>
<tr>
<td>Boys seen as</td>
<td>40</td>
<td>15</td>
<td>65</td>
<td>13</td>
</tr>
</tbody>
</table>

TABLE 10.11:

<table>
<thead>
<tr>
<th></th>
<th>Smile</th>
<th>No Smiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td>Boys seen as</td>
<td>40</td>
<td>93</td>
</tr>
<tr>
<td>Girls</td>
<td>51</td>
<td>82</td>
</tr>
<tr>
<td>Girls seen as</td>
<td>35</td>
<td>98</td>
</tr>
</tbody>
</table>
DISCUSSION

The original prediction was, if parental perception of infant smiles is affected by gender label, then there would be a significant difference between the responses from the Informed group and Misinformed group of mothers. If there were none, then the two groups would behave as if drawn from the same population.

From the "smile" versus "no smile" comparison outlined in Table 10.11, it seems that the experimental hypothesis has been confirmed. From boy infants, the probability of the obtained difference in number of smiles noticed between mothers who saw them as boys and mothers who saw them as girls is less than 0.01. From girls, the difference is nearer to chance but still significant (P < 0.05, > 0.02).

As the same infants produce a significantly different number of perceived smiles when their gender is mislabelled, it seems likely that perception of infants' smiles is affected by gender label irrespective of actual behaviour. In other words, as predicted, infant-directed behaviour is altered as a function of gender label, at least in the mothers tested here.

The "no smile" grouping here consisted of the combined ratings of "no smiles", "wind smile" or "something else". The actual direction of difference obtained is of a decrease
in the number of perceived smiles from the Informed to the Misinformed groups. The latter group tended to see more "wind" smiles, no smiles at all, or "something else" (see Table 10.10).

There were no actual predictions as to direction of difference between informed and misinformed groups, although perhaps an ideal outcome, according to the original hypothesis, would have been a correspondence between boys and girls seen as boys; as well as a correspondence between girls and boys seen as girls. That is, if the original hypothesis is taken to an extreme, the predicted outcome might have been that the responses to boys would have mirrored the responses to girls seen as boys, and similarly for girls and boys seen as girls.

This did not occur. When label was correctly given, more boys were perceived to be smiling. When label was incorrect, more smiles were perceived in false girls than in false boys. What would have been expected on an extreme prediction would be that false boys, like real boys, would also score higher on smiles.

The extreme prediction, however, may well be simply too stringent. Boys (and therefore false girls, who were one and the same) may just have been more "smileable" on any reading. This, in fact, is in accord with the undergraduate ratings of the films. Here gender label was not given. As Table 10.2 indicates, of the total
number of smiles perceived in the 14 "test" infants, 7 girls scored a total of 127 smiles from 45 undergraduates. On the other hand, 7 boys scored a total of 177 smiles. As the undergraduates were not told gender, this suggests that the boy infants in this sample were indeed smiling slightly more than the girls.

Returning to the derived results, the extreme prediction that boys and false boys would be perceived relative to girls and false girls respectively may simply be too extreme, in that it fails to take into account the reality of the smiling behaviour in the infants. In fact, the results from the mothers reflect the responses of the undergraduates, where boys tend to be rated higher, regardless of correct, wrong or unknown gender label. Boys seen as boys scored 62 smiles, while girls seen as girls scored only 51 smiles. When boys are seen as girls, 40 smiles were perceived but this was still more than girls seen as boys, who scored only 35 smiles (see Table 10.4).

Ideally perhaps, only infants who scored an equal number of smiles when gender was unknown should have been used for the experiment. By this means, differences as a result of gender label may come out as the extreme prediction. This, however, would be extremely difficult to achieve without large numbers of infants and therefore beyond the scope of the present work.

Having ascertained that direction of obtained difference probably does to a certain degree reflect the
"smileability" of the infants, the next point is to consider what differences do arise as a function of gender label.

That there is a difference is quite clear. To recap, the same boy infants received ratings which differed to a probability of less than 0.01 as a result of gender label. Girl infants, although scoring less, still received differing responses on a probability of less than 0.05. Overall, the change in response through altered perceived gender tended to be, somewhat intriguingly, a drop in the number of smiles noticed from the Informed to the Misinformed group. Boys dropped from 62 to 40, girls from 51 to 35.

Is this, then, the result of gender-specific expectations regarding infant smiling or not? The answer would appear to be in the affirmative as there can be no alternative explanation as to why the Informed group should see more smiles than the Misinformed group. If perception was not altered as a function of gender label, then the responses should be similar, if not the same, depending on whether the sample was large enough.

On this line of reasoning, it is possible that the loss of "smile" ratings from the Misinformed group was a function of uncertainty arising from a violation of gender-specific expectations. That is, if it can be assumed that there are gender-specific expectations for smiling,
then an obvious explanation of the drop in perceived
smiles from the Misinformed group is that mislabelling,
in that it violates such expectations (consciously or not),
will result in confusion and loss of confidence in
judgement of the smile.

It is understood that this hypothesis is perhaps too
speculative on the basis of the present results, but it
is at least compatible with the otherwise unexplainable
obtained difference in ratings between the Informed and
Misinformed groups.

There is one alternative which is not compatible with
the hypothesized existence of gender-specific expectations,
and this is that mislabelling causes violation of know-
ledge of gender-specific smiles which are derived from
experience with infants. In other words, it is possible
to conceive that differential smiling arises from innate
factors and that the mothers in this experiment were
simply demonstrating their awareness of gender-specific
smiling in the lowering of ratings when they were
misinformed.

Against this interpretation, however, it must be
pointed out that all of the mothers in this experiment
were primiparous mothers and to assume that they all had
had the necessary experience of opposite-sex infants to
become aware of gender differences, is simply not tenable.
Half of the mothers in this experiment had infants who
were less than six weeks (N = 20) and just beginning to smile themselves. To obtain the significance of the differences found here, an explanation of this nature presupposes an extensive experience of smiles from infants of both sexes, which simply was not the case in the Ss used here. Furthermore, if such an awareness of gender differences in smiling was possible even with very little experience one would expect a greater degree of conscious awareness than is generally found. All of the mothers here expressed surprise on being told of Dunkeld's results on gender differences in infants' smiles.

Although an explanation of this nature cannot be dismissed outright on the basis of the present results, it lacks the coherence of the original hypothesis of gender-specific expectations. One obvious lack is the dearth of any known physical differences in the facial structure of young infants. In addition, the lack of significantly correct labelling by the undergraduates suggests that gender was not easily discriminated in the infant actors. Although it can be assumed that the mothers would have had more experience of infants than the undergraduates, it can at least be suggested that this result is further support for the contention that the obtained difference in ratings is not the result of structural differences between the infants.

What actually happens to the lost smile ratings can be seen in Table 10.10. In all, the Misinformed group
perceived 38 smiles less than the control group, 16 less for the girls and 22 less for the boys. There was also a drop in the number of "wind" or "practice" smiles perceived, 3 for girls and 5 for boys. For girls, when they are seen as boys, as opposed to being seen as girls, the total drop is 19. For boys, the total drop is 27. For girls, the lost 19 were seen as 13 non-smiles and 6, "something-elses". For boys, the lost 27 were seen as 19 non-smiles and 8 more "something-elses".

Overall, the pattern is one of a lowering in smile and wind smile ratings for both boys seen as girls and girls seen as boys. This is expressed mostly as an increase in non-smile ratings and a few more "something-elses", which included individuated responses such as yawns, "looks sad", "about to cry".

What is particularly interesting about this drop in perceived smiles is how it differs between boys and girls. Although boys seem to be more readily perceived to be smilers even in the absence of known gender label, as indicated by the undergraduates; when boys are seen as girls, there is a greater drop in number of perceived smiles than from girls seen as girls to girls seen as boys. Granted the difference is not over large (27 less for boys as opposed to 19 less for girls), but there is a slight indication that mislabelling for boys does lower the number of smiles perceived more than where there is mislabelling for girls.
Without basing too much on this, it is interesting to compare it with Dunkeld's findings that boys tend to give more expansive smiles, in that they smile more frequently, for a longer duration and usually score higher on qualitative measures such as eye crinkle, mouth opening, head back, tongue protrusion etc. This being the case, it is possible to speculate that, if differential reinforcement does function for the form of the smile, then for boys, it is likely that there would be a tendency of parents to perceive smiles more readily in boys than in girls. In other words, the hypothesis on how differential reinforcement would function in bringing out more expansive smiles in boys might be that there would be a tendency in parents to be more ready to perceive smiles in boys than in girls.

If this is acceptable, then when this is considered alongside the larger decrease in perceived smiles when boys are seen as girls, it becomes possible to speculate whether this is an indication that there is indeed a readiness for parents to see smiles in boy infants as opposed to girl infants. Although, overall, there are still more smiles seen in the boys here regardless of gender, when there is mislabelling, there is a bigger drop in the number of smiles perceived for the boys than for the girls.

In face of the reality of more smiles in boys anyway (as indicated by the undergraduate ratings), the bigger drop in perceived smiles is virtually unexplainable in any
other framework. On the null hypothesis, neither boys nor girls would receive altered ratings as a function of label. On a nativist hypothesis, that lowering was entirely a function of uncertainty arising from knowledge as opposed to expectation of gender-specific smiling, there is nothing here which would predict the outcome that, when boys are seen as girls, this will produce a bigger drop than between girls as girls and girls as boys. Only the hypothesis that there is a tendency in parents to be more open to smiles from boys fits in with the obtained trend.

In other words, that gender-specific expectations regarding infant smiles exist seems to be the only interpretation of all of the above results. Firstly, there is a difference, as predicted, between the two groups' number of perceived smiles. Secondly, that although more smiles are seen overall for the boys from both groups, there is a bigger drop in the number of perceived smiles between boys seen as boys and boys seen as girls, than there is between girls seen as girls and girls seen as boys. It is speculated that, as infant boys tend to be more expansive in their smiling behaviour, it is possible that differential expectations would take the form of a greater readiness to perceive smiles in boys by parents. When this is violated, there is a corresponding larger decrease when boys are seen as girls as opposed to girls seen as boys. Additional support for this may be found in the overall larger number of smiles seen in boy infants even when gender label is not
known. If mislabelling was not violating expectations as is hypothesized, then it appears to be virtually unexplainable why infants who tend to get overall higher ratings for smiles anyway, should produce a greater drop in smiles perceived when there is mislabelling.

To conclude, from this experiment it is considered that evidence has been found here which supports the contention that gender-specific expectations regarding infant smiles exist in mothers, at least. An additional speculation derived from these results is that such expectations may differ along the lines that there is a greater readiness in mothers to perceive smiles in boy infants rather than in girl infants. This would be compatible with Dunkeld's original findings that boys overall tend to smile more frequently and with more gusto than girl infants. In the absence of any available evidence on gender differences in facial structure, it becomes more likely that differential perceptions have a functional role in the emergence of differentiated smiling in 6 to 12 week olds.
GENERAL SUMMARY

In terms of the original aim, which was to explore for the potential of differential treatment in the ontogeny of gender-specific movement, from the above it can at least be suggested that this is one possible mechanism for early gender differences in smiling. If no variations in the perception of smiles had been obtained, then this would have indicated that perceived gender label does not alter infant-directed behaviour.

Having suggested a role for differential reinforcement in differential smiling, the next point is to consider what (if any) implications this may hold for other types of gender-specific movement.

The analysis of the last chapter, and indeed the results of the main experiments of this thesis, indicate that gender differences exist in broader types of infant movement, including walking. However, it is noted that the infants displaying the latter are much older than those displaying smiling differences. In addition, it can be safely said that walking, and other types of total bodily movement, must come under different structures than those for smiling.

All of this last points to caution in extrapolating from this chapter's results to the other obtained results. Yet, as a pointer for future research, it can perhaps be
suggested that there is scope for an examination of the mechanisms derived from the environment which may be functioning for other types of infant movement. At the least, smiling and grosser forms of bodily movement have in common an absence of any substantial corresponding structural differences in the period of infancy.

Having obtained an indication, therefore, that smiling is subject to parental reinforcement, it is always possible that other types of movement are additionally subject to this mechanism. Given the extent and breadth of gender-specific expectations, as well as their indicated early appearance, it seems not unreasonable to consider this as a possibility for other types of movement.

Naturally, other mechanisms such as imitation, or even as yet unknown structural differences may also be functional. It is by no means suggested here that they should be ignored. Instead, what seems to be important is to examine all potential influences.

Given the pertinence of movement discrimination for many aspects of psychological concern, such as communication, it seems correspondingly important to consider the ontogeny of fine movement differences, particularly if they arise so early.

In the next chapter, an overview is given of the results obtained in this thesis on gender-differentiated movement. In particular, this is discussed with regard to the developing concept of self in infancy.
CHAPTER 11

CONCLUSIONS
The points which this thesis has attempted to explore can be summarized as follows:

(a) There are forms of differential movement efficacious in boy and girl infants, as for example, smiling patterns of 6 week olds and grosser forms of bodily movement, at least in the second year of life.

(b) Possible originating mechanisms for differential movement include biomechanical factors, imitation and differential reinforcement.

(c) Infants, by one year, are capable of perceiving other infants specified only as dots of light attached to the main joints.

(d) One year olds are also capable of perceiving differences in movement patterns in that they will preferentially fixate those of the same-sex. It is suggested that this early form of gender identity is a judgement of "move like-self" distinct from "move not like-self".

(a) Differential Movement

Taking each point in turn, for the first, the evidence presented here considered the grosser form of bodily movement of infants in the second year of life (16-18 months). From analyses of both film and video presentations of seven girl and eight boy infants, certain differences in upper body movement and stepping-behaviour
were noted. Girls appeared to effect greater overall arm-swing, both on right and left arm. Also, subjective ratings by independent observers indicated at least a trend favouring more hip relative to shoulder movement in girls, and the reverse in boys (although it was by no means of the order found in the hip-shoulder proportionate movement of adults). Included in the upper body measures was a pilot analysis of angle change created by the limbs and body relative to the camera. Here an indication of "asymmetry" was found in female ranges of angle change throughout the step-cycle. That is, the girl infants here produced significantly greater changes of angles at the right arm and left leg. This asymmetry was continued into the arm-swing ratings, where right arm for girls was more pronounced than left arm (albeit not significantly).

For stepping-behaviour, from quantitative measures of right and left steps, a trend was found which indicated that girl infants have a slight tendency to vary between right and left more so than boy infants. Again, however, this was not significant. Moreover, it was found that girls tend to take more steps to cross approximately the same distance. Although this measure was problematic, partly due to the difficulty of obtaining controlled walking-behaviour from infants and thereby demarcating a constant distance, the derived results did significantly vary between girls and boys. For speed to cross roughly the same distance, however, no significant differences were
found.

Of particular interest here was whether there was any correspondence between the indicated differences here and those noted elsewhere for adults. Altogether, a slight similarity was found. There was an indicated differing shoulder-pelvic movement ratio, although it was by no means as clear as that obtained in adults. Arm-swing has been observed to be more pronounced in adult females, as it was for the girl infants here. Also, step-size tends to be smaller in adult females, and similarly here. In general, it was suggested that there is some correspondence, albeit slight. This last consideration of adult-infant similarity was included as the next section was concerned with possible originating mechanisms of differential movement.

(b) **Ontogenic Mechanisms**

Here, two types of originating mechanisms were considered. One was innately-generated factors in biomechanical structure. The second included the mechanisms of imitation and differential reinforcement, as possibilities arising from the environment of the infant. For the first, a review of the literature produced little in the way of grossly differing features at this age. The most significant noted were slight differences in pelvic structure, which presumably are forerunners of later
different roles in childbearing. Also, a difference in the
distribution of gluteal mass has been noted by one author
(Davenport, 1944). It was considered possible that this
could give rise to the observed differences in infant
movement. However, as these are only slight structural
variations relative to adult proportions, the possibility
of environmental influence was additionally discussed.

Here, the only applicable data were the results
obtained by Dunkeld (1979) on smiling in boy and girl
infants aged between 6 and 12 weeks. Dunkeld, through a
comparison of the smiling-behaviour of blind and sighted
infants, has suggested a possible role of imitation for
patterns of smiling. As a pointer for future research,
this would be an interesting line of enquiry. However,
here, it was decided to investigate the possible role of
differential reinforcement in the ontogeny of differential
smiling. Although this is clearly distinct from grosser
forms of bodily movement, both have in common at least an
absence of any ready basis in structural differences.

To examine for the potential of differential
reinforcement, films of 6-12 week old infants smiling were
presented to a number of mothers. Half were told the
correct gender label of the infants; half were misinformed.
On being asked to rate the smiles, a difference in the
obtained ratings was found between the two groups. As
these were derived from the same infants, it was argued
that this constitutes evidence for the possible efficacy
of differential reinforcement of smiling as a function of gender. That is, as the mothers' responses varied according to whether the infant was perceived as a boy or girl, it is suggested that this indicates the reality of reinforcement for this type of differential movement.

Although extrapolation from the obtained results here for smiling to other forms of differential movement would be unwise, it is suggested that this line of enquiry may prove fruitful if pursued further in the future. Considering the powerful influence of perceived gender on other areas of parental behaviour, including playing (Will, Self and Datan, 1976), speaking and touching (Goldberg and Lewis, 1969), for example, it is perhaps reasonable to suggest that reinforcement for "feminine" and "masculine" types of bodily movement may also be functional. The obtained results from Experiment 5 suggest that this is at least functional for the movement patterns created in smiling.

Having considered the latter section of this thesis and its concern with differential movement patterns as such, the next two points are over the perception of differential movement by other infants.
(c) **Infant Perception of Movement Patterns**

From Experiments 1 and 2, it is suggested that infants appear to be able to perceive the actors specified as patch-light displays. This contradicts associationist models of the development of perception, wherein meaningful perception is held to be derived from a process of learning-by-association. Alternatively, however, Johansson (1973, 1976) effectively demonstrated with patch-light displays of adults presented to adult Ss, that meaningful perception can occur within a fraction of a second. As no chance for prior learning could have taken place, Johansson's experiments constitute strong support for a theory of perception based on spontaneous organization of invariance in the light array.

In a similar vein, both E.J. Gibson and T.G.R. Bower advance developmental theories of perception which predicate an innate capacity to perceive invariance. For example, Bower (1974) argues that development is a process of differentiation whereby the details of the visual world, such as colour, are acquired as opposed to the basics, such as shape and constancy.

It is argued that the present demonstration of infants viewing other infants as patch-light displays is further support for a differentiation theory of perception. It can safely be assumed that infants, even more so than adults, will have little opportunity for prior learning and yet, to
all intents and purposes, they appear to be able to perceive the dots as persons in motion.

(d) **Identification of Same-Sex from Movement**

This is the second point which is concluded from Experiments 1 and 2, namely that infants by one year appear to be able to perceive the moving dots of light as other infants. More specifically, it is argued that Experiments 1 and 2 indicate that one year olds can discriminate differential movement of boy and girl infants, to the extent of identifying those who are of the same gender category and those of the opposite. This is because the infant Ss here preferentially fixated those of the same-sex, at least on first-look.

From similar results of a tendency to fixate same-sex longer, Lewis and Brooks-Gunn (1979) have argued that this indicates an awareness of the concept of gender in infancy, contrary to the established theories of psychoanalytic, social-learning and cognitive-developmental (as outlined by Kohlberg). Instead, Lewis and Brooks(-Gunn) propose that the capacity to fixate same-sex is indicative of an ability to perceive the similarity between self and other infants, at the level of the gender category. Effectively, it appears that infants, at least by one year, have a form of gender identity.
As with Aitken (1977), it is suggested that the results obtained here constitute further support for the contention that there is an awareness of gender in infancy. In both cases, a same-sex preference was obtained (although here, it was only consistently obtained on first-look). As in neither case no ready explanation could be found in side-effects, order-effects, direction of gaze, or model-effects, it is suggested that these results confirm the original contention of Lewis and Brooks(-Gunn) that infants, by one year, have a concept of gender.

The implications of this extend to both developmental theories of gender identity and the development of the self-concept. With regard to the first, a common assumption of all the established theories is a belief in the initial asociality of infants. For these theories, therefore, a concept of gender cannot emerge for a priori reasons until after the period of infancy. Lewis and Brooks(-Gunn), alternately, assume that there is a distinction of the social from birth. In this sense, Lewis and Brooks(-Gunn) have no such difficulty with their suggestion that there is an awareness of gender in infancy. In a similar vein, more recent developmentalists have also argued that the newborn demonstrates a distinction between the social world and the physical world (e.g. Bower, 1979). In light of such evidence, and the present results which confirm Lewis and Brooks(-Gunn), it is suggested here also that a concept of gender appears earlier than was supposed,
that is, in the period of infancy. Furthermore, in line with the cognitive-developmental approach, the present results suggest that gender identity is functional at this age for the peer group, in that infant same-sex preference here was elicited by other infants.

The point of difference between Lewis and Brooks(-Gunn) and the present results emerges over the second class of theories, namely the representation of self and others in infancy (the self-concept). According to Lewis and Brooks(-Gunn), the obtained result of same-sex preference from one year olds is a function of a tendency to preferentially fixate those infants who are "like-self", over those who are "not like-self". This, for Lewis and Brooks(-Gunn), constitutes the basis for their claim that the infants are identifying gender from the experimental presentations of boy and girl infant photographs. That is, identity lies over the relation of self to the infants in the pictures. Essentially, it is initially a judgement, according to Lewis and Brooks(-Gunn), of perceived similarity to self from other infants who share the same gender category. However, for Lewis and Brooks(-Gunn), the representation of self and others which enables the infant judgement of self-similarity takes place at the level of immediate, featural reality. That is, in this theory, same-sex preference is elicited on the basis of cues such as clothes and hair-length. Here, alternately as with
Aitken (1977), it is suggested that other types of information are more effective, in particular, the movement of the infant actors.

It was argued that, as movement constitutes a "higher-order" type of information than featural cues, this suggests that self representation at one year is alternatively of a higher-order nature than is proposed by Lewis and Brooks(-Gunn). The obtained results are in fact more compatible with the model of social development outlined by Bower (1979, 1982). Here, as with the model proposed for development in the world of objects, Bower indicates that development proceeds from an initial, abstract type of representation to a more specified form. As movement information constitutes a higher-order type relative to that of clothes and hair-length, the obtained same-sex preference from Experiments 1 and 2 can be taken as support for this developmental theory of the self-concept. The constructivist position of Lewis and Brooks(-Gunn) would not have predicted the present results.

Further support for the notion that same-sex preference in this instance is as a function of the judgement of "like-self" can be seen in Experiments 3 and 4. Here, younger infants were shown the same films which elicited appropriate preference from the older infants. Unlike the one year olds, the younger age-groups of 8 month olds and 4 month olds respectively did not demonstrate same-sex preference, neither on first-look or total-look.
As one major point of difference between the younger and older infants was on the age of onset of walking, it was considered a likely explanation of the failure of the former group to fixate same-sex, as the actors in the films were themselves walking. As it is suggested that same-sex preference is a judgement of "like-self", the failure of the later experiments to demonstrate this may be explained as a function of the lack of any basis to effect a match between self-as-non-walker (younger infants) and self-as-walker (older infants). In other words, it is proposed that the results from Experiments 3 and 4 can be taken as further support for the contention that same-sex preference here is a judgement of "move like-self".

**REPRESENTATION OF SELF AND OTHERS FROM MOVEMENT**

While Lewis and Brooks (-Gunn) argue for a self-concept in infancy based on featural cues, here it is suggested, after Bower (1982), that self-other representation can also take place at the level of movement and indeed takes precedence over features. Bower argues that movement both antedates featural representation in development, as well as overrides it when there is conflict. In a similar vein, it is suggested that the present results demonstrate that movement information alone is sufficient to demarcate similarity to self for one year olds.
Taken together, it may be pertinent to speculate further on the notion that movement is included in the infant's concept of self. This suggestion is perhaps not as surprising as might be initially supposed. For example, there is by now a wealth of data on imitation in young infants (Meltzoff and Moore, 1977; Dunkeld, 1979; Field, 1982) which clearly indicates the capacity to represent the analogy between transformations of other's body and transformations of own body.

Indeed, a priori, it is possible to state that movement is one of the most salient characteristics which distinguish the world of people (animate) from the world of objects (inanimate). Arguing from the premise that there is an innate distinction between the two entails a capacity to perceive (represent) human movement distinct from object movement. In support of this, one developmentalist (Trevarthen, 1977) has noted differential affective behaviour in young infants on catching sight of a new type of animation as, for example, that of a dog.

In light of this, the claim that infants have the capacity to represent the movement of self and others, and are sensitive to fine differences in movement patterns, may seem more reasonable. Further support for this consideration of movement in the self-concept may be found in the literature on non-verbal communication (e.g. Argyle, 1982). Here, fine differences in postural change are held to be important for the communication of emotion amongst adults.
Again this could be a further indication that a proposed capacity in infants for sensitivity to human movement may be viable.

THE ROLE OF MOVEMENT IN THE DIFFERENTIATION OF SELF AND OTHERS

If it can be supposed that movement is functional in the developing self-concept, it is possible to additionally speculate on the role of movement in the differentiation of self from others. In Chapter 1 theories which propose that a concept of self develops as a process of differentiation were discussed. Across a broad range, this is a common assumption. Notably in later psychoanalytic theory, the role of the other in the development of a notion of self is extensively discussed.

As a speculation, it could be suggested that, given that movement may be functional denoting self, it may also be functional in originating the distinction between self and others. Here, of course, the distinction would be between self-initiated movement and that initiated by another.

Lewis and Brooks (Gunn) propose that the sense of the self (the "I") arises through contingency feedback derived from action in the world. For example, they suggest that
events such as "close eyes - the world becomes black" form the basis of an awareness of the existential self.

The categorial self (the "me") is alternately considered to be derived additionally from featural representation. It forms the basis for the distinction (and perceived similarity) between self and others. In this sense, visual self-recognition is considered to be an important index of the presence of a concept of self in infants. The mirror lacks only the capacity to present features of the self which are apprehended by the other senses, such as hearing and smell.

For Lewis and Brooks(-Gunn), therefore, self is initially distinguished from others at the level of featural representation. However, if movement, both of self and others, is alternately proposed as the basis for self-other distinction, new possibilities become apparent. For instance, certain problems can be discerned with a developmental theory which assumes progress to be in the form of an increasing recognition of the point-for-point correspondence between features of the self and those of another. One problem in particular is over the time-span such a path of development would require. As Merleau-Ponty states:

To understand how the child arrives at assimilating the one (self) to the other, we must rather, suppose that he has other reasons for doing it than reasons of simple detail. If he comes to identify as bodies .... the bodies of himself and the other, this can only be because he
globally identifies them and not because he constructs a point-for-point correspondence .... this (latter) complicated process would seem to be incompatible with the relative precociousness of the perception of others.

(1964, pp.115-116)

For Lewis and Brooks(-Gunn), the problem is overcome by their proposal that sociality is present at birth, although only as a reflex or "primary circular reaction". In keeping with the Piagetian framework which they ultimately adopt, "precocious" perception of others is explained as a reflexive arc, which does not imply any capacity to represent self and others until the age of onset of featural detection.

Thereafter, the mechanisms of contingency detection and featural representation enable the distinction between self and others. However, if it can be supposed that movement can give rise to the perception of self, both distinct and similar to others, then the continuation of Merleau-Ponty's discussion may be appreciated.

The problem comes close to being solved only on condition that certain classical prejudices are renounced. We must abandon the fundamental prejudice according to which the psyche is that which is accessible only to myself and cannot be seen from outside. My "psyche" is not a series of "states of consciousness" that are rigorously closed in on themselves and inaccessible to anyone but me. My consciousness is turned primarily toward the world, turned toward things; it is above all a relation to the world. The other's consciousness as well is chiefly a certain way of comporting himself toward the world. Thus it is in his conduct, in the manner the other deals with the world, that I will be able to discover his consciousness. If I am a consciousness turned toward things, I can meet in things the actions of
another and find in them a meaning, because they are themes of possible activity for my own body.... we do not at first imitate others but rather the actions of others, and we find others at the point of origin of these actions. (1964, pp.116-117)

In other words, it is suggested here (albeit in a highly speculative manner) that the movement of self and others may form the communal basis out of which the representation of self distinct from others may be originally derived. Particularly interesting here is Bower's (1982) use of "empathy" in the tradition of Michotte (1962). For Bower, neonatal imitation is considered to be a form of movement as a function of a lack of distinction between self-initiated action and that of others. For example, the act of mouth opening may, for the newborn, be indistinguished between that performed by the self and that performed by the mother. Instead, according to Bower, abstract description would define the event more generally for the newborn as "a mouth is opened".

Development, in this theory, is essentially a process which enables specification of agent, so that the original description will become "I open my mouth" and "My mother opens her mouth". For the attainment of this, Bower proposes the developmental mechanism of empathic break, or conflict. For Bower (personal communication, 1984) this would probably occur very early in development, certainly within the first few weeks.
In this sense, a case for movement as the mechanism specifying self-distinct-from-others becomes compatible with the earlier proposals of Merleau-Ponty. That is, in Bower's theory, there is an innate identity between self and other, so that transformations of own body and others are indistinguishable ("global identity" in Merleau-Ponty's terms). Conflict in this original identity thereafter is considered to initiate the differentiation of movement performed by self and that performed by another.

To recap, the above consideration of movement in the differentiation of self from others is a tentative proposal that this may constitute the basis by which self is initially distinguished from others (or the means by which "we find others", as Merleau-Ponty puts it). This would be compatible with Bower's use of empathic break as the developmental mechanism for the original representation of self-distinct-from-others.

At the same time, as the differentiation of self from others is a dual concept, whereby self is both distinguished from others and identified with at least some others, it is also suggested here that movement constitutes the basis by which similarity to self is perceived in others, such as those of the same-sex. In other words, knowing the distinction between those who resemble self, and those who do not is equally important for the discovery of self.

In this sense, concepts of self-others which have the greatest "generality", as Bower (in prep.) describes this,
are likely to appear prior to concepts which have less applicability. That is, in the discovery of the similarity and difference between self and others, concepts which can demarcate, for example, half of humanity in relation to self would have the greatest "generality". Concepts, such as "brunette", alternately would only guarantee description of less than half, as there is also "blonde", "redhead", "black".

Here, the most general is clearly gender. We all belong to one of two categories of gender. In this sense, the proposal that gender appears very early in development becomes, on a priori grounds, more reasonable. More importantly here, as movement is considered to be the originating mechanism for the differentiation of self from others, perhaps now, the proposal that movement also gives rise to an early demarcation of self as one or other gender category can be appreciated. In other words, it is suggested that, finding others, or finding the limitations of self originates with the conflict between self-initiated movement and that initiated by another. As "finding others" necessarily entails discovering what self is as well as what self is not, then the proposal of this thesis that gender, one of the most general categories, originates with movement, can perhaps become acceptable.

To conclude, it is suggested that movement constitutes the basis by which self is originally conceptualized. The
findings of this thesis that self may be recognized in same-sex others at the level of movement is considered to be support for a theory which predicates movement as the originating mechanism for the differentiation of self from others.

**GENDER ROLE DEVELOPMENT**

The concern of this thesis was to consider the role of infancy in the development of gender identity. The particular approach adopted here has been that of cognitive-developmental theory, beginning with Piaget and Kohlberg.

Although the main topic has been over the development of a concept of self as specified by the emergence of a concept of gender, it may be pertinent to consider the fuller implications of a cognitive-developmental approach for gender role development. For feminists, a major concern is to discover the origins of the male-domination that pervades many social institutions. In this tradition, many become worried by the frequent tendency of children to demonstrate stereotyped attitudes appropriate to their gender.

For example, it was mentioned in Chapter 10 that some feminists despair when their girls want pink, frilly dresses or when their sons say that only fathers go out to work.
In Experiment 5, an indication of differential reinforcement in the absence of conscious knowledge was found. It was suggested that this may promote stereotyping in children, despite conscious intentions to avoid this.

However, it is also possible to speculate that even less accessible forces may be at work here, within a cognitive-developmental approach. This is because here, the active role of the child in structuring his environment is emphasised. That is, in cognitive-developmental theory, development is a process of transformation of existing structures, through action in the world.

In this tradition, it is at least possible to speculate that also with the acquisition of behaviours specific to the appropriate gender role, the child takes an active role. In this sense, the little girl who demands pink, frilly dresses is perhaps responding less as a function of "indoctrination" by parents, books and television, but rather is maximising her discovery that there are two gender categories, as part of the general process of conceptual development.

In other words, here it is suggested that the contribution of a cognitive-developmental approach to feminist fears regarding the appearance of stereotyping in the attitudes of their offspring, is the proposal that this could simply be a response to developmental demands.
Maximising the difference between the genders (all females wear frilly dresses, all mothers stay at home), could be a necessary process for advancing an understanding of the concept of gender.

Without sounding pessimistic, it is suggested here that the contribution of a cognitive-developmental approach is that "sexist" children are responding less to indoctrination, and more as a function of their own tendency to maximize difference by way of discovering more about themselves in relation to others. In favour of this interpretation, Donehower (1983) has advanced a developmental profile of children's reasoning about the gender role where, in the early stages, there is an acceptance of the group conceptions of gender. Later, according to Donehower, there is a transition (transcendence) to conceptualize gender in accordance with individual preference. Again, here, stereotyped attitudes in younger children is considered a necessary component in the development of a concept of gender.

From the above, it is suggested that the adoption of extreme gender role behaviour by children need not be a source of concern to parents. Instead, as Lewis and Brooks-Gunn (1979) state:

Our energy may be better spent eliminating sex-role behaviours which do injustice to one or another of the sexes instead of trying to eliminate sex-role behaviour entirely. (p.217)

In other words, the major concern should be the presentation
of models to children which demonstrate difference without the implications of social, economic and political domination of males over females.
APPENDIX

SCORED VALUES OF UPPER-LIMB DISPLACEMENT
FROM GIRL INFANT NO. 6
## SCORED VALUES OF UPPER-LIMB DISPLACEMENT FROM GIRL INFANT NO. 6

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