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## CRAWLING ONSET ORGANIZES AFFECTIVE DEVELOPMENT IN INFANCY

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### INTRODUCTION

When an infant begins to crawl, dramatic and unexpected changes take place in the infant's emotional states. In this paper, we will describe recent research that has documented the nature of these changes, highlight the breadth of influence crawling experience has on emotional expression and emotional communication, and sketch some of the processes that may act in concert to bring about these emotional developments.

To date, there is evidence that the changes in the infant's emotional states following the acquisition of crawling skills include :

- The development of wariness of heights
- A dramatic upsurge in the frequency and intensity of both positive and negative emotional states.
- A step-function increase in the communication of anger, both by the child toward the mother, and by the mother toward the child.
- An increase in social referencing by the infant toward the mother.
- A transformation of the manner in which the child demonstrates affection to his/her parents and siblings.
- A heightened increase in the sensitivity of the child to separation from the mother.
- Changes in the mother's style of face-to-face interaction.

Although these changes have not been predicted specifically or convincingly by any extant theories, the findings are quite relevant to contemporary psychoanalytic

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(Mahler, Pine, & Bergman, 1975), ecological (Bronfenbrenner, & Crouter 1983; Gibson, 1979), and functionalist (Campos, Campos, & Barrett, 1989) views of emotion that stress the role of changes in the child's relation of self to environment as a prime mediator of emotional development.

### THE DEVELOPMENT OF WARINESS OF HEIGHTS

Perhaps the most dramatic instance of a pervasive emotional change that follows the onset of crawling is the emergence of fear of heights. Such fears were often thought to be innate or under maturational control because of their undeniable biological adaptive significance: An animal with built-in programs for avoiding falls from heights would be more likely to survive to reproduce its genes. Moreover, early studies of animals and human infants appeared to demonstrate, as biological theories would predict, that avoidance of heights was present from the earliest testing opportunity in a variety of terrestrial animals (Walk & Gibson, 1961).

There were some vexing exceptions to the conclusions emerging from these early studies—exceptions that raised important doubts about the adequacy of the biological theories originally predicting innate wariness of heights. The well-known studies by Held and Hein (1963) using dark-reared kittens constituted the best known of these exceptions. Held and Hein showed that wariness of heights was dependent upon the coordination of vision with active, self-produced, movement. They showed quite clearly that all their dark-reared kittens with visual experience occurring in the context of such active movement avoided the deep side of the cliff. However, the littermates with visual experience coordinated with passive movement in the apparatus showed no wariness of heights, being just as likely to descend onto the deep side of the cliff as to the shallow.

In addition, Walk (1966) described how, contrary to initial expectation, kittens and rabbits underwent a developmental shift from initial lack of avoidance of heights to consistent preference for the shallow side of the visual cliff.

Impressive as the kitten carousel studies were, their theoretical implications were widely ignored. Doubts were raised about the applicability of findings from dark-reared kittens to human infants reared in normal light, and concerns were voiced that passive visual experience possibly *prevented* maintenance of pre-existing height-avoidance skills in the kitten, rather than that active visual experience induced new skills. Moreover, the Walk studies were not designed to show the process by which avoidance of heights developed. As a result, neither the studies by Held and Hein, nor those by Walk were taken as evidence that locomotion facilitates or induces wariness of heights.

However, it is clearly the case that human infants show the onset of wariness of heights only *after* some time crawling. The evidence comes from a variety of interview and experimental studies. The evidence for these studies comes from our collaborative studies at the University of Denver, the University of Virginia, and the University of Illinois. This evidence will now briefly be reviewed:

a) First, mothers report that there is a stage in their infants' development when their babies will fearlessly go over the edge of a sofa, off the top of a staircase, or over the side of a changing table, with no apparent evidence of fear or apparent avoidance

of danger. Subsequently, mothers go on to report, their infants generally become quite fearful of heights, and avoid heights reliably.

b) Experimental studies contrasting infants of the same age who have no locomotor experience, with those who do have locomotor experience, reveal highly significant cardiac accelerations indicative of fear upon being lowered to the deep side of visual cliff by locomotors, but no significant heart rate changes to the same procedure by infants with no locomotor experience of any sort. However, if prelocomotor infants have had the opportunity to obtain self-produced experience moving about in the environment through the use of walker devices, heart rate accelerates in them as well. This last finding, involving a quasi-experimental manipulation of locomotor experience, is important for inferring that it is experience with locomotion that somehow brings about the wariness of heights. *It is important to note that human infants show evidence of good depth perception even prior to the onset of wariness of heights. Contrary to widespread opinion, the visual cliff is not really a direct test of depth perception.*

c) An infant with orthopedic handicap to locomotion showed no evidence of cardiac responses indicative of wariness of heights for the duration of the motoric handicap, but showed fearful accelerations upon being tested several weeks after the onset of locomotion. Although this study is only a case study, it supports the notion that deprivation of locomotor experience is associated with delayed onset of wariness of heights.

d) Both longitudinal and cross-sectional studies of infants called alternately to cross the deep or the shallow sides of the cliff show that infants quite readily descend onto the cliff to reach the mother shortly after the onset of locomotion, but then avoid crossing to her with additional (41 days) of locomotor experience. The designs of this study permitted the manipulation of age of onset of locomotion independent of the manipulation of locomotor experience, and revealed that it was the latter factor, and not age of onset of locomotion, that was associated with onset of wariness of heights.

Taken in conjunction with the superb developmental animal studies of Held, Hein and their co-workers, these findings allow us to conclude that wariness of heights follows the acquisition of crawling. What, then, are the processes that bring these dramatic changes about?

One process significantly accounting for these developments is experience with falls. Indeed, there is evidence that the latencies for infants to cross the deep side are significantly related to falling accidents, as reported by mothers. However, these data proved insufficient to explain all instances of wariness of heights: Some mothers of non-wary infants reported that they had experienced falls, while other mothers of infants who would not descend onto the deep side of the cliff reported that they had experienced no falls that they knew of. Other processes thus need to be proposed to account for the developmental shift. One of these additional process seems to be social referencing, which is defined as the coordination by the child of maternal emotional information with environmental events the child is encountering.

Mothers can profoundly affect their children's behavior by the type of emotion signals they emit in certain contexts. Thus, a child approaching a potentially danger-

ous fall may hear a gasp and a yell from the mother. If the child attends to both the parental emotional expression and the situation he or she is in, the opportunity exists for the child to link the *mother's* emotion to the dangerous context. Observational learning thus precludes the necessity of direct experience of falling. From studies of 12-month-olds in our laboratory, we know that maternal emotional signals can indeed profoundly influence the tendency of a child to cross or not cross a visual cliff. Although no study to date has documented how long-lasting the consequences of social referencing are in infancy, it seems likely that with sufficiently frequent social referencing cues, infant behavior can be more or less permanently affected.

A third possible process has particular appeal to us because it is potentially pervasive and independent of direct experience with falls or near falls. Moreover, unlike the direct experience and the social referencing explanations, the third process can apply to the cats in the kitten carousel. Such cats, of course, have not had the opportunity to fall and hurt themselves, nor was the mother cat in a position to communicate warning signals to the offspring in the kitten carousel. The third explanation, however, applies to all animals who undergo a transition from nonlocomotion to voluntary movement.

This third process is based on a number of assumptions. First, consistent with Gibson's theory, we assume that peripheral optic flow can specify movement of the self in space. (Peripheral optic flow is the process by which a passenger in a stationary train feels himself moving, from seeing an adjacent train moving by the window to one side.) Second, we assume that it is only after experience with self-produced locomotion (when the nose is typically oriented toward the goal of one's locomotion) that such peripheral flow is coordinated systematically with self-movement. Prior to self-produced locomotion, the infant's head and eyes can be totally uncoordinated with the target of movement. Third, we assume that locomotor experience permits the coordination of peripheral optic flow with vestibular stimulation specifying self-movement. Fourth, we assume that when distances are sufficiently great from the self (as on the deep side of the cliff), slight head movements produce little or no peripheral optic flow, and thus a discrepancy is created between visual and vestibular information specifying self-motion. It is this discrepancy that then produces the distressed, fearful, or vertiginous reaction on the part of the viewer of a dropoff.

Current research in our laboratory is attempting to verify the operation of these processes in producing the "affective sting" of the infant's reaction to heights.

#### THE BLOSSOMING OF EMOTIONALITY, ANGER, AND SOCIAL REFERENCING WITH CRAWLING

When an infant begins to crawl, several factors ensure that there be an upsurge of affectivity. We now know that positive and negative affect are closely linked to the goals and strivings of the organism. When a baby makes effortful but successful progress toward the attainment of goal, joy becomes evident; when obstacles to the attainment of the goal prevent progress, anger or frustration ensue; when the obstacles become too great to be overcome despite effort, sadness and goal relinquishment are evident.

Locomotion necessarily results in the generation of a host of new goals, and thus opportunities for success, frustration, and defeat. The more goals the person has, the more these opportunities, and the greater the likelihood of the manifestation of the affects of joy, anger, and sadness.

However, the coordination of events with goals are not the only means by which affects are elicited. Affect can be the outcome of contagious reception of the emotional signals of others. In short, maternal joy can breed joy in the baby; maternal anger can result in infant anger; maternal fear in infant fear; maternal disgust in infant disgust, and so forth.

When an infant begins to locomote, the opportunities for dramatic changes in affective communication from others in the surround become legion. Often, these changes are positive, as when the mother or father beam with pride at the infant's newfound competence. But equally often, the changes become negative, as the parents find themselves necessarily imposing limits on the child's explorations and mobility. To the extent that parental affect increases in frequency and intensity, we would expect, on the basis of the principle of emotional contagion, that the infant would similarly show increases in frequency and intensity of emotional reactions.

One consequence of increased emotional communication from parent to infant is a likely sensitization of the child to look to the parent when the infant encounters a novel object, or one in which the child is uncertain whether to expect the parent to react positively or negatively to his/her exploring that object. We thus feel it is likely that social referencing may increase in the newly-locomoting infant—a possibility already investigated by Bertenthal and Garland in pilot work in the laboratory.

The evidence relevant to evaluating these propositions comes from one of two recent studies. One is a thorough interview study of mothers of 8-month-old infants who were unaware of the purpose of the interview. (Interview questions revolved around developmental milestones typical of 7-9 month old infants, embedded within which were questions that dealt specifically with the onset of locomotion.) The mother's answers were classified into four groups as a function of their infant's locomotor status:

- a. One group was of prelocomotor infants with no walker experience of any sort.
- b. A second group was of prelocomotor infants with 6-weeks of walker experience.
- c. A third group was of locomotor infants with no walker experience.
- d. A fourth group was of locomotor infants with 6-weeks of walker experience.

There were 16 mothers in each of the four groups.

The second is a logitudinal pilot investigation of 3 infants tested weekly until they were locomoting voluntarily for some 6 weeks. Both investigations were conducted by Marcia Fleener and Stephanie Hanko-Sommers, in collaboration with Dr. Rosanne Kermoian and myself.

Both studies provided considerable evidence for the hypothesized increases in positive and negative affect. The pilot longitudinal study revealed changes in both positive and negative affect from the last prelocomotor week of observation, through

five weeks post-locomotion onset. The increases we observed in this study were especially great in the area of positive affect.

The interview study revealed dramatic changes in maternal reports both of the expression of anger by the infant, as well as by the mother toward the infant. The proportion of mothers reporting increases in anger by their infant following onset of locomotion increased from 22% in prelocomotor infants, to 75% in locomotor infants. In addition, the mothers of locomotor infants reported in 90% of the cases that they showed anger expressions to the infants (often for the first time), compared with only 48% of the mothers in the prelocomotor group.

Also as predicted, locomotor infants more frequently were reported to engage in "checking back" to the mother when they encountered novel objects or found themselves in uncertain circumstances. Only 30% of prelocomotor infants engaged in social referencing, whereas 64% of locomotor infants did.

#### OTHER CHANGES IN MOTHER-CHILD INTERACTION

One of the striking findings from the interview study that was not predicted concerned the sensitivity of the child to maternal departures. Apparently, though the child can now locomote and follow the parent, the infant shows a much more likely negative reaction to the mother's departure from the room. 25% of prelocomotor infants were reported by their mothers to show sensitivity (typically crying and fussing) upon leaving the room, whereas 60% of locomotor infants did so. The explanation for this finding is not entirely clear. It is possible that the child's locomotor skills expands his or her effective visual field in the third dimension, such that the child becomes much more sensitive to the comings and goings of others in the surround. It is possible that, as Bowlby and Ainsworth predict, the attachment relation is heightened with the onset of locomotion, resulting in heightened social signaling under conditions of separation. It is also possible that the child becomes sensitive to the need to have the mother emotionally available to respond to social referencing and similar nonverbal communicational bids, and thus the child becomes upset at the loss of a resource. Most likely, all of these factors play a role.

Interestingly, the manner in which the child shows affection changes dramatically with the onset of locomotion. More locomotor children show hugging, kissing, patting, and cuddling than do prelocomotor infants, according to maternal reports. They also seem to be more likely to interact with siblings, pets, and their fathers than heretofore.

A final finding we shall discuss in connection with changes in affectivity related to locomotion onset involves changes in mother-infant face to face interaction. In our interview study, mothers of locomotor infants reported two differential trends. First, they reported an increase in interactions because their locomotor infants were more fun to play with, and were more responsive and interactive. But they also reported a decrease in interactions, because their locomotor infants were more independent—they spent more time exploring.

#### CONCLUSIONS

The onset of locomotion constitutes a time of rapid social and emotional develop-

mental transition. These transitions involve a multiplicity of processes, of affects, and of social encounters. The changes cannot be summarized succinctly. However, it is clear that by changing the child's ecological niche, locomotion changes both the adaptive demands that the environment places on the child, and the types of emotional changes that the child manifests in an attempt to relate to the changing world he finds himself in.

Furthermore, what we have learned from our explorations into the development of the child's emotions is that no single explanation seems to suffice to account for the developmental changes. Rather, we seem to see in every domain we have investigated the operation of a multiplicity of factors, often in concert, and often in opposition. It becomes a challenge to identify the separate processes that enter into the organization of emotional development, and the principle by which these processes come to cohere.

Finally, we see the inadequacy of attempts to link cognitive or organismic factors in isolation to emotional development. From data not cited in this report, we know that the development of single sensorimotor domains does not predict emotional development; nor is maturation sufficient to account for emotional and social change. It will remain for future conceptual and empirical work to understand not only the organization of development, but the many ways by which such organization can come about. For this reason, we forecast that studies of special populations (e. g., the motorically handicapped) may prove particularly valuable to see multiple developmental pathways in operation.

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