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Development of Self-Produced Locomotion in the First Year: Changes in Parent Perceptions and Infant Behaviour

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Self-produced locomotion is regarded as a setting event for other developmental transitions in infancy with important implications for socioemotional development and parent–child interaction. Using an age-held-constant design, this study examined changes in reported infant behaviour and maternal proactive/reactive control and compared them with direct observations of infant and maternal behaviour associated with the development of self-produced locomotion. Maternal reports were obtained prior to the locomotor transition and, for half the sample, after infants had transitioned to effective mobility. Observations of all infants were conducted shortly after the second interview. Prelocomotor and transitioning infants showed none of the expected behavioural differences (e.g. emotionality and compliance) associated with the locomotor transition. There was modest confirmation of expected differences in maternal behaviour, particularly in the use of reactive control techniques, and mothers of transitioning infants showed higher proactive controls *before* their infants began to crawl. These findings suggest that the changes in parent–child interaction associated with the locomotor transition may have as much to do with parental expectations than with changes in infant socioemotional behaviour. Copyright © 2010 John Wiley & Sons, Ltd.

Key words: infancy; transitions; crawling; parent-child relations

Certain developmental milestones are important because they are setting events for a variety of conceptual and socioemotional advances in the child and changes

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in child–environment transactions (Bertenthal & Campos, 1990; Campos *et al*., 2000; Campos, Kermoian, & Zumbahlen, 1992; Herbert, Gross, & Hayne, 2007). In the case of self-produced locomotion, for example, infants become capable of intentionally approaching objects and people of interest and initiating independent exploration. As a consequence, this developmental transition is believed to be associated with a cascade of conceptual changes related to infant–environment relations (such as postural compensation to changes in peripheral optic flow perception, advances in distance perception and increased wariness of heights, and more sophisticated spatial search strategies), including advances in referential communication, means-ends understanding, and social interaction across a distance (Campos *et al*., 2000; Tamis-LeMonda *et al*., 2008).

The development of self-produced locomotion may also be associated with socioemotional changes in the infant and adjustments for the family. Affective changes in the infant may arise from the new emotional reactions associated with independent locomotion, including delight in new forms of self-efficacy, anxiety about the realization of distance from attachment figures, and frustration when goals are blocked. Adjustments for the family system arise from the enhanced activity, proneness to danger, and monitoring required of a newly locomotor infant, causing parents to be more vigilant, prohibitive, and proactive to supervise a mobile child (Ishak, Tamis-LeMonda, & Adolph, 2007; Tamis-LeMonda, Adolph, Dimitropoulou, & Zack, 2007). Parents quickly become aware of these changes in their caregiving responsibilities and, indeed, may anticipate them before independent locomotion has actually developed in offspring.

Viewed in this light, the child's transition from prelocomotor to locomotor status may also be viewed as a setting event for parents because it is associated with changes in adult behaviour that influence their everyday interactions with offspring, perceived responsibilities as parents, and affective experience of parenting. This study was designed to systematically assess, using an age-held-constant research design, changes in maternal experience and perceptions and infant behaviour associated with the development of self-produced locomotion in offspring. This is the first study in which maternal perceptions and direct observations of maternal and infant behaviour were gathered on the same sample and thus could be compared. Owing to the self-report nature of previous work, consistency between parental experiences, parenting behaviours, and infant responses could not be established. The current design enabled us to examine whether parents' reports were consistent with direct observations of child and parent behaviour.

A number of studies have found that the locomotor onset at around 8 months is associated with significant changes in parental reports of their offspring and of their own behaviour. In an initial study, Campos *et al*. (1992) interviewed 64 mothers of locomotor and prelocomotor 8-month-old infants and found that the parents of locomoting infants indicated that they used more verbal prohibitions, had higher expectations for the child's compliance, and used greater disciplinary interventions than reported by the parents of prelocomotor infants. These parents also reported that their offspring not only showed greater sensitivity to the parents' location and emotional signals, including separation anxiety, and exhibited increased expressions of anger and frustration, but also showed more intense affectionate behaviour and greater engagement in interactive play. In short, parents perceived that their responsibilities had changed significantly, along with their affective experience of parenting and the baby's emotional responses to them. These interview responses compared parents of locomoting and prelocomoting infants at a single age, however, and thus did not permit an

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analysis of changes in parental perceptions over time associated with the onset of self-produced locomotion. This was also a study of parental perceptions of infant behaviour in which parental expectations may confound reports of actual behavioural changes in the baby.

Behavioural studies have confirmed some, but not all, of these interview reports. Zumbahlen and Crawley (1996) observed 41 infants and mothers at home at 6 and 8 months, with more than half the infants capable of crawling by the latter observation. They found that the number of prohibitions directed toward infants increased following the onset of locomotion, by which time the mothers of crawling infants more frequently used power assertion, redirection, and negative vocal and facial expressions to regulate infant behaviour compared with the mothers of prelocomotor infants. Crawling infants more frequently checked back with their caregivers and expressed more intense negative affect when prohibited compared with noncrawling infants. But these differences in maternal prohibition and infant frustration are difficult to interpret because crawling and noncrawling infants apparently did not have comparable opportunities to engage in misbehaviour; more specifically, attractive items specifically placed nearby to elicit misbehaviour (and parental prohibition) were out of reach of the prelocomotor infants.

Similarly, in an age-held-constant observational study of 46 families, Biringen, Emde, Campos, and Appelbaum (1995) found that the mothers of walkers praised less and repeated prohibitions more [regarded by the authors as resulting from the child's 'testing of wills' (p. 511) as infants persisted in behaviours prohibited by the parent] than did mothers of prewalkers, although there were no differences in infant emotionality. However, lower amounts of maternal praise were observed for the early walking group even *before* infants began walking, and across both groups there were developmental increases in infant positive emotion, maternal praise, and maternal-repeated prohibitions. It is important to note that this study did not address the transition to self-produced locomotion but rather, for children who were already mobile, the transition from crawling to walking.

Taken together, previous literature suggests that the onset of self-produced locomotion may be an important transition for socioemotional development. The purpose of this study, therefore, was to examine changes in maternal perceptions and infant and parent behaviour accompanying the locomotor transition in a more incisive manner than afforded by earlier research. The current project combined a parental interview with an observation of parent–infant interaction where opportunities for frustration and resistance to maternal control were comparable for infants transitioning to locomotion and those who were not yet mobile.

Two issues were particularly important. First, we sought to directly compare maternal perceptions of changes in child behaviour and emotion with observations of the affective and behavioural reactions of nonlocomoting and 'transitioning' (to locomotion) infants. In this manner, maternal perceptions could be compared with observed infant behaviour. Second, a research design was required in which the onset of self-produced locomotion was not confounded with other maturational changes in the first year to ensure that behavioural changes in the infant were associated with locomotor onset. Campos *et al*. (1992) relied on maternal reports of infant behaviour but did not observe the infants themselves, and interviewed parents when infants were 8 months of age. Half the children were capable of self-produced locomotion and the others were not. Consequently, the results of Campos *et al*. (1992) may have been due to preexisting differences in

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the two groups that were independent of self-produced locomotion. Therefore, the addition of an interview when the children were 6 months of age and none were capable of self-produced locomotion allowed us to establish a baseline of behaviour. The addition of the observation allowed us to confirm parental reports of changes in the infant–adult interaction.

In this study, maternal reports of infant behaviour were obtained when all infants were 6-months old and incapable of locomotion. Maternal reports of behaviour were obtained again at approximately age 8 months when half the sample had achieved locomotor status but age-matched comparison infants had not. Observations of mother–infant interaction were also performed at this time. Based on prior research, we expected that there would be an interaction between time of observation and infant locomotor status. Specifically, we anticipated that the mothers of infants who had achieved self-produced locomotion would show greater proactive and reactive control techniques. Furthermore, the transitioning infants would exhibit less compliance and more negative affect in response to maternal control, and greater separation anxiety.

METHOD

Participants

Forty infants (26 males and 14 females) were recruited by contacting families with 6-month-old infants based on newspaper birth announcements. Only families with children who were not capable of self-produced locomotion were recruited. The sample reflected the ethnic and sociodemographic characteristics of the Mid-western community from which they were recruited. Thirty-nine of the children were Caucasian, and one was Caucasian/Hispanic. All parents were high-school graduates, were married, and over 75% had education beyond high school.

Procedure

Mothers were contacted by phone when infants were 6-months-old to solicit their participation and, if they agreed, to confirm the child's prelocomotor status. Further interview questions followed to assess the child's behaviour and maternal caregiving practices as described below. Subsequently, mothers received a mailed packet of information that included demographic questions that were returned by mail.

Using a matching procedure adapted from Biringen *et al*. (1995), telephone contacts with mothers were carried out biweekly after the initial telephone interview to track infants' locomoting skill development. Specifically, mothers were asked whether their children could now move forward a distance of 3 feet within 30 s under their own power. Infants who were capable of performing this task were placed in the transitioning group ($n = 20$). When a child was identified as transitioning, the child was matched with another child of the same gender who was within 2 weeks of the same age, but who had yet to reach self-produced locomotion. These latter children were considered to be the prelocomotor group ($n = 20$). To ensure age equivalence, age was counterbalanced within the dyads. In half of the dyads, the transitioning child was older and in the other half the prelocomoting child was older. Infants were 187 days of age at the time of the first telephone contact, and 240 days at the time of the lab assessment; there were no significant differences in age between children in each group at each assessment.

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At the lab assessment, the mother was taken to a room with a chair next to a messy desk and piles of papers on the floor for the prohibition task. On the desk surface, various objects attractive to young children were displayed. Mothers were given a questionnaire to complete during this time. While doing so, they were asked to hold their children on their laps to avoid mishaps in the room. A video camera was located approximately 6 feet across the room from the mothers in order to record mother–infant interaction. In this context, the mother's efforts to prevent the child from grabbing objects on the desk within arm's reach, while preoccupied with the questionnaire, were observed. Therefore, the prohibition task was designed to be comparable for transitioning and prelocomotor infants because, contrary to earlier research, infants in each group had equivalent opportunities to reach for the forbidden objects.

Next, the mother and researcher sat on the floor and allowed the infant to play with toys. Initially, the toys were placed 3 feet from the child. Mothers encouraged the children to try to obtain the toys through verbal instructions and by holding the toys just out of the infants' reach. This was done with all infants in the sample to confirm the children's locomotor (in)ability. Subsequently, the toys were given to the children to play with while the mother was interviewed a second time. The same interview protocol initially conducted over the telephone was used. Mothers were debriefed, thanked for participation, and were given a small gift for the child as a token of appreciation for their participation.

Measures

Maternal interview

Mothers were asked a series of questions during the initial telephone contact and during the lab assessment concerning their child's social and emotional behaviour, proactive and reactive prohibition techniques used in the family, and child compliance. Questions were adapted from the interview used by Campos *et al*. (1992), with most questions framed in a yes/no format. Responses to yes/no questions were composited to provide several general indices as described below.

Four interview questions concerned indications of the baby's separation anxiety (e.g. fussing when left with a babysitter; crying when mother leaves the room). 'Yes' responses on these four questions were aggregated to create a summary index, ranging from 0 to 4, with higher scores indicating greater separation anxiety. Mothers were also asked specific questions about their proactive control practices, such as child-proofing strategies. They were asked to indicate whether they used each of seven different practices, such as using cabinet latches, electrical outlet covers, and relocating dangerous objects, and the number of different practices was summed (range 0–7). At each interview, mothers were asked about reactive control approaches they used when the child acted in a prohibited manner. More specifically, they were asked to indicate which, if any, of ten specific practices they used (e.g. saying 'no,' using negative vocal tone, redirecting the child's activity, moving the child away). The number of endorsed control practices was counted (range 0–10). Other questions asked about the extent to which their child engaged in anticipatory checking with the mother (i.e. looking to the mother immediately before acting in a prohibited way) and their judgment of whether their child understood the word 'no.' Finally, questions regarding compliance with maternal prohibitions were included.

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Observational coding

From videotapes of the lab observation, maternal and child behaviour was assessed beginning when the mother started to work on the questionnaire and continuing until she completed the questionnaire or 10 min had elapsed, whichever came first. Time-sampled ratings of maternal control behaviour and infant affect (which included resistance to the mother's efforts) were conducted for consecutive 20-s intervals. Because the length of the observational session varied, frequency measures were converted into proportion scores adjusted by the observation duration. Observational coding was conducted by two independent raters who were blind to the child's locomotor status.

Two kinds of maternal control techniques were coded. First, maternal proactive control was assessed by counting the frequency with which mothers provided an acceptable *alternative object* for the child to play with (such as a toy or a blanket), *interacted* with the child (such as by bouncing or rocking the child), or *talked pleasantly* to the child (such as commenting about a toy the child was playing with). Second, maternal reactive control was assessed by counting the frequency with which mothers *said 'no'* to the child, *restrained* the child's actions (such as by the child away from the desk), *removed objects* from the child's grasp, or *guided hands* away from forbidden objects. An independent recoding of 13 mother–child observations yielded inter-rater reliability coefficients (using Pearson correlations) consistently above 0.83.

For each instance of maternal reactive control, the child's *compliance* was assessed (based on Kochanska & Aksan, 1995). The child's response was identified as committed compliance, partial compliance, or defiance. A child was considered to have complied if the child obeyed the mother. When the mother distracted or redirected the child, for example, the child made no further attempt to touch or play with the objects (Kochanska & Aksan, 1995). Partial compliance was noted when children responded to maternal intervention either with good-natured temporary withdrawal or by ignoring her and continuing to touch the objects (Kochanska & Aksan, 1995). When coding partial compliance, children tended to return to an object within the same 20-s interval or in the succeeding one. Occasionally, a child delayed their return for several minutes but did return to the object within the taping session. Defiance was manifested in resistance, whining, and/or tantrum (Kochanska & Aksan, 1995). The infant did not accept prohibitions. Ratings were corrected to reflect the proportion of intervals in which each type of compliance occurred. Based on an independent recoding of 13 observations, inter-rater reliability (based on Pearson correlation) was above 0.82.

In addition, the child's emotional reactions were coded (based on Kochanska and Aksan, 1995; Gustafson, 1984). The child's predominant emotion for each 20-s interval was coded as either *positive* (exhibiting warm smiles, vocalizing, or laughter, interest in maternal behaviour, quiet play) or *negative* (whining, crying, and physically struggling against restraint). If children did not display one of the behaviours listed within an interval, no response was recorded in that interval. Based on an independent recoding of 34 mother–child observations, inter-rater reliability for positive affect was 0.80, and for negative affect was 0.94. As with the frequency ratings of maternal control techniques, the number of intervals in which each kind of emotion was predominant was counted and divided by the total number of coded intervals to control for variable observational duration.

RESULTS

In the results reported below, analyses of maternal responses to the interview questions conducted during the initial telephone contact and the subsequent lab

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session are reported first, followed by analyses of maternal and child behaviour during the observation. Repeated-measures ANOVAs were used for the interview questions. We were particularly interested in the interaction between locomotor status and time of assessment (i.e. telephone contact or lab) as an indication of changes in maternal behaviour or perceptions of the child as a result of the locomotor transition. ANOVA and MANOVA were used to analyze the observational data, focused on comparisons between dyads with a transitioning child and dyads with a prelocomotor child. Child sex was also a factor in these analyses following prior research (e.g. Biringen *et al*., 1995).

Interview Responses

Proactive control practices

At each interview, mothers estimated the number of different strategies they used to *childproof* the home. Table 1 displays the child-proofing strategies and the number of mothers using them by locomotor status and time. A 2×2 repeated-measures ANOVA with locomotor status as the between factor and time as the within factor was conducted on the number of practices utilized showed significantly greater use of child-proofing in the homes of transitioning infants than prelocomotor infants, $F(1, 38) = 6.86$, $p = 0.013$, and a significant increase in child-proofing from the first assessment to the second assessment, $F(1, 38) = 9.61$, $p = 0.004$. There was no significant interaction between locomotor status and assessment time. During the first interview, mothers of transitioning children reported more child-proofing changes ($M = 2.65$, S.D. = 2.03) than did mothers of prelocomoting children ($M = 1.40$, S.D. = 1.27). At the second interview, there were also more reports of child-proofing by the mothers of transitioning infants ($M = 3.50$, S.D. = 1.70) compared with mothers of prelocomotors ($M = 2.50$, S.D. = 1.63), even though the amount of child-proofing increased over time for both groups.

Reactive control practices

At each interview, mothers were asked to indicate which, if any, of 10 specific control practices they used. Table 2 displays the control practices and the number of mothers utilizing them by child locomotor status and time. A 2×2 repeated-measures ANOVA with locomotor status as the between factor and time as the

Table 1. Numbers of mothers responding 'yes' to child-proofing strategies

Strategy	Time one		Time two	
	Prelocomotor	Transitioning	Prelocomotor	Transitioning
Put away delicate objects	5 (31)	7 (41)	8 (40)	10 (56)
Rearranged furniture	2 (13)	4 (24)	4 (20)	6 (30)
Put bumpers on furniture	1 (6)	1 (6)	1 (5)	1 (5)
Tied up/cut blind strings	4 (27)	6 (43)	8 (42)	8 (47)
Used cabinet latches	1 (6)	7 (44)*	4 (20)	12 (63)*
Used electrical outlet covers	4 (25)	13 (81)*	11 (55)	16 (80)
Clean more often	11 (73)	15 (88)	14 (70)	17 (85)

Values within parenthesis represent percentages.
*$p < 0.05$.

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Table 2. Number of mothers responding 'yes' to use of control practices

Style	Time one		Time two	
	Prelocomotor	Transitioning	Prelocomotor	Transitioning
Use your voice	12 (60)	13 (65)	14 (70)	20 (100)*
Adjust your tone of voice	9 (45)	12 (60)	5 (25)	12 (60)*
Use physical gestures	5 (25)	3 (15)	3 (15)	4 (20)
Use facial expressions	9 (45)	9 (45)	3 (15)	9 (45)*
Move the child	12 (60)	13 (65)	12 (60)	19 (95)*
Move the object	5 (25)	8 (40)	8 (40)	15 (75)*
Distract the child	8 (40)	8 (40)	9 (45)	17 (85)*
Time-out	1 (5)	1 (5)	0 (0)	2 (10)
Slap the child's hands	3 (15)	2 (10)	5 (25)	7 (35)
Spank the child	1 (5)	0 (0)	1 (5)	2 (10)

Note. Each group, locomoting and prelocomoting, contained 20 children. Values within parenthesis represent percentages.
*$p < 0.05$.

within factor, revealed a main effect of locomotor status, $F(1, 38) = 4.21$, $p = 0.047$, together with a significant interaction between locomotor status and time, $F(1, 38) = 5.86$, $p = 0.02$; there was no main effect of time of assessment. At the first interview, mothers of transitioning children reported using more control techniques ($M = 3.45$, S.D. = 2.48) than did mothers of prelocomotor children ($M = 3.25$, S.D. = 2.79). By the second interview, mothers of transitioning children reported a noteworthy increase in control methods used ($M = 5.35$, S.D. = 1.90), whereas mothers of prelocomotor children reported a slight decrease in the number of their control practices ($M = 3.00$, S.D. = 2.41).

For each specific control technique, χ^2 analysis was performed to find which techniques were most often used by mothers. Results showed that at the follow-up interview (but not at the first interview), mothers of transitioning infants were more likely to use verbal control, $\chi^2(1, N = 40) = 7.06$, $p < 0.01$. All mothers of transitioning children reported using their voice (e.g. saying 'no,' giving instructions) as a form of control compared with 70% of the mothers of prelocomoting children. In addition, mothers of transitioning infants were significantly more likely to use a negative vocal tone, $\chi^2(1, N = 40) = 5.01$, $p = 0.025$, cautionary facial expression, $\chi^2(1, N = 40) = 4.29$, $p = 0.038$, physically moving the child from the scene, $\chi^2(1, N = 40) = 7.03$, $p = 0.008$, moving a forbidden object away, $\chi^2(1, N = 40) = 5.01$, $p = 0.025$, and distraction, $\chi^2(1, N = 40) = 7.03$, $p = 0.008$, than were mothers of prelocomotor infants.

The efficacy of these strategies might be associated with the child's response to misbehaviour or anticipated misbehaviour. To explore this, mothers were asked whether their children looked at them prior to engaging in a forbidden activity. There was no association between anticipatory checking with the mother and the child's locomotor status at the first interview. However, χ^2 analysis revealed a significant association at the second interview, $\chi^2(1, N = 37) = 14.30$, $p < 0.001$. Three mothers (17.6%) of prelocomoting infants and 16 mothers (80%) of transitioning infants responded by saying their child looked at them prior to enacting a forbidden activity. In a similar fashion, there were no differences by locomotor status at the first interview in maternal reports that their child understood the word 'no.' By the second interview, however, χ^2 analyses revealed a significant association with locomotor status, $\chi^2(1, N = 39) = 5.77$, $p = 0.016$, with

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five mothers (25%) of prelocomoting children indicating that their child understood 'no' while 12 mothers (63%) of transitioning children responded this way. There were, however, no differences by locomotor group in maternal responses to an interview question concerning the child's compliance with maternal prohibitions.

Finally, indications of separation anxiety as reported by the mother on the interviews were assessed. A 2×2 repeated-measures ANOVA using locomotor status as the between factor and time as the within factor revealed a main effect of time, $F(1, 38) = 5.47$, $p = 0.025$, with infants perceived as showing more separation anxiety at the second interview ($M = 1.95$, S.D. = 1.08) than the first ($M = 1.48$, S.D. = 1.04). There was no main effect of locomotor group, however, and no interaction between locomotion status and time.

Observational Measures

Maternal proactive and reactive control

To assess the differences between mothers of transitioning and prelocomotor infants in their use of proactive control during the observational session, a 2 (locomotor group) $\times$ 3 (proactive approach) MANOVA was used to analyze proactive control approaches. There were no significant differences in maternal proactive behaviour to transitioning and prelocomoting infants. Although rates of proactive control were slightly higher by the mothers of transitioning infants, they were generally low for both groups. Mothers of both groups were most likely to interact with their child (Transitioning $M = 0.56$, S.D. = 0.10; Prelocomotor $M = 0.42$, S.D. = 0.10), followed by talking (Transitioning $M = 0.49$, S.D. = 0.10; Prelocomotor $M = 0.41$, S.D. = 0.09) and providing an alternative object (Transitioning $M = 0.16$, S.D. = 0.04; Prelocomotor $M = 0.12$, S.D. = 0.04).

A second 2 (locomotor group) $\times$ 4 (reactive approach) MANOVA was used to analyze group differences in reactive control approaches. This revealed a significant locomotor group difference, $F(4, 30) = 3.82$, $p = 0.013$. Planned comparisons conducted on each of the reactive control measures revealed one group difference for maternal use of the word 'no,' $t(33) = 3.10$, $p = 0.004$. Mothers told transitioning children 'no' significantly more often ($M = 0.06$, S.D. = 0.06) than they prohibited prelocomoting children in this way ($M = 0.02$, S.D. = 0.03), although rates were low for both groups. Although there were no other group differences, mothers of transitioning infants were most likely to use restraint ($M = 0.24$, S.D. = 0.19), followed by hand guidance ($M = 0.14$, S.D. = 0.21), and object removal ($M = 0.12$, S.D. = 0.08). Mothers of prelocomotors were most likely to use restraint ($M = 0.37$, S.D. = 0.36), followed by object removal ($M = 0.13$, S.D. = 0.14), and hand guidance ($M = 0.06$, S.D. = 0.11).

Child compliance and emotional reactions

Children predominantly responded with partial compliance to maternal reactive control efforts. Table 3 presents means and standard deviations for the observational measures of child compliance. A 2 (locomotor status) $\times$ 2 (gender) $\times$ 3 (compliance status) MANOVA revealed no differences by locomotor group or child sex, but there was an interaction between locomotor status and child sex, $F(3, 29) = 3.56$, $p = 0.026$. Among transitioning infants, girls were more compliant than boys, but the reverse was true of prelocomoting infants. However, none of the follow-up univariate tests identified a significant sex $\times$ locomotor status interaction, and on only one measure was there a significant main effect: prelocomoting

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Table 3. Means and standard deviations for observed compliance measures

Group	Compliance categories		
	Committed	Partial	Defiance
Transitioning			
Boys	0.03 (0.03)	0.46 (0.30)	0.00 (0.00)
Girls	0.02 (0.04)	0.31 (0.25)	0.02 (0.04)
Prelocomotors			
Boys	0.01 (0.02)	0.36 (0.28)	0.08 (0.11)
Girls	0.02 (0.02)	0.63 (0.47)	0.04 (0.08)

children ($M = 0.07$, S.D. = 0.10) were more defiant than transitioning children ($M = 0.01$, S.D. = 0.03), $F(1, 33) = 4.87$, $p = 0.034$. There were no significant differences between transitioning and prelocomotor infants in their positive or negative emotional expressions during the observational session.

DISCUSSION

This longitudinal study examined changes in maternal perceptions and infant and parent behaviour accompanying the locomotor transition. It is the first study in which both maternal reports and direct observations on the same sample were obtained and could be directly compared. Based on prior theory and research, we anticipated that at the follow-up interview, mothers of transitioning infants—but not mothers of infants who were still prelocomotor—would report using a greater number and variety of proactive interventions and reactive control strategies, and would describe their children as exhibiting greater defiance but also increased separation anxiety. These differences would be apparent by an interaction between locomotor group and time in the analysis of the maternal interview responses. We also anticipated that these group differences would be apparent in the laboratory observation at the follow-up assessment, when the mothers of transitioning infants were expected to exhibit greater amounts of proactive and reactive control efforts, and their infants to show less compliance and greater negative emotional reactivity to maternal control than prelocomotor infants.

The findings of this study did not provide strong support for the expected changes in infant behaviour although there was greater (albeit modest) confirmation of some predicted differences in maternal behaviour. With respect to the interview data, the expected interaction between locomotor status and time of interview was apparent only for parental behaviour most directly relevant to managing the child's locomotor transition: mothers of transitioning infants expanded the number of reactive control practices they acknowledged using at home compared with the mothers of prelocomotor infants. This was confirmed by our observation that, in the laboratory, mothers of transitioning infants more frequently enlisted reactive control, particularly their use of the word 'no,' compared with the mothers of prelocomotor infants. This is consistent with the observations of greater maternal reactive control of Zumbahlen and Crawley (1996) and Biringen *et al*. (1995), although observed differences in maternal reactive control between mothers of transitioning and prelocomotor infants in our study were not large.

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The use of verbal prohibitions was also consistent with results of Tamis-LeMonda *et al*. (2007) who noted that mothers were most likely to use prohibitive words (e.g. no, stop, don't) to stop babies in potentially dangerous situations. Nevertheless, mothers interviewed by Tamis-LeMonda *et al*. also mentioned that they used a physical response, such as rushing to stop the baby, along with the verbal warning. Mothers of transitioning infants in this study used 'no' more than other types of verbal communications but at a rather low rate, although they were using it with infants who were seated on their laps. Verbal prohibitions are often perceived as a distal communication (Tamis-LeMonda *et al*., 2007). Therefore, the slight increase in the use of 'no' when the child is in such close proximity to the parent is noteworthy.

With respect to infant compliance, only during the second interview did mothers of transitioning infants report their children checking-back with the mother prior to engaging in misbehaviour and understanding the word 'no' more than did the mothers of prelocomotor infants. There were, however, no differences between mothers of transitioning and prelocomotor infants in their reports of child compliance at either interview, nor were there comparable behavioural differences in compliance in the lab between transitioning and prelocomotor infants.

Other findings were consistent with the general expectation of parental adaptation to a locomotor infant. Mothers of transitioning infants reported greater child-proofing precautions at *each* interview, and mothers generally increased their child-proofing of the house over time, but there was no interaction of infant locomotor status with time. With respect to separation anxiety—an hypothesized emotional consequence of increased locomotor ability—mothers reported greater distress related to separation at the follow-up interview regardless of locomotor status.

Taken together, these findings yield two conclusions. First, there were no confirmations of the expected changes in infant behaviour according to locomotor status over time in mothers' reports, and no confirmations of expected behavioural differences between transitioning and prelocomotor infants in the laboratory observation. This suggests that claims by Campos *et al*. (1992) of changes in infant behaviour after locomotor onset may have been primarily a function of parental perception. It is particularly important that behavioural differences were not observed in a laboratory procedure specifically designed to present equivalent challenges to prelocomotor and transitioning infants, suggesting that the variance accounted for by the infant's locomotor status in compliance, emotionality, and sensitivity to parents' signals is not great.

Second, the confirmations of hypothesized changes deriving from the locomotor transition were in maternal behaviour, particularly aspects of reactive control practices most directly related to having a mobile infant, rather than in infant behaviour. Together with the fact that differences between the mothers of prelocomotor and transitioning infants in the use of proactive control techniques were observed *before* babies had become capable of significant self-produced locomotion, this suggests that the infant locomotor transition is a significant event for parents regardless of its broader effects on infant socioemotional behaviour. Such a finding is consistent with Tamis-LeMonda, Chen, and Bornstein (1998) and Tamis-LeMonda, Shannon, and Spellmann (2002) who suggest mothers' parenting beliefs influence their exchanges with their children and the way they set up the environment in anticipation of upcoming developmental changes. Such anticipation of developmental changes warrants further examination in future studies. The cues indicating appropriate timing of activities such as child-proofing as we have described are not clearly delineated.

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Anticipation of self-produced locomotion seems to inaugurate a variety of adaptive strategies (e.g. enhanced child-proofing the home) even before offspring are mobile. After children are crawling or creeping, mothers are expanding their use of disciplinary practices (especially their use of 'no' as a regulatory control), becoming more proactive, and responding in other ways that reflect their appreciation of the changes that are about to occur in the baby and in family life. The changes in parent–child relationships and in the family system associated with the locomotor transition should be regarded at least as much a function of parental expectations and anticipations as they are a direct result of changes in infant behaviour. Knowledge about upcoming developmental changes may be especially salient for parents who want to be prepared for the next step, as they learn about these expected changes from other parents, the media, and from other sources (Tamis-LeMonda *et al*., 1998; Tamis-LeMonda *et al*., 2002). As children advance, mothers' attention shifts to their most recent accomplishments as well as ones expected in the near future (Tamis-LeMonda *et al*., 1998).

The findings of this study suggest that further research on the impact of the transition to self-produced locomotion is needed. By using a longitudinal method, the current results did not support past research (e.g. Campos *et al*., 1992; Zumbahlen & Crawley, 1996) suggesting that infants who have transitioned to locomotion exhibit significant concurrent changes in their behaviour and affect. Instead, it appears that the most significant changes are in maternal behaviour and perceptions accompanying the expectation of having a locomoting infant at home. Further examination of maternal and infant behaviour in other contexts—especially those where infant locomotion is even more likely to require parental control—is warranted. For the present, the development of self-produced locomotion in the first year should perhaps be viewed not only as a maturational event in the infant but also as a developmental milestone for their caregivers. The latter highlights the potentially important bidirectional influences that occur as parents anticipate and prepare for the locomotor transition—possibly creating conditions fostering its emergence—and then respond along with the infant to its unfolding consequences for the family. Parent knowledge regarding particular domains of development affects the amount and quality of their relations with their infants, which may sometimes encourage infant development in these emerging domains (Tamis-LeMonda *et al*., 1998).

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