Infant and Child Development
Inf. Child Dev. **17**: 607–615 (2008)
Published online 19 March 2008 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/icd.571

Older Siblings Influence Younger Siblings' Motor Development

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Evidence exists for two competing theories about the effects of having an older sibling on development. Previous research has found that having an older sibling has both advantages and disadvantages for younger siblings' development. This study examined whether and how older siblings influenced the onset of their own younger siblings' motor milestones, a heretofore unstudied developmental domain in the sibling literature. Parents of 51 sibling pairs reported their children's crawling and walking onset dates. In keeping with imitation theories, in families where younger siblings crawled or walked earlier than their own older sibling, they did so significantly earlier. Moreover, in keeping with limited parental resource theories, in families where older siblings crawled or walked earlier than their own younger sibling, they did so significantly earlier. Older siblings did influence younger siblings' motor development, but how they did so may have depended on unique family characteristics. **Copyright © 2008 John Wiley & Sons, Ltd.**

Key words: motor development; infancy; siblings; crawling; walking

Very young children (preschool age and younger) with siblings spend more time interacting with their siblings than with any other person, including their parents (Abramovitch, Corter, & Lando, 1979; Dunn & Dale, 1984; McHale & Crouter, 1996). This unique relationship influences younger siblings' development. For example, younger siblings' language development is facilitated by observing the interactions between their older sibling and their mother (Oshima-Takane, Goodz, & Deverensky, 1996; Woollett, 1986) and their cognitive development is facilitated by rich cooperative activities that older siblings make possible (Perner, Ruffman, & Leekham, 1994). Moreover, infants can learn to carry out a simple action plan without direct instruction, simply by observing their older sibling performing the task (Barr, Hildreth, & Rovee-Collier, 2001), and infants with older siblings imitated more behaviors without instruction than did children without siblings (Barr & Hayne, 2003). Older siblings provide developmentally more advanced models for younger siblings and help create a stimulating,

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enriched environment that seems to enhance younger siblings' development (Barr & Hayne, 2003; Woollett, 1986).

On the other hand, not all of the effects of older siblings on the development of younger siblings are beneficial. For example, in the presence of an older sibling, younger siblings' opportunities to participate in conversations are diminished: younger siblings produce fewer utterances and fewer answers to questions than when the older sibling is absent (Wellen, 1985). As a result, the presence of older siblings may be detrimental to language learning. Moreover, the greater the number of children per family, the fewer the parental resources available per child (Blake, 1987). Younger siblings received less linguistic attention from their mothers than older siblings did (Woollett, 1986) and the presence of older siblings resulted in less conversation between mother and younger siblings (Wellen, 1985). Even without the immediate presence of first born children, mothers still spent less time interacting with their later born children (Putnick, Suwalsky, & Bornstein, 2007).

Previous research has examined the effects of having an older sibling on development in the domains of language, social interaction and imitation. Because most studies have focused on the long-term effects of the sibling relationship (e.g. Gass, Jenkins, & Dunn, 2007; Paulhus, Trapnell, & Chen, 1999) and because motor milestones are typically acquired before the age of 18 months, one domain that has not yet been studied in the context of sibling effects is motor development. The normal age range for the onset of motor milestones is wide—6–10 months for the onset of independent crawling (Adolph, Vereijken, & Denny, 1998) and 10–16 months for the onset of independent walking (Adolph, Vereijken, & Shrout, 2003). The first aim of this study was to examine whether older siblings influence the onset of younger siblings' motor development in infancy.

The second aim of this study was to examine the nature of older siblings' influence on their younger siblings' motor development—whether motor development was affected in the same way as other domains of development. If younger siblings imitate motor milestones in the same way that they imitate other behaviors (e.g. Barr *et al*., 2001), then we would expect younger siblings to reach their motor milestones earlier than their own older siblings did. For example, older siblings may serve as an incentive for younger siblings to gain independent mobility—they can imitate the older sibling more easily if they can keep up with them. Moreover, it may be easier for younger siblings to solve the problem of locomotion if older siblings serve as a salient model. In contrast, if older siblings interfere with younger siblings' development (e.g. Wellen, 1985; Woollett, 1986), then we would expect older siblings to reach their motor milestones earlier than their own younger siblings. In this scenario, having the undivided attention of a parent may give older siblings an advantage unavailable to younger siblings. Of course, the third possibility is that having a sibling does not affect motor development at all (Schmuckler, Bhagoutie, & Dzinas, 2002). Due to the wide range of typical motor milestone onsets as well as the variability of family dynamics, rather than simply examining the effects of birth order on motor development (Schmuckler *et al*., 2002), we compared younger siblings' motor milestone onsets relative to their own older siblings.

METHODS

Participants

Parents of 51 sibling pairs participated in a structured interview (e.g. Adolph *et al*., 2003; Berger, Theuring, & Adolph, 2007) about the onset of their children's

DOI: 10.1002/icd

motor milestones. Infants were recruited using purchased mailing lists from the New York city metropolitan area: Manhattan county ($n = 32$ sibling pairs), Richmond county ($n = 7$ pairs), Nassau county ($n = 8$ pairs), Kings county ($n = 2$ pairs), and Bergen county ($n = 1$ pair) plus 1 family from Baltimore county. In 20 sibling pairs, both siblings were the same gender (13 male, 7 female). In 31 sibling pairs, the siblings were different genders (18 older female, younger male; 13 older male, younger female). All infants were healthy with no history of motor problems and born at term. We included sibling pairs only composed of first- and second-born children, sharing the same mother and father.

Procedure

The survey was part of a battery of questions routinely asked of parents who brought their children to the laboratory to participate in a separate study about cognitive or motor development. Eligibility for participating in these studies was contingent on having achieved a particular motor skill (crawling or walking, depending on the study) prior to participation. Therefore, participation in another study could not affect infants' motor milestone onset for the purposes of this study because onset had already occurred. In addition, longitudinal studies of infant motor development (e.g. Adolph, 1997) find no significant differences between the motor milestone onsets for children who are tracked longitudinally and the onsets of matched control groups who participate only one time.

For 17 sibling pairs, motor milestone data were collected when each sibling participated in a laboratory study. For 16 sibling pairs, motor milestone data for one sibling were collected as part of a laboratory study and milestone data for the other sibling were collected in a telephone interview, explicitly for this study. For 18 sibling pairs, milestone data for both siblings were collected via telephone interview, specifically for this study.

Most of the data were collected retrospectively ($n = 95$ children), whereby parents who brought their children to the laboratory or who participated by telephone were asked to recall onset dates of their children's motor milestones. Parents consulted their personal records, such as a baby book, calendar, journal, videotapes, or photographs. An experimenter prompted parents' memories using temporal landmarks, such as holidays, vacations, and family events, as reference dates. After probing, if parents still could not remember certain dates, these data were considered missing. For the rest of the sample ($n = 7$; 2 older siblings, 5 younger sibling), data were collected prospectively, either because parents were participating in longitudinal studies and kept daily records or because they were asked to call us specifically for this study.

For statistical purposes, each sibling in a pair had to provide data for each milestone. The original parent interviews asked about the onsets of several motor milestones. For this study, however, we were interested in only crawling and walking because these milestones were most frequently and reliably observed. Using standard criteria in the literature for the onset of these locomotor milestones (i.e. Adolph, 1997; Adolph *et al.*, 1998; Adolph *et al.*, 2003), crawling onset was defined as the first day infants traveled 10 feet continuously across the room, without pause or assistance, on hands and knees (or hands and feet), without their abdomen touching the floor. Walking onset was defined as the first day infants walked 10 feet independently, without pause or assistance. We also asked whether siblings achieved their milestones in the same home.

DOI: 10.1002/icd

RESULTS

Time between Milestone Onset and Report

Typically, several months passed between the time when infants' milestones occurred and when parents reported the onsets (see Table 1). About 25.5% of parents used babybooks, 15.7% used calendars, 5% used some other type of written record of their infants' milestones, and 8.8% of parents used a combination of these methods. There was no time lapse for seven infants because their parents were keeping ongoing records of infants' motor milestones. Thirty-nine percent of parents relied on memory for their reports.

Age of Milestone Onsets

The mean age of crawling onset was 7.66 months (S.D. = 1.69 months) for older siblings and 7.95 months (S.D. = 1.45 months) for younger siblings. The mean age of walking onset was 12.55 months (S.D. = 1.95 months) for older siblings and 12.11 months (S.D. = 1.66 months) for younger siblings. Simple *t*-tests of whether birth order affected age of motor milestone onset revealed no significant differences between older and younger siblings. However, because the range of normal motor milestone onsets is so broad, both in this sample and in the population in general, we reasoned that the crucial test was a comparison of younger siblings' age of onset relative to their own older sibling.

Onset Differences

Of the 38 sibling pairs who provided dates of crawling onset for both siblings, 18 younger siblings crawled earlier and 20 younger siblings crawled later than their own older sibling. Of the 42 sibling pairs who provided dates of walking onset for both siblings, 26 younger siblings walked earlier and 16 younger siblings walked later than their own older sibling.

For each analysis, the sample was split into two groups: one group in which the older sibling performed the milestone earlier than the younger sibling and another group in which the younger sibling performed the motor milestone earlier. No siblings began crawling or walking at the same age. We divided the sample because we had no reason to believe that either of the prominent approaches in the sibling literature was more applicable than the other to motor development. Whereas some have argued that the presence of an older sibling facilitates younger siblings' development (e.g. Barr *et al*., 2001; Barr & Hayne, 2003; Brody, 2004; Hanna & Meltzoff, 1993; McHale & Updegraff, 2001; Meltzoff & Moore, 1994), others have argued that it can be detrimental (e.g. Putnick *et al*.,

Table 1. Time (in months) between infants' milestone onsets and report date

Motor milestone	Sibling					
	Older			Younger		
	N	*M*	S.D.	*N*	*M*	S.D.
Crawling	42	24.93	18.74	44	9.94	9.51
Walking	48	19.55	17.45	43	7.62	9.4

DOI: 10.1002/icd

2007; Wellen, 1985; Woollett, 1986). As neither approach examined motor development, both views were tested.

As suggested by modeling theories which propose that younger siblings learn from their older siblings, in families where younger siblings crawled earlier ($M = 7.18$ months), they did so significantly earlier than their own older siblings ($M = 8.65$ months). A paired samples *t*-test of the age of crawl onset revealed a significant difference between younger and older siblings, $t(17) = 4.26$, $p < 0.01$. In addition, when younger siblings walked earlier ($M = 11.59$ months), it was significantly earlier than their own older siblings ($M = 13.20$ months), $t(25) = 7.04$, $p < 0.00$.

In contrast, as suggested by limited parental resource theories, in families where older siblings crawled earlier ($M = 6.86$ months), they did so significantly earlier than their own younger siblings ($M = 8.43$ months). A paired samples *t*-test of the age of crawl onset revealed a significant difference between older and younger siblings, $t(19) = 9.37$, $p < 0.00$. In addition, when older siblings walked earlier ($M = 11.15$ months), it was significantly earlier than their younger siblings ($M = 12.58$ months), $t(15) = 4.31$, $p < 0.01$.

Gender

Chi square analyses of the relationship between the gender of each sibling in a pair and whether the younger sibling crawled or walked earlier were not significant. Whether siblings were of the same or different gender did not affect whether younger siblings crawled or walked earlier or later than their own older sibling.

Age Difference

Pearson correlations between the age difference between siblings and the age at which younger siblings crawled and walked were not significant. Whether siblings were close or far apart in age did not affect the age at which younger siblings achieved their milestones.

An independent samples *t*-test of the age difference between siblings in pairs where the younger sibling walked earlier ($M = 2.46$ years) and the age difference in pairs where the older sibling walked earlier ($M = 2.0$ years) revealed that there was a significantly larger age gap between siblings when the younger sibling walked earlier, $t(40) = 2.24$, $p < 0.04$. The age gap between siblings was not related to whether the younger or older sibling crawled earlier.

Size Differences

Because infants who are lighter in weight crawl and walk earlier than heavier infants (Adolph, 1997; Adolph *et al.*, 1998), we examined whether differences in siblings' sizes contributed to differences in their milestone onsets. We used infants' birth weight as a crude measure of their size. Pearson correlations between the birth weight difference between siblings and the age at which younger siblings walked and crawled were not significant. Independent samples *t*-tests comparing the weight differences of siblings in pairs where younger siblings crawled earlier with pairs where older siblings crawled earlier, and comparing pairs where younger siblings walked earlier with pairs where older

DOI: 10.1002/icd

siblings walked earlier were not significant. Size differences between siblings were not a cause for differences in motor milestone onsets.

DISCUSSION

As expected, older siblings influenced the onset of their younger siblings' motor milestones. In contrast to previous theories of the effects of having an older sibling on development, we found evidence for competing hypotheses. In some families, younger siblings crawled and walked earlier than their older siblings did, suggesting that the onset of younger siblings' motor milestones may be facilitated by imitating or modeling their own older siblings (e.g. Abramovitch *et al*., 1979; Barr *et al*., 2001; Barr & Hayne, 2003; Oshima-Takane *et al*., 1996; Woollett, 1986). In contrast, in other families, older siblings crawled and walked significantly earlier, suggesting a delay in the onset of younger siblings' motor milestones. In these cases, parental 'resources' may have been split between the two siblings, creating a disparity between the amount of attention available to the older sibling prior to the birth of the younger sibling and the amount of attention available for two children (Blake, 1987; Putnick *et al*., 2007; Zajonc, 2001). Neither siblings' gender nor weight influenced whether younger siblings crawled or walked earlier or later than their older siblings.

Previous work that considered birth order alone as a possible influence on motor development (Schmuckler *et al*., 2002) may not have found any significant effects because the range of normal motor milestone onsets is so broad. More importantly, using birth order alone as a predictor of motor development may overlook unique family factors shared by siblings that may shape the environment in which young children acquire their motor milestones (Zajonc, 2001). One explanation for why we found two different patterns of sibling influence on motor development is simply that families are different. Opposing views of what siblings experience are common in the literature. Findings that older siblings are 'displaced' after the birth of a younger sibling (Dunn, 2002) compete with findings that older siblings receive more parental attention than younger siblings even when the younger sibling is absent (Putnick *et al*., 2007). Research showing that siblings model their parents' contentious relationship by fighting with one another (Dunn, Deater-Deckard, Pickering, & Golding, 1999) contrasts with studies showing that siblings come together for support in times of stress, such as during the divorce of their parents (e.g. Gass *et al*., 2007). Our approach of using paired samples of siblings was our best attempt to control for family environment. However, future research should explicitly examine how family dynamics influences the way that having an older sibling affects younger siblings' motor development.

As with most studies based on retrospective data, there are potential concerns regarding the accuracy of the participants' reports, especially after a delay between event and report. Ideally, motor milestone onsets would be collected prospectively, with parents documenting infants' milestones as they occur. The parent interview used in this study was the same one used in several other previous studies of infant motor development (Berger *et al*., 2007; Garciaguirre, Adolph, & Shrout, 2007; Joh & Adolph, 2006). Across interviewers and across studies, the same mean ages for and variability in walking and crawling onsets were obtained using the same survey method. In addition, the ages of onset obtained via this parent interview match ages of onset for motor milestones typically reported by other laboratories using different parent surveys (e.g.

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Benson, 1993; Clearfield, 2004). Moreover, in previous experiments when the parent interview was used in conjunction with behavioral measures, parents' reports of experience were correlated with infants' locomotor skill (e.g. Adolph, 1995, 1997). Finally, a recent independent assessment of the validity of parental reports of their own infants' gross motor milestone attainment found that parents reports of sitting, crawling, and walking were highly dependable (Bodnarchuk & Eaton, 2004). However, to address concerns about the validity of parents' retrospective reports, future research, conducted prospectively, needs to replicate our findings.

Although our study was not designed to explicitly examine family characteristics, some of our findings suggest possible explanations for sources of differences in milestone onset patterns. For example, in families where the younger sibling walked earlier, the age difference between siblings was about 6 months greater than in families where the older sibling walked earlier. The extra time that passed before a second child was born in those families may have meant that the older sibling was sufficiently independent to free up more parental resources for younger siblings or that the older sibling was prepared to take on a 'tutoring' role for the younger sibling (Zajonc, 2001). The greater the age gap between siblings, the more likely younger siblings are to accept guidance from their older sibling (Abramovitch *et al*., 1979).

Parental expectations may also have served as a source of differences in milestone onsets. Cross-cultural comparisons of expectations of infants' motor development can influence the timing of motor milestone onset. For example, in a sample of Jamaican mothers, crawling around on hands and knees was perceived as 'non-human' (Hopkins & Westra, 1989). As a result, infants are rarely placed prone and often skipped crawling altogether. In contrast, in western cultures, parents expect infants to crawl and even set aside special 'tummy time' so that infants have the opportunity to get used to being on the floor and to strengthen the muscles they will need to crawl. Just as different cultural practices regarding the handling and accepted postures of infants yield different patterns of motor development (Hopkins & Westra, 1988, 1990), different cultural practices regarding the role of siblings may determine the potential for siblings to influence each others' motor development. For example, in some cultures older siblings even as young as 4 or 5 years of age serve as the primary care taker of younger siblings 30–40% of the time, depending on culture and observational method (see Weisner, 1987, for a review). In these cases, younger siblings may have more opportunities to model their older siblings than in cultures where sibling caretaking is not common.

In one of the first attempts to study the effects of an older sibling on the onset of motor milestones, this study begins to document the interaction between social and motor development and introduces a new set of questions. Whereas previous research has demonstrated that infants can be explicitly taught new motor skills by their parents (Berger *et al*., 2007; Lobo, Ishak, Tamis-Lemonda, & Adolph, 2005) and they can learn to perform familiar actions in new contexts by imitating their older siblings (Barr *et al*., 2001), evidence is still needed regarding whether infants can and will directly model novel motor skills from their older siblings. Like classic studies of preschoolers demonstrating that younger siblings imitate older siblings' play and social behaviors (Abramovitch *et al*., 1979; Lamb, 1978), naturalistic observations focusing on younger age groups should assess whether younger siblings have opportunities to imitate older siblings' motor behaviors, and whether younger siblings directly model older siblings' novel behaviors. Future studies should also take into account the quality of the relationship

DOI: 10.1002/icd

between siblings. Observational studies can document the possible social exchange that may precede the onset of infants' motor milestones.

ACKNOWLEDGEMENTS

This manuscript is based, in part, on an undergraduate departmental honor's thesis submitted to the Department of Psychology, The College of Staten Island of the City University of New York, by Katie Nuzzo in partial fulfillment of the requirements for graduating with honors. This research was supported in part by a Professional Staff Congress-City University of New York research award to S.B. and a Dean's Undergraduate Summer Research grant to K.N. Portions of this research were presented at the Third Biennial Meeting of the Society for the Study of Human Development, Boston, MA, November 2003. We gratefully acknowledge all of the babies and caregivers who participated in this research, Julia Fisher, and members of the Adelphi University and College of Staten Island Child Development Labs and the New York University Action Lab for their assistance.

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DOI: 10.1002/icd