Gross Motor Development and Birth Order Effects in Large Families

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Accessibility
Gross Motor Development and Birth Order

Effects in Large Families

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A Thesis in the Field of Clinical Psychology

for the Degree of Master of Liberal Arts in Extension Studies

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Abstract

This research aims to clarify the relationship between the achievement of gross motor milestones (turning over, sitting up, crawling, standing and walking) in infancy, and birth-order in large families (five or more children). The study also addresses many factors that may influence a child’s development. It was hypothesized that younger children born to large families would achieve their motor milestones at younger ages than their older siblings, that a larger age difference between sibling pairs would be inversely correlated with the younger child’s achievement of motor milestones, that the effects would be stronger if an older sibling is a female than if the older sibling is a male, and that although other factors influence the achievement of gross motor milestones, the older sibling’s age of achievement will prove to be the most significant predictor. The study was conducted on 29 sibling pairs within the Orthodox Jewish population in Israel. A parental questionnaire was administered to assess the development rates as well as other familial characteristics for each sibling pair. Results showed that birth order tends to be a hindering factor in that younger children were consistently later in achieving their motor milestones compared to their own older siblings. Relationships between the age gap and gender of the older child were not significant in this sample. Finally, results suggest that older siblings achievements are the best predictor of their younger sibling’s development. This study provides additional data to the sparse existing literature on the relationships between known factors effecting infant development and how they play out in large families.
Dedication

I dedicate this thesis to my parents Tzvi and Chaya Rubin, my husband Betzalel Marcus, and to my adorable boys Yisroel Shlomo and Yehuda Yehoshua Marcus, for their unconditional love and support throughout.
Acknowledgements

I would like to express my deepest gratitude to my thesis advisor and director, Dr. Dante Spetter as well as to my Proseminar instructor, Dr. Evan Kleiman for their patient guidance, support and advice. I would also like to thank my grandmother, Mrs. Felicia Rubin, for enabling me to pursue my degree.
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Chapter 1
Introduction

Developmental psychology is a scientific discipline which studies how and why human beings change over time, with many theories focused upon development during infancy and childhood (McLeod, 2012). Developmental psychologists seek to describe, explain, and optimize development (Baltes, Reese, & Lipsitt, 1980). Many internal and external factors work to influence development rates, as gross and fine motor skills integrate into more refined movements as a child matures. This pattern of skill acquisition is often referred to as “normal or typical development,” and it is used to monitor the developmental progress of a child (Children’s Medical Services, 2012). In some cases, failure to attain specific milestones within the time period considered “normal,” may indicate a developmental delay (Brouwer, van Beijsterveldt, Bartels, Hudziak & Boomsma, 2006).

Developmental delays may be a cause for concern because even slight delays are sufficient to impact upon a child’s school readiness and educational outcomes (American Academy of Pediatrics Committee on Children with Disabilities, 2001). There are growing concerns about the increasing prevalence of childhood socioemotional and behavioral problems (Brauner & Stephens, 2006) and the impact of these issues on longer term outcomes (Fergusson, Horwood, & Ridder, 2005). Current research is investigating potential factors that may contribute to child development, with the influence of siblings
being one such factor. Research conducted on the topic, however, suggests contradictory evidence for these sibling effects (Cruise & O’Reilly, 2014).

The present research focuses on clarifying the relationship between the achievement of motor milestones and possible birth order effects in infants and toddlers born to large families. Specifically, do later-born children of large families develop their motor skills more quickly than their earlier born siblings? Does it matter if the eldest child in the family is male or female? What are the effects of siblings’ age differences? What other familial factors might effect a child’s development and what is their relative importance? To record, very few studies of this type have been conducted and results could potentially shed new insights in the discipline. While results indicated that these children developed within the normal range, they fell to the lower end of normal, thereby shifting the normal curve slightly to the left. Although technically a small difference, this disparity may practically indicate a more significant developmental pattern, as very young children develop quite rapidly (i.e., there exist significant observable differences between the behaviors of a two-month-old versus a three-month-old baby).

Clinically, health care professionals should be made aware of these possible differences because the timely attainment of motor milestones is of great importance and delays can be indicators of abnormal development (Brouwer et al., 2006). Diamond (2000) presents a complex picture of the interrelation between motor development, development of the neocerebellum area of the infant brain, cognitive abilities and the development of the dorsolateral prefrontal cortex. Leonard and Hill (2016) point out that the timely attainment of motor milestones could have important implications in identifying risk factors for poor motor skills, which in turn may lead to poor cognitive, as
well as socioemotional and health outcomes. As such, early identification is crucial in optimizing delayed-development intervention programs, should they be necessary, and may also lead to better outcomes (Giagazoglou et al., 2011).

The present study employed a correlational design that assessed developmental differences between younger and older children of large families by using a parent report. The hypotheses suggested that younger children born to large families would achieve their motor milestones before their older siblings, and although many factors (to be discussed below) may influence the achievement of gross motor milestones, the achievements of their own older siblings would be the strongest predictor.

To my knowledge, no other studies have been conducted which specifically tested the effects of older siblings on their younger siblings’ motor development within large families. As such, this study may be helpful in understanding the normal development of such children.

Background

As noted above, development, the maturation of function with age, is reflected by the sequential achievement of various milestones (Vaida, 2013). As new synaptic connections are formed in the brain, increasing levels of complex skills can be learned. The development of gross motor skills begins from birth, as infants learn to hold their heads and move their arms, progress to rolling over, and with time learn how to walk. The development of these skills may depend upon factors such as the infant’s age, gender, existence of siblings and physical activity (Venetsanou & Kambas, 2010). As
these factors, and others, work together to influence a child’s development, consideration must be given to them when studying this topic.

Gender as a Developmental Factor

Children’s gender is related to their early development. An early study conducted by Clark, Wyon, and Richards (1969) aimed to describe nursery school behavior among young children (such as choice of friends, selection of traditional “boy” vs. “girl” toys, etc.) and ways in which this behavior could be explained by the basic biological variables of gender and birth position. Results indicated that young girls preferred fine motor activities while boys spent more time engaged in gross motor activities. These findings were confirmed by Krombholz (2006), who, when testing physical performance among preschool children, discovered significant gender-based differences between the sexes. Boys demonstrated superior performance in gross motor activities such as jumping and running, while girls performed better in areas of manual dexterity. Research on developmental disabilities (Giagazoglou et al., 2011) however, found that the impact of gender on children’s motor development was small, was not consistent across ages, and was statistically non-significant. Furthermore, in their research on the role of older siblings on infant development, Leonard and Hill (2016) found that the gender of the older sibling of sibling pairs had no influence on infant development.

Mother’s Highest Level of Education as a Developmental Influence

A mother’s level of education has also been shown to effect a child’s development. In a study conducted by Syrengelas, Kalampoki, Kleisiouni, Konstantinou,
and Siahanidou (2014), researchers used the Alberta Infant Motor Scale (AIMS) to investigate the gross motor development of Greek infants and examine possible associations between AIMS scores and mother’s education levels (as well as possible socioeconomic factors). Syrengelas, et al. (2014) found significant correlations between the child’s scores and the mother’s education levels, with the highest AIMS scores achieved by babies whose mothers had post-secondary education.

Gutman and Feinstein (2007) found that mothers with higher education levels and greater family income interacted with their children more outdoors, and provided more stimulation and teaching inside the home. The more stimulating home environment was directly related to the child’s receiving higher scores on children’s fine and gross motor development tests.

Socioeconomic Factors as a Developmental Influence

In his above-referenced study, Krombholz (2006) found that children from higher socioeconomic backgrounds surpassed children from lower socioeconomic backgrounds in most motor skills. Miquelote, Santos, Caçola, de L. Montebelo, and Gabbard (2012), discussed the effect of home environment on motor development. They found that a larger income in the home might provide essential resources that can promote motor skills in young children.

The availability of stimulating play materials was a predictor of future mental behavior, and the availability of outdoor and indoor play space could enhance the development of physical faculties. Miquelote et al. (2012) indicated that although the
impact of the home environment is relatively small, it provides a fundamental clue for understanding the complex nature of human development.

Alternate Caregivers as a Developmental Influence

Different cultural practices in the home may also significantly effect a child’s development. In some cultures, older siblings (as young as four or five years of age) are the primary caretakers of their younger siblings for much of their day. In this way, younger siblings have more opportunities to model the behavior of their older siblings, which may lead to an advancement of the developmental process (Weisner, 1987).

Children spending significant time in the care of babysitters or grandparents may do better as well. Syrengelas et al. (2014) noted that very high AIMS scores were found in infants cared for primarily by grandparents or babysitters. Grandparents and babysitters are often more relaxed than busy parents and can spend more exclusive quality time playing with children, possibly resulting in more stimuli for developing motor ability. Additionally, both grandparents and babysitters may be able to provide more focused encouragement and motivation for children to perfect movements, resulting in more expedient development. Similarly, Vaida (2013) found that children of working mothers (raised by babysitters) attained various milestones significantly earlier than other children.

Birth Order as a Developmental Influence

Scientists’ curiosity about the effects of birth order on a child’s development is not a new phenomenon. Francis Galton (1822-1911), a well-known English scientist and
intellectual, published a book in 1874 entitled *English Men of Science: Their Nature and Nurture*, which gathered data on over 100 English scientists (many of whom were firstborn), and concluded that birth order indeed influences a child’s development (The Institute for the Study of Labor, 2012). Since then a plethora of research has examined how birth order may effect a child’s development.

However, how exactly siblings facilitate development, change the environment, and provide new experiences for their other siblings is a relatively unexplored area of developmental psychology (Reid, Stahl, & Striano, 2010). There is wide variation in results concerning the effect of siblings and the direction of the effects. These mixed results may be due to the difference in measures used and the ages of participants across studies. In addition, most of this research focuses on the presence or absence of a sibling and does not account for many siblings or characteristics of the siblings (Leonard & Hill, 2016).

Absence of Older Siblings

Scientific literature suggests theories as to why older-born siblings may develop more robustly than their younger siblings. Older-born siblings often benefit from more linguistic attention from their mothers, and therefore converse more with them (Woollett, 1986). Putnick, Suwalsky, and Bornstein (2007) found that, even when their first-born children were out of the house, mothers spent less time interacting with their later-born children. The parents’ undivided attention toward the older sibling (e.g., playing on the floor with them) would indicate that these children might attain motor milestones earlier than their younger siblings (Berger & Nuzzo, 2008). This finding was confirmed by
Vaida (2013), who found that motor milestones were achieved significantly earlier, on average, amongst the first- and second-born children in a family, compared to later-born children.

Blake (1989) has several theories as to the psychological, and economic causes of these negative birth order effects. Firstly, the intellectual environment into which first-borns are born tends to be at a higher level than their younger siblings are born into. Zajonc and Markus (1975) suggest a confluence model, which asserts that the birth of each additional child strains parental resources, leading younger children to spend larger amounts of time with their older siblings who cannot provide the quality of cognitive stimulation that would be provided by parents.

Secondly, first-born children may also benefit from greater financial resources, as mentioned above. These increased parental investitures in older children have been shown to benefit older siblings, as evidenced in better overall school performance (The Institute for the Study of Labor, 2012). In his dilution theory, Blake (1981) suggests that as family size increases, family financial resources (as well as parental time and energy) are diluted. This tendency negatively affects the younger-born children in such families (Rodgers, 2001). The Wisconsin Longitudinal Study corroborates these findings, indicating that parents indeed spend significantly less money on later-born children (The Institute for the Study of Labor, 2012).

It should be noted that a recent study (Cruise and O’Reilly, 2014) collected data from a sample of more than 10,000 caregivers of 9-month-old infants, and reported significantly poorer performance on motor measures for infants with older siblings compared to those without siblings.
Presence of Older Siblings

In contrast to the above, evidence exists to support the theory that younger siblings might out-perform their older siblings. In addition to being born to more experienced parents, Abramovitch, Corter, and Lando (1979) note that very young children often spend more time interacting with their siblings than with any other person, including their parents. Such children may be more likely to explore their environments if their older sibling is present, providing more opportunities for social and cognitive development (Samuels, 1980).

Research by Sommerville, Woodward and Needham (2005) examining the relationships between the perception of an action and the production of the action in infants, suggested the possibility that the frequency of observed goal-directed actions is increased for a baby with older siblings since an only child may limited to observing solely the behavior of their caregiver. Older siblings also provide developmentally more advanced models for younger siblings, and help create a stimulating, enriched environment that seems to enhance their younger siblings’ development (Berger & Nuzzo, 2008). Barr and Hayne (2003) confirm this conclusion, finding that in families with older siblings, infants performed more spontaneous imitative acts than those without.

In addition to the frequency of their modeling motor behaviors, siblings also may produce actions that are more congruent with the motor abilities of a developing infant. It is conceivable that most parental actions an infant observes are not geared to facilitate infant understanding but are instead produced for the efficient attainment of goals. In a home environment without siblings, an infant therefore observes more human behavior
and movement that cannot be enacted by their own biomechanical makeup (Reid, Stahl, & Striano, 2010).

Older siblings may also provide motivation for their younger siblings to gain independent mobility by incentivizing their innate desire to keep up with them (Berger & Nuzzo, 2008). If younger siblings imitate motor activities in the same way that they imitate other behaviors, then younger siblings might be expected to reach their motor milestones earlier than their own older siblings did. These theories have been confirmed by Berger and Nuzzo (2008), who found that children with older brothers or sisters outperform only or first-born children with regard to motor development on certain milestones.

Interestingly, Barr & Hayne (2003) suggest that infants who are closer in age to their older sibling (and thus more similar in their motor abilities) did not produce more imitation than those with a wider age gap. In fact the opposite appears to occur, as Abramovitch, Corter, and Lando, (1979) point out that the greater the age gap between siblings, the more likely the younger siblings are to model their siblings’ behaviors.

The presence of older siblings, however, has not consistently proven to promote gross motor development for younger siblings. In a recent study, Leonard and Hill (2016) considered older sibling effects and whether characteristics of the older sibling, or of the sibling relationship, had an effect on their younger siblings’ motor skills during the first 18 months of life. The researchers employed a longitudinal diary method to record infant motor milestones from 23 infants with a single older sibling, along with parent reports and standardized assessments of motor skills.
Leonard and Hill (2016) found that the age of the achievement of rolling over was significantly earlier for infants than their older sibling, whereas crawling was reported significantly later. There was no significance regarding any other milestones, nor were age and gender found to have any significance on any measure of infant development. These results are somewhat inconclusive and portray that the imitation of older siblings’ actions seem to be less important of a factor than expected. Leonard and Hill (2016) conclude that the suggestion that older siblings can be viewed as a model for their younger siblings is not supported by their current data. Although an important study, all participants had only one older sibling and that may have had a substantial effect on the results. Additionally, the sample size upon which this study was conducted was quite small and therefore not necessarily representative of this population.

Cruise and O’Reilly (2014) reported consistent results with Leonard and Hill (2016). Their study examined the apparent contradictory evidence for the effect of siblings and also looked at the influence of a child’s proximal social environment, such as their parents or other important caregivers on an infant’s motor development. Participants were recruited from the Growing Up In Ireland (GUI) study, a commissioned study by the Irish government to examine the health and well-being of Irish children. In total, 10,748 primary caregivers of 9-month-old children completed a developmental questionnaire and provided information on social environment.

Binary logistic regressions indicated that the presence of siblings in the household was a consistent predictor of failing to reach milestones in gross motor, problem-solving and social development at their expected time. Additionally, there was an increasing likelihood of delay in these milestones with an increase in the number of siblings. These
observed negative effects of siblings seem to support the confluence and resource dilution models of sibling effect mentioned above. Interestingly, non-parental care decreased the likelihood of failing in these areas. It should be noted, however, that in this study, the difference between sibling ages and the amount of time spent in non-parental care was not accounted for and these factors may have had a substantial influence on study results.

The Current Study

Existing research regarding sibling effects relating to gross motor milestones is by no means exhaustive. Although much research has examined long-term effects of sibling relationships and general development, motor milestones, which are usually acquired before the age of 18 months, have typically been overlooked (Adolph, Vereijken, & Denny, 1998). The current research tested for milestones that are typically achieved by 18 months of age: turning over, sitting up, crawling, standing and walking. These milestones were used by Brouwer et al. (2006) in a study that also measured gross motor milestones in infants. The current study also builds on the above research by testing the general developmental theories as to their specific effect on gross-motor development. The study focuses on a unique population, that of Orthodox Jewish families living in Israel. Although placing a high value on education, parents do not typically hold postgraduate degrees, and are generally not embracing a materialistic lifestyle. Homes tend to be modest-sized and an overriding importance is placed on cultural practices. As each of the above factors has been shown to effect a child’s development, it was interesting to study these effects within the above confines.
An additional factor that was unique to the study was that, unlike mainstream studies on this topic, it focused on large families—those with five or more children (Staffierei & Bassett, 1970). This parameter works well with the Orthodox Jewish population in Israel, as within this group, families average 6.2 children (Paltiel, Sepulchre, Kornilenko, & Maldonado, 2014). This group was also chosen due to the sizeable role that older siblings tend to play in caring for their younger siblings, as parents are often busy with the practical demands of raising their families. Religious sensitivities also seem to influence sibling involvement in this regard, as strong emphasis is traditionally placed on children honoring and respecting their parents and therefore helping out in any way they can.

Children of this population seem to display high amounts of emotional maturity at young ages. It is not uncommon in Israel to find children as young as four years old picking up milk or sugar at the corner store. By the age of five or six, children can be found accompanying their younger siblings to the park or to school, without the presence of an adult nearby. It was therefore of interest to study whether this apparent advanced emotional maturity would coincide with the early physical maturation of the younger sibling.

Hypotheses

For the purpose of this study, four hypotheses were generated. The first hypothesis was that within the specific families tested, birth order would be inversely correlated with the achievement of gross motor milestones (turning over, sitting up,
crawling, standing and walking), such that in these large families the younger siblings would achieve milestones on average, before their older siblings.

The second hypothesis was that greater age differences between the two siblings would be inversely correlated with the achievement of gross motor milestones, such that the greater the age difference between the older and younger siblings, the earlier the younger child would achieve motor milestones (Abramovitch, Corter, & Lando, 1979).

The third hypothesis was that a female eldest child would be correlated with the earlier achievement of their younger siblings’ gross motor milestones, as in the Orthodox Jewish community first-born females often assume somewhat of a “second mother” role, having extensive contact with younger siblings and thereby providing a close model. In contrast, males in this community tend to spend many more hours in school than their female counterparts, often returning home at night long after their younger siblings are sleeping.

The fourth hypothesis was that the milestone achievements of the older siblings would be the most significant variable in determining the variance in younger siblings’ gross-motor development within their own families. Other known factors to influence development (e.g., mother’s education level, home environment) would be used as variables as well.

Importance

This study is important for several reasons. The first years of a child’s life mark intense biological maturation and behavioral change, especially in motor behavior. Motor development is a critical factor in child behavior, as it is associated with cognitive ability
(Miquelote et al., 2012). Since motor development has such profound effects on a child’s overall healthy development, early identification of motor difficulties is important to ensure that children reach their full developmental potential (Miquelote et al., 2012). This study may help to identify risk factors that could impair motor development, and subsequent steps can be taken, or research conducted, for improving the chances of regular development for these children (Giagazoglou et al., 2011).

Current scientific literature focuses on the acquisition of motor milestones by children above the age of 18 months (Adolph, Vereijken, & Denny, 1998). The focus of this study is on younger children, seeking to provide information that is missing from current literature.

An additional factor unique to this study is that, unlike mainstream studies on this topic, it focused on large families—those with five or more children (Staffierei & Bassett, 1970).
Chapter II

Method

The study was designed to test all of the hypotheses using a correlational design in order to ascertain whether birth order and gross motor development are related. This research was modeled after a similar study conducted by Berger and Nuzzo (2008), which examined whether and how having older siblings influences the onset of their own younger siblings’ motor development. Berger and Nuzzo (2008) relied upon parental recall of their children’s motor milestones onset dates, utilizing data for sibling pairs in order to compare children within the same family. Such a design could serve to corroborate or disprove the hypotheses. The present study built on past research by focusing specifically on an infant’s gross motor development, while taking into account other variables that may affect it (as mentioned above).

The study was designed in a way that compares children within the same family. Due to the wide range of typicality over which development occurs, infant gross motor development was compared to siblings within their own family (Berger & Nuzzo, 2008). In order to accomplish this, information was provided for each milestone, for each of the two participating siblings.

Participants

A total of 52 families contacted researcher for potential participation in this study, with 29 families completing it. The sample consisted of twenty-seven males (n=27) and
thirty-one females (n=31). There were nine (31%) same-gender sibling pairs, five of which were female and four of which were male. There were twenty (69%) opposite-gender sibling pairs, eight pairs in which the female was older and male younger, and twelve pairs in which the male was older and female younger.

Participating sibling pairs were from two-parent homes (in an attempt to eliminate the possibility that they were not spending artificially inflated amounts of time in sibling care due to lack of parental time resources). The older child studied was either the first (n=26) or second (n=1) or third (n=2) child of the family, so as not to have had the experience of growing up with many older siblings (respondent families in which the second or third child was represented as the “older sibling,” had either one or two older siblings who did not meet inclusion criteria). The younger child of the pair was at least three siblings removed (e.g., the first and fifth child or second and sixth) affording them the dual experience of being born to a dynamically large family and that of growing up with siblings. This also provided the younger sibling a range of sibling behaviors to model from (not just the oldest sibling, but all of those in between). The mean age of the older sibling was 20.25 (SD= 9.558) and the mean age of the younger sibling was 7.5 (SD= 6.991). The mean age difference between the two siblings was 12.89 years (SD= 5.2). The mean space gap between the two siblings participating in the study was 4.83 siblings (SD= 2.08).

Participants were recruited from the Israeli Orthodox Jewish population. Four principle reasons led to choosing this population, with the first being that this group tends to have large families, a crucial aspect of this study. Secondly, the population tends towards homogeneity, with less overall variation among the outside variables that may
effect infant development (e.g., mother’s education level, socio-economic status).

Thirdly, within these families eldest girls often tend to assume a caretaker role of their younger siblings, a fact that was useful in testing one of my hypotheses. Lastly, the sample was convenient for study since this is the community in which I was born and raised and I am personally familiar with it.

Siblings studied were healthy, with no significant medical or psychological problems (as such issues may influence rates of development). Since the last milestone tested for was walking, the younger child of the pair had to have reached this milestone. Due to the fact that pre-term infants may develop at a different pace than full-term (Syrengelas et al., 2014), both of the siblings tested were full-term. The number of original respondents who did not meet the above inclusion criteria was 11, and the remaining 12 of the original respondents not included in the study simply did not mail back their questionnaires.

Participants were recruited using advertisements, both online and in printed circular publications which are distributed weekly within this population. As compensation for their participation, families were entered in a raffle for 600nis cash (approximately $170).

Measures

The study protocol utilized two separate measures. The first was employed to determine eligibility for participation, and the second was used to collect the data needed for this study. As in the study conducted by Berger and Nuzzo (2008), the data was
collected retrospectively using measures that were generated by the researcher in order to assess the specific variables being tested for.

The eligibility form functioned as a preliminary screening measure in order to exclude participants who did not meet the basic criteria for study participation (see Appendix A). This form was seen solely by the researcher and was administered over the telephone. The first two questions involved general family information, while the remaining four questions focused on the specific sibling pair to be included in the study. Questions included but were not limited to whether children were from a two-parent home, whether the family consisted of at least five children, and whether either of the siblings was born prematurely.

Parental questionnaires functioned as developmental reports and were filled out by participating parents in order to collect information about the sibling pairs (see Appendix B for English version, and Appendix C for Hebrew version). The questionnaires began with instructions for filling them out, and were followed by a table gathering general information about the two sibling participants. For each child, space was allotted to record gender, age, where these children fell within the family order (e.g., first and fifth or second and sixth) and birth weight [since birth weight has been shown to have a significant effect on the achievement of motor milestones (Vaida, 2013)]. The table then assessed the average amount of time per week the child spent from 0-18 months under grandparent or babysitter care using the following scale: under 10 hours, 10-30 hours, or over-30 hours.
The questionnaire continued with a second table to record the onset ages in which the two sibling participants reached the specific motor milestones tested for (turning over, sitting up, crawling, standing and walking).

Other factors known to influence gross motor development were assessed through a series of scales. Household income was assessed on a four-point scale: poverty, low-income, middle-class or high-income (actual per-year dollar amount cut-off points were indicated on the questionnaire immediately prior to commencement of the study to ensure accuracy). Mother’s highest education level was assessed according to the following scale: completion of eighth grade, high school, diploma, bachelor’s degree or advanced degree. A final scale was used to assess the size of the family home: small, average or large, with an associated question asking whether any adjacent play space (e.g., porch or yard) to the home exists (actual by-meter cut-off points for home size were indicated on the questionnaire immediately prior to commencement of the study to ensure accuracy).

Evidence exists as to the validity of such parental reports (Bodnarchuk & Eaton, 2004; Knobloch et al., 1979; Cruise & O’Reilly, 2014; Reid, Stahl & Striano, 2010). Parents were encouraged to consult personal records (such as home videos, photo albums, baby books, etc.) in order to record the onset dates for their children’s achievement of milestones. (Several parents in fact mentioned that they intended to make use of this suggestion during their telephone eligibility interview). Parents were also made aware of the option to request developmental reports from their children’s pediatric clinics or nursing stations.
Procedure

As this study involved retrieving information regarding human participants, prior to its commencement an application was sent to the Institutional Review Board (IRB) for approval. A revised application was subsequently submitted since according to the protocol below participants’ identities would not remain completely anonymous (as stipulated in the original request). The subsequent request was amended to read “data will remain confidential.”

Once the application was approved by the IRB, the advertising stage began. Advertisements (see Appendix D for English version, and Appendix E for Hebrew version) were posted in neighborhood online forums, as well as in printed circulars distributed weekly within this population. The study was also advertised via word of mouth, between friends and family members of the researcher. A contact phone number and email address were provided in order for interested parents to request an eligibility interview (see Appendix A).

The researcher conducted eligibility interviews over the telephone. Parents meeting eligibility requirements generally provided both a mailing address and email address in order to enroll in the study; those families without email capability provided a telephone number along with their mailing address.

According to their personal preference, qualified parents were mailed either a physical or electronic copy of the Letter of Intent/Consent (see Appendix F for English version, and Appendix G for Hebrew version) along with the parental questionnaire. This Letter of Intent/Consent openly described the study’s intent, with no information hidden from participants. The purpose of the research, potential benefits, any compensation for
participation, and the protocol for keeping the data collected as confidential as possible were all explained. Additionally, participants were advised about how to contact the researcher if they had any questions or concerns about the study, either during or after participation. This letter eliminated the need for a debriefing at the end of the study.

Participants were instructed to initial and date their Letter of Intent/Consent and return the executed form along with their completed questionnaire. In order to protect participants’ privacy, only initials were requested on the Letter of Intent/Consent Form and no identifying information was requested on the parental questionnaire. For those participants who were mailed a physical copy of the study materials for participation, a self-addressed, stamped envelope was provided in which to return the completed forms. Those participants who opted to receive the measures by email returned their data electronically (they were aware of the fact that by doing so, their data would have slightly less confidentiality and would be more easily identifiable).

Each questionnaire was numbered from 1-41 in the bottom right-hand corner. Physical copies of the questionnaire were stuffed into an envelope together with a correspondingly numbered card (which participants were asked to keep as identification for the 600nis raffle following the study’s completion). These were sealed and shuffled prior to addressing them in order to ensure participants’ confidentiality. Electronic questionnaires were sent with a note that requested participants to record and save the number of their questionnaire for purposes of raffle identification.

Following 45 days of collection, a total of 29 completed questionnaires were received and the data collection stage concluded. Record was kept of questionnaire numbers returned, in order for each participating family to be entered into the
compensation raffle. Data was entered onto the researcher’s personal laptop computer, protected by an 8-digit passcode. Physical questionnaires were then shredded.

Upon completion of the data entry, a raffle was conducted by writing all of the questionnaire numbers on identical white papers that were then folded and mixed in a large bowl. One winning number was chosen. All participants were notified by email or telephone of the winning number, and were thanked for their time and participation.
Chapter III

Results

Survey responses were coded and entered into excel and moved for analysis to SPSS. Descriptive statistics were run on the data as a preliminary check to make sure that the data was consistent with expectations and that no significant data was omitted.

Data analysis plan

In order to investigate whether or not younger children born to large families achieve gross motor milestones before their own older siblings, a series of t-tests were conducted. If a significant difference was present, mean ages for achievement were used to establish direction.

Pearson’s correlations were conducted on each milestone achieved by the younger child in order to examine if an inverse correlation exists between having a larger age gap between siblings, and the earlier achievement of motor milestones in the younger sibling.

To check if having an older sibling who is female was related to the development of their younger siblings such that they achieve milestones earlier than in families where the older child is male, a series of Pearson’s correlations were used to detect if a relationship existed between gender and the younger child’s achievement of milestone. As results were insignificant, means were not compared.

In order to test the hypothesis that among the factors studied that may influence a child’s development, interfamily variability would be the strongest predictor, Pearson
correlations were conducted first to check if older and younger siblings’ milestones were at all related. Then, a series of stepwise linear regressions were conducted to test the amount of variance that could be explained by all variables in the equation, while at the same time ranking the variables in order of importance and significance.

Demographic characteristics

The final sample included 58 individuals from 29 sibling pairs. There were 30 male participants and 28 females. As shown below in the descriptive statistics table (Table 1), the mean age of the older sibling was 20.259 (SD= 9.5587) and the mean age of the younger was 7.5 (SD= 6.9911), thus following that the mean age gap between siblings was 12.897 (SD= 5.2). It can also be gleaned from the chart below that the average child spent about 20 hours per week in care other than their parents’ (M= .62, SD= .834), and that the mean family income was 1.68 (SD= .811). This means that the average family participating in this study had a slightly lower than average income for a large Israeli family. Homes seemed to be average for Israel (M= 1.10, SD= .765), and the average mother in the study had completed high school and received a diploma (M= 2.17, SD= .84). It is interesting to note that only 7 mothers completed college and only an additional 2 had any advanced degree.

Additionally, before presenting the analysis, it should be mentioned that some data was missing: four of the subjects for age of sitting, two subjects for age of crawling, and one subject each for ages of standing and walking.
Table 1

Descriptive statistics on sample variables

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgeDiff</td>
<td>58</td>
<td>4.5</td>
<td>25.0</td>
<td>12.897</td>
<td>5.2002</td>
</tr>
<tr>
<td>Birthweight</td>
<td>58</td>
<td>2.50</td>
<td>4.70</td>
<td>3.3634</td>
<td>.44906</td>
</tr>
<tr>
<td>AgeTurn</td>
<td>58</td>
<td>2.0</td>
<td>8.5</td>
<td>3.780</td>
<td>1.4065</td>
</tr>
<tr>
<td>AgeSit</td>
<td>54</td>
<td>4.0</td>
<td>11.0</td>
<td>6.963</td>
<td>1.7316</td>
</tr>
<tr>
<td>AgeCrawl</td>
<td>56</td>
<td>4.0</td>
<td>14.0</td>
<td>7.750</td>
<td>2.0649</td>
</tr>
<tr>
<td>AgeStand</td>
<td>57</td>
<td>5.5</td>
<td>16.0</td>
<td>10.026</td>
<td>2.0646</td>
</tr>
<tr>
<td>AgeWalk</td>
<td>57</td>
<td>9.0</td>
<td>22.0</td>
<td>13.342</td>
<td>2.8663</td>
</tr>
<tr>
<td>Hour ayCare</td>
<td>58</td>
<td>0</td>
<td>2</td>
<td>.62</td>
<td>.834</td>
</tr>
<tr>
<td>FamIncome</td>
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<td>0</td>
<td>3</td>
<td>1.68</td>
<td>.811</td>
</tr>
<tr>
<td>MothersEdu</td>
<td>58</td>
<td>1</td>
<td>4</td>
<td>2.17</td>
<td>.841</td>
</tr>
<tr>
<td>HouseSize</td>
<td>58</td>
<td>0</td>
<td>2</td>
<td>1.10</td>
<td>.765</td>
</tr>
<tr>
<td>AgeOlder</td>
<td>29</td>
<td>8.0</td>
<td>51.0</td>
<td>20.259</td>
<td>9.5587</td>
</tr>
<tr>
<td>AgeYounger</td>
<td>29</td>
<td>1.0</td>
<td>28.0</td>
<td>7.500</td>
<td>6.9911</td>
</tr>
</tbody>
</table>

Birth order and milestone achievement

Significant differences were found between the ages of achievement of older and younger children’s milestones (Table 2). However, results were found in the opposite direction then originally hypothesized, whereas older children constantly outperformed their younger siblings by reaching their motor milestones earlier as opposed to the younger children developing more rapidly (Figure 1).

To test the hypothesis that younger siblings turn over at a younger age than their own older siblings, means were compared. Overall, in the entire sample the mean age of achievement was 3.78 months (SD= 1.4). The mean for all older siblings in the sample was 3.62 months (SD= 1.36) and for all younger siblings 3.94 months (SD= 1.455).
significant difference in ages was found between the ages of younger and older children learning to turn over \((t(28)=14.33, p<.001)\), whereas older siblings achieved this milestone on average earlier than their younger siblings.

**Figure 1**

*Means (marked x) and standard deviations per milestone for younger and older children*

Similarly, when checking if younger siblings sat before their own older siblings, means were compared. The average age of achieving this milestone in the entire sample was 6.96 months (SD= 1.73). Older siblings averaged 6.64 months (SD= 1.71) and younger siblings 7.27 (SD= 1.72) months. T-tests displayed a significant difference in ages of achievement \((t(26)=20.151, p<.001)\), whereas older siblings achieved this milestone significantly earlier than their own younger siblings.
In order to test if a significant difference in means existed between the ages that older and younger siblings learned how to crawl, t-tests were once again conducted. The mean age of achievement in the entire sample was 7.75 months (SD= 2.06). The average age of the older siblings learning to sit was 7.57 months (SD= 1.71) and the average for the younger child was 7.9 months (SD= 1.72). The t-test was significant (t(28)=23.14, p<.001), and showed once again that earlier born children achieve this milestone before their own younger siblings.

In the same manner, in order to check if younger siblings stand earlier than their older siblings, means were compared. The average age of achieving this milestone throughout the sample was 10.026 months (SD= 2.064). The mean age of achievement for older siblings was 9.82 months (SD= 1.96) and for the younger sibling 10.23 months (SD= 2.18). Again, t-tests showed that the opposite was true (t(28)= 26.99, p<.001). Older siblings learned how to stand significantly earlier than their younger counterparts.

Lastly, to test the hypothesis that younger children would learn how to walk earlier than their older siblings, means were compared. The average age of achieving this milestone across the sample was 13.342 months (SD= 2.866). Older children averaged mastering this milestone at 13.241 months (SD= 3.13) and younger children at 13.45 months (SD= 2.62). A significant difference was found between ages of achievement of this milestone (t(28)=22.8, p<.001) such that, as in all the other milestones, older children achieved walking significantly before their own younger siblings.
Table 2

*T-tests results for all milestones*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>DF</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TurnOld</td>
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<td>3.621</td>
<td>1.3605</td>
<td>14.331</td>
<td>28</td>
<td>.000</td>
</tr>
<tr>
<td>TurnYoung</td>
<td>29</td>
<td>3.941</td>
<td>1.4552</td>
<td>14.586</td>
<td>28</td>
<td>.000</td>
</tr>
<tr>
<td>SitOld</td>
<td>27</td>
<td>6.648</td>
<td>1.7143</td>
<td>20.151</td>
<td>26</td>
<td>.000</td>
</tr>
<tr>
<td>SitYoung</td>
<td>27</td>
<td>7.278</td>
<td>1.7228</td>
<td>21.951</td>
<td>26</td>
<td>.000</td>
</tr>
<tr>
<td>CrawlOld</td>
<td>29</td>
<td>7.569</td>
<td>1.7613</td>
<td>23.142</td>
<td>28</td>
<td>.000</td>
</tr>
<tr>
<td>CrawlYoung</td>
<td>27</td>
<td>7.926</td>
<td>2.3967</td>
<td>17.184</td>
<td>26</td>
<td>.000</td>
</tr>
<tr>
<td>StandOld</td>
<td>29</td>
<td>9.828</td>
<td>1.9607</td>
<td>26.992</td>
<td>28</td>
<td>.000</td>
</tr>
<tr>
<td>StandYoung</td>
<td>28</td>
<td>10.232</td>
<td>2.1836</td>
<td>24.795</td>
<td>27</td>
<td>.000</td>
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<td>WalkOld</td>
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<td>13.241</td>
<td>3.1271</td>
<td>22.803</td>
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</tr>
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<td>WalkYoung</td>
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<td>13.446</td>
<td>2.6223</td>
<td>27.133</td>
<td>27</td>
<td>.000</td>
</tr>
</tbody>
</table>

Age gap and milestone achievement

In order to test the hypothesis that a larger age gap between siblings would lead to earlier milestone attainment of the younger sibling, a series of Pearson correlations were used (Table 3). An inverse and significant correlation would support the hypothesis for any of the milestones, but as can be seen in the table below, this was not the case for any of them. The correlation between the age gap among siblings and the age of learning to turn over had a Pearson correlation of .087 and was insignificant. A rather weak inverse correlation between the sibling age gap and the younger child’s achievement of sitting was found; however, it was insignificant (p= .101). The correlations between crawling and standing with age gap were positive (r= .197, r=.037 respectively) and insignificant.
Another very weak inverse linear correlation was found between age difference and the younger child learning to walk, however this as well was insignificant.

**Table 3**

*Pearson correlations for age difference and the age of achievement of younger siblings’ milestones*

<table>
<thead>
<tr>
<th></th>
<th>AgeDiff</th>
<th>FlipYoung</th>
<th>SitYoung</th>
<th>CrawlYoung</th>
<th>StandYoung</th>
<th>WalkYoung</th>
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<tr>
<td>AgeDiff Pearson Corr.</td>
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<td>.087</td>
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<td>.037</td>
<td>-.054</td>
</tr>
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<td>27</td>
<td>27</td>
<td>28</td>
<td>28</td>
<td></td>
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<tr>
<td>FlipYoung Pearson Corr.</td>
<td>1</td>
<td>.552**</td>
<td>.551**</td>
<td>.623**</td>
<td>.615**</td>
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<td>27</td>
<td>28</td>
<td>28</td>
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<tr>
<td>SitYoung Pearson Corr.</td>
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<td>.590**</td>
<td>.590**</td>
<td>.536**</td>
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<td></td>
</tr>
<tr>
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<td>26</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CrawlYoung Pearson Corr.</td>
<td>1</td>
<td></td>
<td>.660**</td>
<td>.466*</td>
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<td></td>
</tr>
<tr>
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<td></td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>StandYoung Pearson Corr.</td>
<td>1</td>
<td></td>
<td></td>
<td>.734**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td></td>
<td></td>
<td>27</td>
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</tr>
<tr>
<td>WalkYoung Pearson Corr.</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).**

**Gender of older child and milestone achievement**

Pearson correlations were conducted to determine if there was any relationship between the gender of the older sibling in the family and the achievement of the younger child’s motor milestones. This would be the first step in attempting to prove the hypothesis that having an older sibling who is female may lead to the earlier achievement of motor milestones for the younger child. As can be seen in the table below (Table 4), although the correlation between the gender of the older child, and the younger child’s age at walking (r= .339) approached significance (p= .077), all other correlations were
insignificant (p > 0.05) and weak (r < 0.3) hence it was unnecessary to continue this analysis.

Table 4

**Pearson correlations for gender of the older sibling and the age of achievement of younger siblings’ milestones**

<table>
<thead>
<tr>
<th>GenOlder</th>
<th>Pearson Corr.</th>
<th>FlipYoung</th>
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<th>.100</th>
<th>.121</th>
<th>.235</th>
<th>.116</th>
<th>.339*</th>
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<td>27</td>
<td>27</td>
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<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>SitYoung</td>
<td>Pearson Corr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>26</td>
<td>26</td>
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<td>25</td>
</tr>
<tr>
<td>StandYoung</td>
<td>Pearson Corr.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>N</td>
<td></td>
<td>1</td>
<td>.660*</td>
<td>.536**</td>
<td>.536**</td>
<td>.536**</td>
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<td>1</td>
<td>.734**</td>
<td>.536**</td>
<td>.536**</td>
<td>.536**</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).**

*Correlation is significant at the 0.05 level (2-tailed).

Correlation approaches significance.

Predicting milestone achievement

Tables 5 through 9, and Figures 2 through 6 below, display the correlation coefficients between the older and younger siblings’ achievement of identical milestones. This series of Pearson correlations was done as a preliminary analysis in order to help prove the hypothesis that although many variables are involved in influencing a child’s development such as their mother’s education level, socioeconomic status etc., a child’s own older sibling’s achievements would be the strongest predictor of their development. As expected, a strong correlation ($r = .645$, $p < .001$) was found between the older child’s
age at turning over and their own younger sibling’s age at achieving this milestone.

Additionally, a strong correlation was found between the ages older and younger siblings learning to sit ($r = .546, p < .001$), as well as between sibling ages of achieving crawling and standing ($r = .754, p < .001$; $r = .690, p < .001$ respectively). However, the correlation between older and younger siblings’ achievement of walking was only significant at the 0.05 level for a two-tailed test ($r = .471, p < .05$).

Table 10 displays the correlations between all of the variables added to the regression model (aside from the older child’s milestone achievements) which are known to affect child development (see introduction). This was done to detect collinearity, since multicollinearity results in unstable parameter estimates, which in turn makes it very difficult to assess the effects of independent variables on the dependent variable. Indeed, significant correlations were found between a family’s monthly income and the size of their house ($r = .451, p < .001$), and between a family’s house size and whether or not there was adjacent play space ($r = .303, p < .05$). The correlation between a child’s birth order and birth weight approached significance ($r = .246, p = .063$) and the correlation between a child’s birth weight and their family’s monthly income, although also rather weak, also approached significance ($r = -.248, p = .065$). This data was useful when building the linear regression model to test the hypothesis, because the variable for a family’s house size was removed from the model and the family’s monthly income was used as a reliable substitute.
Table 5

*Pearson correlations for siblings’ achievement of turning over*

<table>
<thead>
<tr>
<th></th>
<th>FlipOld</th>
<th>FlipYoung</th>
</tr>
</thead>
<tbody>
<tr>
<td>FlipOld Pearson Corr.</td>
<td>1</td>
<td>.645**</td>
</tr>
<tr>
<td>N</td>
<td>29</td>
<td>1</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2

*Correlation scatterplot for siblings’ achievement of turning over*
Table 6

*Pearson correlations for siblings’ achievement of sitting*

<table>
<thead>
<tr>
<th></th>
<th>SitOld</th>
<th>SitYoung</th>
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</thead>
<tbody>
<tr>
<td>SitOld Pearson Corr.</td>
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<td>.546**</td>
</tr>
<tr>
<td>N</td>
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<td></td>
</tr>
<tr>
<td>SitYoung Pearson Corr.</td>
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<td></td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 3

*Correlation scatterplot for siblings’ achievement of sitting*
Table 7

*Pearson correlations for siblings’ achievement of crawling*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CrawlOld</td>
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</tr>
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<td>27</td>
<td></td>
</tr>
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<td>Pearson Corr.</td>
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</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4

*Correlation scatterplot for siblings’ achievement of crawling*

$R^2$ Linear = 0.569
Table 8

*Pearson correlations for siblings’ achievement of standing*

<table>
<thead>
<tr>
<th></th>
<th>StandOld</th>
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</thead>
<tbody>
<tr>
<td>StandOld</td>
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</tr>
<tr>
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</tr>
<tr>
<td>StandYoung</td>
<td>Pearson Corr.</td>
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</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 5

*Correlation scatterplot for siblings’ achievement of standing*
Table 9

*Pearson correlations for siblings’ achievement of walking*

<table>
<thead>
<tr>
<th></th>
<th>WalkOld</th>
<th>WalkYoung</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
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<td>28</td>
<td>1</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 6

*Correlation scatterplot for siblings’ achievement of walking*
Table 10

Pearson correlation matrix used to detect collinearity among variables used in the linear regression model

<table>
<thead>
<tr>
<th>Correlations</th>
<th>BirthOrder</th>
<th>Birthweight</th>
<th>HrsDayCare</th>
<th>MothersEdu</th>
<th>FamIncome</th>
<th>HouseSize</th>
<th>AdjPlaySpace</th>
</tr>
</thead>
<tbody>
<tr>
<td>BirthOrder</td>
<td>Pearson Corr.</td>
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<td>.246</td>
<td>-.134</td>
<td>-.012</td>
<td>-.021</td>
<td>.107</td>
</tr>
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<td>58</td>
<td>56</td>
<td>58</td>
<td>58</td>
<td></td>
</tr>
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<td>Pearson Corr.</td>
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<td>.011</td>
<td>-.100</td>
<td>-.248</td>
<td>-.115</td>
<td>-.092</td>
</tr>
<tr>
<td>N</td>
<td>58</td>
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<td>.071</td>
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<td>FamIncome</td>
<td>Pearson Corr.</td>
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<td>.451**</td>
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<tr>
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<td>.303*</td>
<td>.107</td>
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</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
B. Correlation approaches significance.

In order to test the hypothesis that interfamily variability plays the largest role in predicting the overall variability in the achievement of the younger born sibling’s milestones (as opposed to many other known variables presented in the literature), stepwise linear regression analyses were run five times (Table 11), the dependent variable was a different one of the younger sibling’s milestones each time. As expected, stepwise regressions eliminated all insignificant variables and produced models in which the only independent variable fitted was the older sibling’s achievement of the same milestone.

When testing which variables would explain most of the variance in a younger child’s achievement of turning over, the younger child’s birth weight, mother’s education
level, family income, average hours at day care, whether or not the family had outdoor play space, and the ages of their own older siblings achieving this milestone were entered as variables. Stepwise regression fitted a model in which the younger child’s attainments could be predicted by their own older sibling’s attainments alone, using the following formula: younger child’s age at turning over = 1.576 + .662 x older child’s age at turning over ($R^2=.388$, $F=16.502$, $p<.001$). All other variables were found to be insignificant ($p>.05$) and therefore not useful to the model.

Similarly, tests were run to see which variables would explain the most variance in the younger sibling’s achievement of all the other milestones. The same variables mentioned in the above model were placed in the regression equation, and their older sibling’s attainment of each particular milestone was used as well. Stepwise regressions once again fitted models whereas the younger children’s milestone achievements were best predicted by interfamily variability. All other variables entered were insignificant ($p>.05$) and therefore excluded. The younger sibling’s attainment of sitting was predicted using the following formula: younger child’s age at sitting = 3.663 + .548 x older child’s age at sitting ($R^2=.298$, $F=10.592$, $p<.005$). The younger sibling’s attainment of crawling was similarly predicted using the formula: younger child’s age at crawling = .336 + 1.019 x older child’s age at crawling ($R^2=.559$, $F=30.383$, $p<.001$). In the same way, the younger sibling’s attainment of standing was predicted using the formula: younger child’s age at standing = 2.987 + .747 x older child’s age at standing ($R^2=.476$, $F=22.733$, $p<.001$); and lastly, the younger sibling’s attainment of walking was best predicted by: younger child’s age at walking = 8.579 + .372 x older child’s age at walking ($R^2=.205$, $F=6.449$, $p<.05$).
Table 11

*Results for all five stepwise regression analyses*

<table>
<thead>
<tr>
<th>Model</th>
<th>R Square</th>
<th>β constant</th>
<th>β independent</th>
<th>F</th>
<th>Sig.</th>
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<td>1.576</td>
<td>.662</td>
<td>16.502</td>
<td>.000</td>
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<tr>
<td>Sitting</td>
<td>.298</td>
<td>3.633</td>
<td>.548</td>
<td>10.592</td>
<td>.003</td>
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<td>Crawling</td>
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<td>.336</td>
<td>1.019</td>
<td>30.383</td>
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<tr>
<td>Standing</td>
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<td>2.987</td>
<td>.747</td>
<td>22.733</td>
<td>.000</td>
</tr>
<tr>
<td>Walking</td>
<td>.205</td>
<td>8.576</td>
<td>.372</td>
<td>6.449</td>
<td>.018</td>
</tr>
</tbody>
</table>
Chapter IV

Discussion

The purpose of this study was to examine the relationship between the achievement of motor milestones and possible birth order effects in infants and toddlers born to large families, while additionally testing for other known variables that have been shown to significantly effect gross motor development. After examining the average characteristics of the population for all variables in order to determine the overall features of the sample, the study tested four hypotheses: that younger children would develop faster than their own older siblings for all five milestones being tested; that the larger the difference in age between sibling pairs, the sooner the younger sibling would achieve proficiency of the milestones tested; that a female eldest child would be correlated with the earlier achievement of their younger siblings’ gross motor milestones; and that the milestone achievements of the older siblings would be the most significant variable in determining the variance in younger siblings’ gross-motor development within their own families. Other influences on development (e.g., mother’s education level, home environment) were tested for as well. The objective of the study, in generalized terms, was to expand upon on the sparse existing literature concerning the interaction between these variables.

T-test analyses comparing the mean age of achievement of motor milestones for younger children as compared to their older siblings showed significant differences in attainment age for all milestones being tested. It was hypothesized that younger siblings
would achieve their milestones earlier than their older siblings; however, mean comparisons showed that the opposite was true for all milestones. Younger children consistently reached milestones at later ages than their older siblings reached them. A possible explanation for this finding may be that the presence of numerous older children in such households may have resulted in the younger child being held more often than their older siblings, thereby reducing floor time and potentially slowing motor development.

Another possible explanation for the results may stem from parental efforts in protecting their younger children from possible harm in an active household. As previously mentioned, the average home size in Israel is relatively small, and with large families living in close quarters the possibility of infants sustaining inadvertent harm by older siblings is magnified. In order to protect their babies, parents may have been removing them from the floor and confining them to playpens, strollers or high chairs. Such actions, although well meaning, may have delayed their motor development. These findings corroborate the findings of Cruise and O’Reilly (2014) who found that the presence of siblings in a household is a consistent predictor of failing to reach gross motor milestones at the same ages as their older siblings.

It should be noted that the American Academy of Pediatrics and the Canadian Society for Exercise Physiology actively encourage physical movement in young children in order to promote proper development and combat obesity. To this end, they have published guidelines that recommend limiting stroller use for young children. The CSEP further advocates limiting prolonged sitting or being restrained, such as in a high chair, for more than one hour at a time. Researchers have suggested that restraining children
and/or confining them are a risk factor for limited physical activity (Gunner, Atkinson, and Nichols, 2005).

Research examining the differences in gross motor development between children attending day care centers as opposed to family day care did not yield substantive results. Most current studies focus on the difference in educational and/or emotional outcomes between these two types of day care and do not directly address the effects on motor development. Future research may seek to explore these differences with regard to motor development, since day care centers group the children by age while family day cares tend to have many children of different ages sharing the same space.

Because analysis of the data showed the opposite of what was predicted, it would follow that health care professionals working with infants and young children (such as within pediatric clinics and nursing stations), as well as day-care providers, should be made aware that although it could be expected that younger born children may be developing at a slightly slower rate than their older siblings, this still should not be overlooked. These younger children may very likely fall to the lower end of normal development, thereby shifting the normal curve slightly to the left for younger born children in large families. This scientific knowledge may be both important and useful in properly tracking the developmental progress of such children.

One practical application of this idea would be in assisting the early identification of Developmental Coordination Disorder (DCD) disorder. DCD is a chronic neurological disorder that affects a child’s motor skills (Camden, Wilson, Kirby, Sugden, & Missiuna, 2014). Children suffering from DCD have difficulties with routine motor skills and coordination, which result in an inability to perform certain everyday tasks. This condition
is rarely diagnosed before the age of five, a fact that is problematic since the longer the
disorder is left untreated, the greater the possibility that secondary difficulties may arise
(Giagazoglou et al., 2011). Hence, increased data regarding the timely attainment of
infant motor milestones may help to detect such conditions in a more timely manner
which might greatly assist treatment efficacy.

Pearson correlations examining the relationship between the age differences in
sibling pairs and the younger child’s achievement of motor milestones found no
significant data to corroborate the hypothesis that the larger the age gap between siblings,
the earlier the younger child would achieve their motor milestones (only two out of five
relationships were inverse and neither approached significance). In fact, no significant
correlation in either direction was found. This finding was surprising as Abramovitch,
Corter, and Lando, (1979) contend that the greater the age gap between siblings, the more
likely the younger siblings are to model their older siblings’ behaviors.

In their study, Abramovitch, Corter, and Lando (1979) do not specify the age limit
until which this hypothesis is still valid; therefore, it is possible that the substantial
differences found between the sibling pairs’ ages in the current study might help to
explain the results received. The rather large age gap that was often present between the
older sibling involved in childcare and their younger sibling may have caused the concept
of this model to lose some of its relevancy. Since the actual data was non-significant, the
possibility may also exist that behavioral modeling does not consistently lead to gross
motor development. Another possible explanation for this finding might be that the
sample size was too small to accurately test this hypothesis.
The third hypothesis was that having a female older sibling would coincide with their younger sibling’s earlier achievement of motor milestones. Pearson correlations found no significant correlations between these variables. Possible explanations for these findings include the very small sample size as well as the likelihood that the reported older child was not a primary caregiver of their younger sibling—that role may have fallen to another older child in the family. It would have been interesting to request data from parents on whether or not the older child was a primary caregiver.

As expected, correlational analyses testing for the relationships between older and younger siblings’ achievements of the same milestones were significant. Stepwise regressions conducted on all variables known to effect a child’s gross motor development eliminated all variables except for the older child’s achievements, thereby producing significant models whereas interfamily variability played the largest role in determining the overall variance when attempting to predict younger siblings’ development. This held true across all five milestones tested: turning over, sitting, crawling, standing and walking.

It was surprising to the researcher that all the other entered variables were insignificant and none even approached significance, because these are established variables known to effect child development. Many possible reasons for this discrepancy may exist, the first being that many of the studies published on gross motor development in infancy were not conducted on large families. Having many older siblings can change the dynamic of an infant’s environment, thereby rendering some of these variables not useful. Another possibility may be the demographic characteristics of this particular sample. The lack of interfamily variability may have led to restriction of range for these
demographic variables, and restricted range may have led to attenuated correlations. Additionally, the small sample size used in this study would play a role in the results.

Although not all hypotheses were supported, findings shed light on the relationship between many factors known to effect infant development and the attainment of gross motor milestones. This data should prove useful in generating awareness among childcare professionals as to the importance of these factors in a child’s development, since it can be expected that younger children’s motor development achievements may be predicted from their older sibling’s development. Such professionals may then choose to establish informational profiles on individual children and to consult them in order to optimize and adapt early intervention programs, should the need arise (Giagazoglou et al., 2011).

It is important to mention that this study was conducted with a focus on an infant’s achievement of gross motor milestones. It would be enlightening to study the effects of having many older siblings on other facets of early development. Quite possibly the outcomes of the study would be different if language development or social awareness would be tested for. Likely in these areas younger children would master such skills earlier than their older siblings.

Limitations

This study may be considered somewhat limited due to its utilization of a correlational design approach. Although correlational studies may determine whether a relationship between two variables exists, such studies do not establish causation. Therefore, although the findings of the current research may help to explain certain
aspects of the relationships between having older siblings and gross motor development in infants (as well as the relationships between other known variables to effect infant development and how they play out in large families), it is incorrect to assume that any one variable has directly caused a change in another variable.

The study was completed as part of a thesis assignment and was thus narrow in scope. The sample size used was small (29 families) and the participants were collected from a specific and limited population, those of large Orthodox Jewish families residing in Israel. Testing such a constricted population effectively negates the feasibility of drawing any generalized conclusions within society as a whole from the current research findings.

Reliability is the degree of consistency of a measure, with such a measure producing stable and consistent results during a study’s replication. Because the researcher generated the measures utilized by this study, the possibility exists that internal validity may have been questionable. Possible inaccuracies in this area may have caused the collected data to become skewed, subsequently tainting the statistical analysis that relied upon it.

External validity may have been compromised as the study was intended for a narrow population, with the measures used being designed specifically for use therein. It could therefore be confounding to utilize the study’s measures outside of Israel. For example, whereas homes in Israel are notably smaller, on average, than those in the United States, they are quite possibly larger than homes in China. In order to replicate the study with any population other than the original population for which it was intended,
measures would require evaluating and fine-tuning for the specific parameters existing within the intended population.

Another limitation of the measures used was that operational definitions were not provided to the participants for filling out of their questionnaires—the interpretation of each “milestone” was left completely to the discretion of the parent. The questionnaire, for example, requested parents to enter the onset age of their child “walking.” This can be interpreted as the child taking their first step, six consecutive steps, or as the age in which the child achieved complete proficiency. Differences between these sub-categories of achievement could possibly have been weeks apart. This limitation would hold true for all milestones tested for.

The current study examines the relationships between other family factors that may effect the achievement of gross motor milestones in infants. The researcher chose these specific factors, stemming from personal interest and applicability to the population being tested. Most of these variables were not correlated with infant gross motor development in this study. The possibility exists, however, that other potentially significant factors that may have effected the achievement of gross motor capabilities in infants, or even development within a large family, may have been omitted and therefore untested.

Parental recall was relied upon heavily in the data collection process. Although certain research suggests that parental reports are valid, there exists the possibility that parental recall may have been inaccurate. By way of design this process was somewhat unavoidable, however this factor should be taken into account.
Further compounding the issue of parental recall was the fact that some of the participating siblings in this sample were already considerably older children [as mentioned above, the mean age for the older sibling was over 20 years of age (Table 1)]. As parental recall naturally diminishes somewhat as children age, such parents may have had a more difficult time accurately reporting milestone onset ages. Despite the fact that parents may often place more significance on the milestone achievements of their older versus their younger children (often documenting each achievement with photographs and/or memory books), even these memories are subject to distortion with the passage of time.

In order to accurately ensure recall for older siblings’ motor milestones, data would need to be collected prospectively in a similar way for older and younger siblings during the appropriate timeframe for each child. This would either be possible by implementing a longitudinal study design or alternately a large cohort study, where the older sibling is already being studied and then their younger siblings would be followed up on.

One main unanswered question that arises from this study is that of the possible effects of the middle siblings. The study tests only for the older and younger sibling, but the (at minimum) three siblings between the pair are unaccounted for. This is a significant shortcoming in obtaining an accurate picture of the sibling pairs within their families. These middle siblings may have been closer or father in age from the younger, with these differences affecting development in different ways. For example, having a sibling very close in age affords a young child with a close model that is easy to imitate. On the other hand, having several siblings farther apart in age might minimize a child’s
need to achieve independent mobility since such a child may always be held. Testing for middle siblings might also shed light on potential developmental trends within the family (e.g. does development become progressively faster or slower? Is there a difference between genders? etc.).

The quality of the relationship between the siblings, both between the participating sibling pairs as well as the middle siblings, may have additionally effected the younger child’s development. A significant correlation was found by Leonard and Hill (2016) between perceived aggressive behavior between siblings and infant motor skills at 18 months, suggesting the importance of considering reciprocal effects of motor development on sibling relationships. Future research may seek to explore how relationships between members of large families, and the dynamics unique therein, play a role in this regard.

Although the present study was designed to examine the influence of older siblings, parental care, mother’s education, socioeconomic status, house size and more on the development of infant gross motor skills, it is appropriate to acknowledge that these variables could very possibly have been confounded by one another. Although significant collinearity issues were taken into account, other relationships were close to approaching significance, and with a bigger sample size, would likely have been significant, thereby negatively affecting the regression model. As shown in the results section (Table 10), one such example is infant birth weight: although birth weight is used as a variable in this study, the possible interaction between birth weight and birth order was not controlled for. Firstborns tend to have lower birth weights than later-borns (Khong, Adema, & Erwich, 2003). Additionally, birth weights for male children are traditionally higher than
for female children (Kramer, 1987), conveying toward these children a disadvantage in terms of ease of mobility.

It is also important to note that although participating children were screened for significant medical issues known to effect development, some may have presented with relatively minor complicating conditions affecting development, such as acid reflux or trouble nursing (both of which are known to affect infant weight gain). Although these factors may have had a technical influence on the cleanliness of the data, arguably the data may be construed to be more representative and generalizable since many children do indeed live with these conditions.

Selection bias may have been present in this study as well. Due to the nature of this study as a thesis project, funds were limited leading to a smaller compensation offer for participants. It is therefore feasible to assume that primarily participants who were somewhat financially limited would take the time to respond for the chance of winning the raffle. Indeed, the mean income for this sample was 1.68, translating into lower-than-average income (2.0). Many of these participants voluntarily described themselves as teachers or running home-based playgroups and mentioned that they responded because of their personal interest in the topic.

Finally, although somewhat obvious, it is important to note that with regard to parental characteristics the researcher relied on the general aptitude of the parents to provide adequate childcare and balanced nutrition for their families.
Future Directions

Room exists for additional research on these topics. In the future the researcher would advise that given proper resources a longitudinal design study be conducted for the collection of a cleaner data base. Not only would such a design eliminate the need to rely on parental recall, but it would also enable the researchers to test children for milestones using existing measures with established validity such as the Bayley-III scale (thereby reducing possible confusion with operational definitions). This design would also afford the researcher the possibility of testing all the children in the family. The large amount of comprehensive data collected would lend to achieving a much more accurate picture of gross motor development in families. In establishing such a study, however, one would need to hope that the families studied would have enough children over the years to match the definition of a “large family.”

Researchers may seek to test whether the findings from this study are applicable to other ethnic populations, religions, cultures and lifestyles. Additionally, the study design may also be used in future research to establish relationships between other categories of development, such as fine motor skills, in children born to large families.

Finally, future developmental research may uncover new factors that may influence infant gross motor skills development, and researchers may seek to explore how these factors play out in large families.
References


Appendix A: Eligibility Interview Form

Dear Parent,

Thank you for your interest in this study. In order to participate, it is necessary to make sure that certain criteria are met:

1. Are your children currently being raised by two parents?
   - Yes
   - No

2. Does your family consist of at least five children?
   - Yes
   - No

In order to complete this study, we will require information about two siblings. The younger child of the pair should be at least three siblings removed (e.g., the first and fifth child or second and sixth), as this will afford them the dual experience of being born to a dynamically large family and also that of growing up with siblings.

Please answer the following questions while keeping these two siblings in mind:

3. Does either sibling have any diagnosed medical condition?
   - Yes
   - No

4. Does either sibling have any diagnosed psychological condition?
   - Yes
   - No

5. Was either sibling born before 39 gestational weeks?
   - Yes
   - No

6. Has the younger sibling learned how to walk?
   - Yes
   - No
Appendix B: Parental Questionnaire—English Version

Gross Motor Development Questionnaire

Instructions:
Thank you for participating in this study. Please fill out this questionnaire as accurately as possible. You may consult photo albums, home videos or your Tipat Chalav records in order to assist you in remembering dates.

For this questionnaire, you will be providing on children at least 3 children apart (ie first and fifth or second and sixth), preferably the oldest and youngest children in the family.

GENERAL

<table>
<thead>
<tr>
<th></th>
<th>Older Child</th>
<th>Younger Child</th>
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<td>Gender of child</td>
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<tr>
<td>Age of child</td>
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</tr>
<tr>
<td>Child’s position in the family (ie first, second, etc.)</td>
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<tr>
<td>Birth weight of child</td>
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<td>How many hours, per week, did the child typically spend in babysitter or grandparent’s care? (Choose Letter: A. &gt;10, B. 10-30, C. &lt;30 )</td>
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MILESTONES:
At what age did your child first begin to (in months):

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<thead>
<tr>
<th></th>
<th>Older Child</th>
<th>Younger Child</th>
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<tr>
<td>Turn over</td>
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<tr>
<td>Sit up</td>
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<tr>
<td>Crawl</td>
<td></td>
<td></td>
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<tr>
<td>Stand</td>
<td></td>
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<tr>
<td>Walk</td>
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</tbody>
</table>

Household Income: poverty (less than 8000nis/mo.) / low (between 8000-15000nis/mo) / middle (around 15000nis/mo.) / high (over 15000nis/mo.)

Mother’s Highest Education Level: completion of 8th grade / completion of high school / completion of a diploma / completion of college / some advanced degree

Family Home: small (less than 100m) / average (between 100-150m) / large (over 150m)

Family Home: Does your home have any adjacent play space over 10 meters (such as a porch or yard)? Yes / No
Questionnaire No. ______

Appendix C: Parental Questionnaire—Hebrew Version

שאולן פיתוח מוטוריקה

הוראות:

זה במחקר השתתפותך עליך תודה. מדבאופן זהשאלון למילאנא 할וג issuer
cכלול יום, ספורי זיון בּיֵיטוּם ורשירות שים חולים שגנאתם בּוותכוור
tאודוים.

שאולן זה תבצע על הילדים שיש ביניהם שלושה אחיות לפחלות, רשלא ענרי מינימ (כלומר: ילד הרושא
יח年之יך ואילד משני והישי), או רצי ילדלא לאחר השאלון על ילד המבוגר הצעיר בוחר במשפחתו.

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<th>מבוגר/ת</th>
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<tr>
<td>גל ילד/ה</td>
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<td>משלק ילד/ה של ילד/ה</td>
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<tr>
<td>ממוקא שבועית ילד/ה/יה בישועתה בייביסטר ועצל סבא ואנה או</td>
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</tr>
<tr>
<td>ממוקא שבועית תונוק עד גל 18 דרימים (א: 10 כב: 10 ג: 30 +30)</td>
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</tr>
</tbody>
</table>

אצנים דרכ

бавאיל ילד/ה, התחלתי (bahod) להנהף
לשתה
לודול
לעומר
לחכית

הכמסה למקש ביח: עוני (פוחתת שבש 8000 / 8000) / הבגשה נמוכה / ממד يكون (15,000 שבש בוער) / הכמסה

בבוחה

רמת המשך הבוגרה בוור כל האמה: הפילוגה דצ פייה ו/ או סיריה לשנים 10:2 תוך / הוראה והודעה

(דרפילוגה) / סיריה מהלוך / הוראה והודעה

גודל בית המגורים: 150 מטר או פוחת / 150 מטר / 150 מטר או עוני 150 מטר או יותר

אם סוחר ילד/ית יש לשחק מאל 10 מטר (בעמוד הפרסום או זכר) ? נ/ לא

שאולן המס
Appendix D: Advertisement for Study Participation—English Version

ADVERTISEMENT FOR STUDY PARTICIPATION

Looking for 30 families to participate in a research study examining effects of birth order on gross motor development.

Eligible families should have at least five children, with no known disabilities.

The study will involve completing a short questionnaire and mailing it back to researcher (at researcher’s expense).

_All data will be kept completely confidential._

Study will take place from ___(date)____ to ___(date)____.

Participants will be entered into a raffle among all participants for 600nis.

For more information please contact the researcher, Miriam Marcus, at 052-569-9314 or mim4303@g.harvard.edu.
רוצח להשתתף בהמחקר?

אני מחפשת משפחות שה Önמון להשתתף בהמחקר לבודת השפעת סדר הלידה על פיתוח המוטורייה והнима בילדות קצנים. למשפחות מתאימות זוכות ללוות אותה הירושה ילידים, ולא מוגבלויות ידועות.

המחקר יחיי זורק בשאלת שאלון קצרים (וד אני) שלישיה והורה בוודא להתחבר לפני השאלון (על השובחת של המחקרה). הממחק סותר כי will ינותננו יישומי בפורים מותחאות, ולהתחברות לא תוכל לשיח נודע למשתתף.

למשל 30 המשמעותיים והראשונים ישוחזור שאלוןiola יוכו pov לותרת לכרת עובר ש"ה 600.

המחק יקיי בין ההורים 17 ל 8.1.17 אלא אם כן התבקל 22.1.17 שאלון 30 שאלונים מלאים קודם לכל.

לකבלת מידע נוכך אתו الكويت עם המחקרה. מיום מירkus, טל: mim4303@g.harvard.edu או דוא"ל: 0525699314.

רוחב יוקלד הנביכה 10 דרה 13, רמת ביית שמש ג'.

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Appendix F: Letter of Intent/Consent Form for Parents of Participating Sibling Pairs—English Version

| Study Title: Examining gross motor development and birth order effects in large families |
| Researcher: Miriam Marcus |
| Version Date: October 23, 2017 |

**Participation is voluntary**
It is your choice whether or not to participate in this research. If you choose to participate, you may change your mind and leave the study at any time. Refusal to participate or stopping your participation will involve no penalty or loss of benefits to which you are otherwise entitled.

**What is the purpose of this research?**
The purpose of this research is to study the gross motor development in children born to large families.

**How long will I take part in this research?**
Your participation will take approximately 15-20 minutes to complete.

**What can I expect if I take part in this research?**
As a participant, you will be recording information about two of your children’s development. You may need to consult your personal records in order to provide accurate information. The completed questionnaire should be returned to the researcher in the enclosed self-addressed, stamped envelope.

**What are the risks and possible discomforts?**
There should be no risks or discomforts involved.

**Are there any benefits from being in this research study?**
Aside from the possibility of winning the raffle, there are no direct benefits to study participants. Should you be interested in the research outcome, you may contact the researcher to request a copy of the study results.

**Will I be compensated for participating in this research?**
Yes. With the attached questionnaire, you will find a numbered card, corresponding to the number of your questionnaire. Once your questionnaire is returned to researcher, its number will be entered into a raffle for 600nis. We will inform all participants by email of the winning number once the study is concluded and the questionnaires are disposed of.

**If I take part in this research, how will my privacy be protected? What happens to the information you collect?**
The data we collect will be kept as confidential as possible. No full names are involved in this study, however researcher will have either your home or email address in order to technically send study questionnaire. Your questionnaire is numbered and
no one will know which number questionnaire corresponds to which family. Additionally, you will be returning your completed questionnaire in a pre-addressed and stamped envelope, with no indication of a return address.

Data obtained from questionnaires will be stored on researcher’s coded personal computer. Once the data from the questionnaires has been recorded, all questionnaires will be shredded. Data is for researcher’s personal use only and will not be shared.

If I have any questions, concerns or complaints about this research study, who can I talk to?
The researcher for this study is Miriam Marcus who can be reached at 052-716-5699, 6/3 Shaulzon Street, Har Nof, Jerusalem, mim4303@g.harvard.edu. The faculty sponsor is Dr. Dante Spetter who can be reached at (617) 496-4967.
- If you have questions, concerns, or complaints,
- If you would like to talk to the research team,
- If you think the research has harmed you, or
- If you wish to withdraw from the study.

This research has been reviewed by the Committee on the Use of Human Subjects in Research at Harvard University. They can be reached at 617-496-2847, 1350 Massachusetts Avenue, Ste. 935, Second Floor, Cambridge, MA 02138, or cuhs@harvard.edu for any of the following:
- If your questions, concerns, or complaints are not being answered by the research team,
- If you cannot reach the research team,
- If you want to talk to someone besides the research team, or
- If you have questions about your rights as a research participant.

Statement of Consent –
I have read the information in this consent form. All my questions about the research have been answered to my satisfaction.

SIGNATURE
Your signature below indicates your permission to take part in this research.

_________________________________  _____________________________
Initials of participant                  Date

***** PLEASE RETURN THIS SIGNED FORM ALONG WITH YOUR *****
***** COMPLETED QUESTIONNAIRE *****
***** SHOULD YOU DESIRE, PLEASE RETAIN A COPY FOR YOUR RECORDS *****
Appendix G: Letter of Intent/Consent Form for Parents of Participating Sibling Pairs—Hebrew Version

מכחב מכתב / תכנית קצוב לחרטום לשחקי זוגיות אביה

כותרת: בהינתן השפעת סדר לידתון על המוטוריקה הנсужה במשלחת גאולה
תחקירנית: מרים מרקוב
תאריך: אוגוסט 23, 2017

ведение

ותבחיים שלול לשחקית במחוקו, אמא ח当たり/לتحقق, או/א/she יכל צוגה את עטיר ולקוב את המחקר.
בכל תע, יסורים למשתתף ואלה השחיה לא היה נוכר בשום קצב ואבניד.
כל חוד שואיה?

מ㎞ פפורט שלול מחוק זה?

מכתב המחוק היא להבוקה ואלה התשאות המוטוריקה הנושא את ידיב שלוקת למשלחת גאולה (ברוח).

למה זכויות עלולKCתק חולק מחוק זה?

כמנה מכ-heroית על الفقرת 15 200 shocks בכיי לשלישים.

为何宏说为什么没有 lehetש חולק מחוק זה?

אתה יכול לצבור את אנובי חולק מחוק זה?

כמנה מחוק, נוכל לק אלף הנפש עם מחוק המחוק וההיתונה (השניה) של יאאמ אמא מוגנית.זח
 bağח, אם תירוגו מטוטימי והן מכיסו לשלוש.

_REPEAT

אתה אמור ל księg המ_meshות מחוק זה?

כן. עם השלוח המפורץ, נוכל/ו לצבור אחרים מוספר שומחא למספר השלוחן של. לאואר תשלוח
שלוח תרוין הקופר כדי בכס ולחבה בחר 600 ש"ח.אתונה דודיע לקול המשתפות בברואר,על
המספר אתונה ברגר ספרמחק יאתוח השלוחן יאני פסקל שמי.

MessageBox שמידה בראג מכיסו השלוחן וממשיח מחוק זה?

אם ואת חולק מחוק זה, אז יא´s המשמח שול סיה מונחת? מה עוד בידוע שמאשו מקסימום?

генירות שאıyla מימוח מемся. או שפרמז מימוח מחוק זה. השלוחן שלמקסימום או אחא
לא צור אתוח שלוח מקסבל לאוריה משמחה. בן, השלוחן יائر במעוף מוכנה וברווילע נמחוק.
תחקירנית לכל צドイツ סוח מחוק זה.

לأخر נוחת המיזון מהשלוחון, לכל השלוחון ושם.
אם יש לך שאלות, בעיות או תלונות על מחקר זה,どういう פתרון לפגוש?

mim4303@g.harvard.edu
כתובת: הנביא חזקאל רחוב 10, רמת ד, הוא פקולת הסגל - ספטר דנטה ר- Dr. Dante Spetter - קשר אתה עם נировать הקטגורי: 0525699314.

dוא"ל: mim4303@g.harvard.edu
כתובת: הנביא חזקאל רחוב 10, דירה 13, שמש בית רמת ד

● אם יש לך שאלות, חששות, או תלונות, אם אתה רוצה לɟזר đè צוות המחקר, אם אתה רוצה שהצוות יכול לאיתכן, או אם אתה רוצה לה는데 פתרון

● מחקר זה נבדק על ידי המשמע של השרmostat שלbru שפע במדחק (IRB) (שבאיגורבריסיט הרוגארד) מחקה זה נבדק על ידי המשמע שלbru שפע במדחק - IRB (הרווארד שבאוניברסיטת Harvard).

ארה"ב: (1-617-496-4967)
כתובת: Massachusetts Avenue, 2nd Floor, Cambridge, MA 02138
דוא"ל: cuhs@fas.harvard.edu

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