Evolutionary Psychology

www.epjournal.net – 2007. 5(4): 844-859

Original Article

Parental Investment in Children with Chronic Disease: The Effect of Child's and Mother's Age

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Abstract: Parents do not invest their resources in their children equally. Three factors which elicit differential parental investment are the parent's reproductive value, the child's reproductive value (RV), and the impact of the investment on the child (II). As the child matures, his RV increases while the II may decrease. This raises a question regarding the favored strategy of investment by child age. It was hypothesized that different categories of parental investment generate different age-based strategies. Emotional investment, such as maternal worrying for the child's health, was hypothesized to increase with the child's age, while direct care was hypothesized to decrease with the child's age. Both categories were hypothesized to increase with the mother's age at childbirth. 137 Israeli mothers of children with chronic neurological conditions reported levels of worrying for their child and levels of change in direct care. Maternal worrying about the child's health was positively associated with the child's age at diagnosis and the severity of his illness, and negatively associated with the time from diagnosis**.** An increase in direct care was positively associated with maternal age at childbirth and illness severity, and negatively associated with the time from diagnosis, and the duration of the marriage. Contrary to the hypothesis, the child's age had no effect on changes in direct care. It appears that in mothers of children with adverse neurological conditions, child and maternal age effect parental investment differently. While the child's age is related to maternal worrying about his health, the mother's age at childbirth is related to changes in direct care.

Keywords: parental investment, pediatric psychology, age, reproductive value, worrying.

Introduction

Chronically ill children require a great deal of parental care. In addition to conventional care that is granted to all children, sick children require additional care in terms of time, money and attention. This care may be regarded as parental investment (Trivers, 1972). Many factors contribute to the scope of parental investment, including the child's reproductive value (RV), and the impact of the investment (II) on the child (Salmon, 2005).

In !Kung bushmen RV increases from birth to pubescence, mainly due to a high rate of juvenile deaths (Howell, 1979, p.106). This serves as a good approximation of age-related changes in RV in the environment of evolutionary adaptedness (EEA). If children's RV increased with age in the EEA, it can be hypothesized that parental investment would have been selected to increase with age as well. However, not all measures of parental investment are expected to positively correlate with the child's age. Some types of parental investment are crucial for the young offspring who have high needs, while their II on older offspring is smaller (Clutton-Brock, 1991, p. 161). In fact, both longitudinal (Belsky et al., 1984) and cross-cultural (Whiting and Edwards, 1988, p. 118) studies show that maternal care and nurturance decrease as the child grows.

Hagen, Barrett, and Price (2006) identify several proxy measures of parental investment that include lactation, direct care, educational investment and emotional attitudes towards children. While lactation and direct care appear to decrease over age, due to their higher II for the young, in the present study it was hypothesized that emotional attitudes increase from birth to pubescence as a result of the escalation of RV. These emotional attitudes include parental worrying and grieving.

In spite of the importance of parent-child relations, only two studies have attempted to assess the link between children's ages and their parents' emotional attitudes towards them (Crawford, Salter, and Jang, 1989; Littlefield and Rushton, 1986). These studies focus on parental grief and are somewhat problematic since they use retrospective or hypothetical methodology. Littlefield and Rushton (1986) conducted a retrospective study, collecting data two years after the child's death, on average. They found a low correlation between children's age (ranging from birth to 45 years) and parental grief intensity, when parental age was controlled. While the child's age and RV are positively correlated from birth to approximately 18, they are negatively correlated thereafter; that is, from age 18 RV decreases (Fisher, 1958, p. 28; Keyfitz and Flieger, 1971, p. 303). Crawford et al. (1989) argued that RV should be a better predictor of parental investment than the child's age and therefore it should be used instead. They found a high correlation between EEA RV and parental grief. However, their study was a hypothetical one in which respondents evaluated whether parents would experience a greater sense of loss for child A or child B, in different age combinations from 1 day to 50 years.

There is a debate whether grief per se is adaptive at all since it can no longer assist the dead child. While Nesse (2000) mentions a number of ways in which grief could be adaptive (e.g., eliciting pity, preventing further losses), Archer (1999) reaches the conclusion that the grief reactions are not adaptive per se but are the by-product of attachment (p. 62). Worrying over a sick child, however, has a more comprehensible adaptive basis. While parental grief occurs after the child's death, worrying starts with the first signs of adversity. High levels of worrying in mothers of sick children may be adaptive since they cause the mother to exercise more vigilance to her child's condition, and may propel her to advance his health. As anxiety protects us from danger, keeping us away from dangerous places (Nesse and Williams, 1994, p. 212), maternal worrying increases maternal attention although it impairs maternal well-being. Indeed, it has been suggested in the past that parental anxiety can increase the offspring's chance of surviving by prompting the parent to seek interventions (Cassidy, 2000, p. 88).

The present study attempts to test the hypothesis that mothers show greater emotional attitudes towards children as they grow. Because past studies are sparse, and deal only with grief, the present study evaluates maternal worrying over chronically ill children, a behavior that is more clearly adaptive. In contrast to the methodological flaws of past studies the present study uses a prospective design based on actual life cases. The study incorporates growth curve analysis which distinguishes the effects of the different time-related variables: child's age at time of diagnosis, mother's age at time of birth, duration of the marriage, and duration of the child's illness.

In addition to the main hypothesis that the child's age is correlated with maternal worrying, it was hypothesized that the mother's age at childbirth, and the severity of the child's illness are also positively correlated with maternal worrying, while the duration of illness is negatively correlated with maternal worrying. Maternal age influences the amount of parental investment (Bjorklund and Pellegrini, 2000, p. 231). Older mothers, with relatively fewer opportunities to bear additional offspring, may have been selected to invest more in a sick child than younger mothers, who have a greater number of reproductive years ahead. Studies in other animals demonstrate that older Mongolian gerbil mothers are more maternal than younger ones (Clark, Moghaddas, and Galef, 2002), and older California gulls provide more food to offspring by working harder at foraging (Pugesek, 1981, 1995). Similar findings have emerged for humans as well. Younger mothers show higher rates of infanticide in both traditional (Bugos and McCarthy, 1984) and modern (Daly and Wilson, 1988, p. 63) societies. In addition, older mothers show lower levels of post-partum depression, which is interpreted by Hagen (2002) as a lower inclination to reduce investment in new offspring (p. 325). However, a correlation between mother's age and child's age leads to issues of multicollinearity. Indeed, Littlefield and Rushton (1986) found no association between grief and parental age when controlling for child's age. To eliminate the problem of multicollinearity, we did not measure the mother's age. Instead, we measured the mother's age at childbirth, which was not correlated to her child's age (r = 0.03).

In the present study, maternal worrying was measured with respect to the health status of the child. Hence, it seemed reasonable that mothers would worry more over children with higher illness severity. Maternal worrying was hypothesized to decrease over

time. The period of diagnosis is usually the most taxing for parents (Hoekstra-Weebers, Jaspers, Kamps, and Klip, 2001; Steele, Long, Reddy, Luhr, and Phipps, 2003). Therefore it is expected that maternal worrying will be highest at this time.

While the main hypotheses were related to maternal emotional attitudes, we also examined direct maternal care of the children. Direct care involves routine behaviors such as feeding, carrying, bathing, nursing and supervising. As in maternal worrying, direct care was also hypothesized to positively correlate with maternal age at childbirth and illness severity, and negatively correlate with time from diagnosis. However, in contrast to maternal worrying it was postulated that direct care will decrease as the child grows, since the II of direct care should decrease as the child grows. Belsky et al. (1984) observed that as the child grew from one to nine months old, maternal caregiving (e.g., diapering, washing, wiping, or grooming) decreased. A cross-cultural study of seven pre-industrial communities (Whiting and Edwards, 1988) found that maternal nurturance declines dramatically from age 2-3 to age 4-5, and from age 4-5 to age 6-8 (p.118).

Materials and Methods

Procedure

The study was conducted in the Department of Pediatric Neurosurgery, Dana Children's Hospital, Tel-Aviv Sourasky Medical Center, Israel, and approved by the hospital's Human Subjects Ethical Committee. All eligible mothers of children treated in the unit received questionnaires by mail, and were asked to mail them back in a pre-stamped envelope. The objectives of the research were explained and all participating mothers provided written consent. Mothers were sent a letter of thanks from the head of the department and a small toy for the child upon receipt of the completed questionnaire. Medical data were collected via the coordinating nurse to reduce shared method variance. Such potential bias occurred in previous studies, where the parents reported illness variables. For example, mothers with high levels of anxiety may have reported their child's condition to be worse than it actually was, leading to a spurious correlation between illness variables and maternal worrying.

Participants

Our sample was composed of 137 Israeli mothers whose children underwent neurosurgery due to chronic health conditions, as defined by Stein, Westbrook, and Bauman (1997). That is, all children had a biological, psychological, or cognitive disorder, with a duration or expected duration of at least 12 months, and with specific consequences, such as: (a) functional limitations, (b) reliance on compensatory mechanisms or assistance, or (c) service use or need beyond that which is considered routine. Children ranged in age from two weeks to 19 years (Mean ± *SD* = 4.6 ± 5.2) and were diagnosed with hydrocephalus (40%), low-grade tumors (24%), high-grade tumors (9%), craniosynostosis (13%), open spina bifida (4%), spina bifida occulta (5%), or other diagnoses (5%). All children (62% boys) had been diagnosed during the previous 24 months. Of the 137

children, only one boy died during the study period.

Mothers ranged in age from 21 to 54 years (Mean ± *SD* = 35.2 ± 7.3); most were married (90%). Thirty percent of the mothers did not graduate from high school, 58% were high-school graduates, and 12% had post-secondary education. The number of children in the family was quite large (Mean ± *SD* = 3.0 ± 1.9). Since Israel is an immigrant-based society, ethnic diversity was large. Fathers of the mothers in the sample were born in Israel (28%), Europe (25%), Africa (23%), Asia (15%) and America (9%).

Of the 203 mothers whose participation in the study was requested, 66 declined. The examination of available medical data for 48 of the 66 decliners showed that their children's functional status, as measured by the Karnofsky scale (Karnofsky, Abelmann, Craver, and Burchena, 1948) was lower (Mean ± *SD* = 75.4 ± 19.0) compared with our sample (Mean ± *SD* = 83.7 ± 16.9), *t*-test: $t_{176} = 2.81$; $p < .05$; $d = .49$. Mothers were recruited over a three-year period, and each was asked to complete a questionnaire approximately every six months, with a maximum of four questionnaires per mother (T1–T4). Since mothers were recruited throughout the study period, there were differences in the number of questionnaires completed by each mother. Some mothers were contacted early resulting in a longer follow-up period. However, some mothers were given the diagnosis only at the end of the research period and therefore did not have the opportunity to fill as many questionnaires. The average number of questionnaires per mother was 2.4, totaling 334 questionnaires from the time of diagnosis to 3 years after diagnosis. Response rates for T2, T3 and T4 were 76%, 83%, 60% respectively. Following Goodman and Blum (1996), a logistic regression analysis showed that there was no difference on all outcome variables and major predictors between mothers who completed a single questionnaire and mothers who completed a greater number of questionnaires; therefore it appears that mothers were missing at random.

Measures

Medical Severity Index. In order to ascertain the severity of the child's illness, the nurse evaluated the child's medical condition based on nine variables (the Karnofsky scale [Karnofsky et al., 1948] and eight variables based on Rolland's [1994, p. 20] typology). The evaluation was done once the child's medical condition stabilized. Principle-components factor analysis yielded one factor (eigenvalue = 5.4) which accounted for 60.4% of the variance, and seemed to reflect the severity of the pediatric illness. Subsequently, each mother was attributed a *z*-score reflecting her child's illness severity. The Karnofsky Performance Scale (Karnofsky, et al., 1948) is a one-item 11-point scale ranging from 0 (*deceased*) through 50 (*requires considerable assistance and frequent care*) to 100 (*normal*), used for measuring a patient's functional status. The scale has been found to have good inter-observer reliability (Taylor, Olver, Sivanthan, Chi, and Purnell, 1999). Based on Rolland's (1994) psychosocial typology of illness, we devised a questionnaire that measured the following illness variables: symptom visibility, cognitive deficit, motor deficit, age-relative functioning, expected deficit, expected changes, expected length of life, and treatment needs. Each variable was measured on a single-item scale ranging between 2 and 5 points. Symptom visibility, for example, was rated on a 4-point scale regarding the

extent of the illness visibility (1 = *none*, 2 = *scarring*, 3 = *small extent*, 4 = *large extent*).

Maternal Worrying. Using the Child Health Worry Scale (following Miles, Holditch-Davis, Burchinal, and Nelson, 1999), mothers rated the degree to which they worry about their child's health on a scale of 1 (*not worried at all*) to 4 (*very worried*). The scale includes five items, with sample items such as "I worry about my child's medical situation," and "I worry about whether my child might die." Cronbach's alpha in the present study was .88, demonstrating high internal consistency.

Change in Direct Care. Objective Burden is a measure of the changes in time, money, and energy resources due to caregiving (Montgomery, Gonyea, and Hooyman, 1985). This measure comprises nine items which are rated on a scale of 1 (*much less than before the child's illness*) to 5 (*much more than before the child's illness*). Sample items include "The amount of time you have for yourself," and "The amount of money you have available to meet expenses." The scale has good content validity (Montgomery et al., 1985) and internal consistency (in the present study, Cronbach's alpha was .87). As this scale was composed for caregivers of patients with Alzheimer's disease, one item was revised.

Analyses

Study hypotheses were tested with the general linear mixed model (Cnaan, Laird, and Slasor, 1997) using MLWin 1.10 software (Rasbash, Browne, and Goldstein, 2000). The general linear mixed model allows for unbalanced data, such as the data available in this study, where the number of maternal measurements varied from one to four, and the timing of measurement varied as well. The study data can be viewed as comprising two levels: level 1 consists of the measurements, and level two consists of the mothers. A basic hierarchical model for repeated measurements can be stated as follows:

$$y_{ij} = \alpha + \beta x_{ij} + u_j + v_j x_{ij} + e_{ij}$$

where y_{ij} marks the result of subject j (j=1,…,n) in measurement i (i=1,…,m); x_{ij} is the time of measurement; the fixed parameter α represents the average intercept (level); the fixed parameter β represents the average slope (change); and u_j, v_j are random effects (between subjects) that allow a personal slope and intercept for each individual. Hence, u_j represents the deviation of the individual's intercept from the average intercept, and v_j represents the deviation of the individual's slope from the average slope. Finally, e_{ij} is the variance within individuals. The model can be extended to include additional explanatory variables. Maternal worrying and change in direct care were modeled as a function of time from diagnosis, medical severity, child's age at diagnosis, and mother's age at childbirth.

In the case of worrying, y_{ij} represents level of worrying of mother j (j=1,…,148) at measurement i (i=1,…,4); x_{ij} is the number of months that have passed since the child's diagnosis; intercept α represents the average level of worrying at the time of diagnosis, β represents the average linear change in worrying, per month; u_j represents the deviation of the mother's intercept from the average intercept, and v_j represents the deviation of the

mother's slope from the average slope. Finally, e_{ij} is the variance within the individuals.

The statistical significance of every variable added to the above model (e.g. medical severity, child's age, and mother's age at childbirth) was evaluated by a *z*-type test. A separate model was constructed for each of the parental investment proxies (maternal worrying and change in direct care). First, the general time trend in investment was evaluated using linear and quadratic terms, and then medical severity, child's age at diagnosis, and mother's age at childbirth were assessed. The purpose of the first stage of analysis was to assess which variables contribute to the linear change in worrying, per month. Next, possible confounding variables were evaluated. These included duration of marriage, number of siblings, birth order, maternal education, family income, ethnicity, and the child's sex. Each change in the model was appraised by a χ^2 test on the change of the 2*log-likelihood, and if the test was significant, the revised model was retained. Since the sample size was not large, Restricted Iterative Generalized Least Square (RIGLS) estimation method was used (Goldstein, Browne, and Rasbash, 2002).

Results

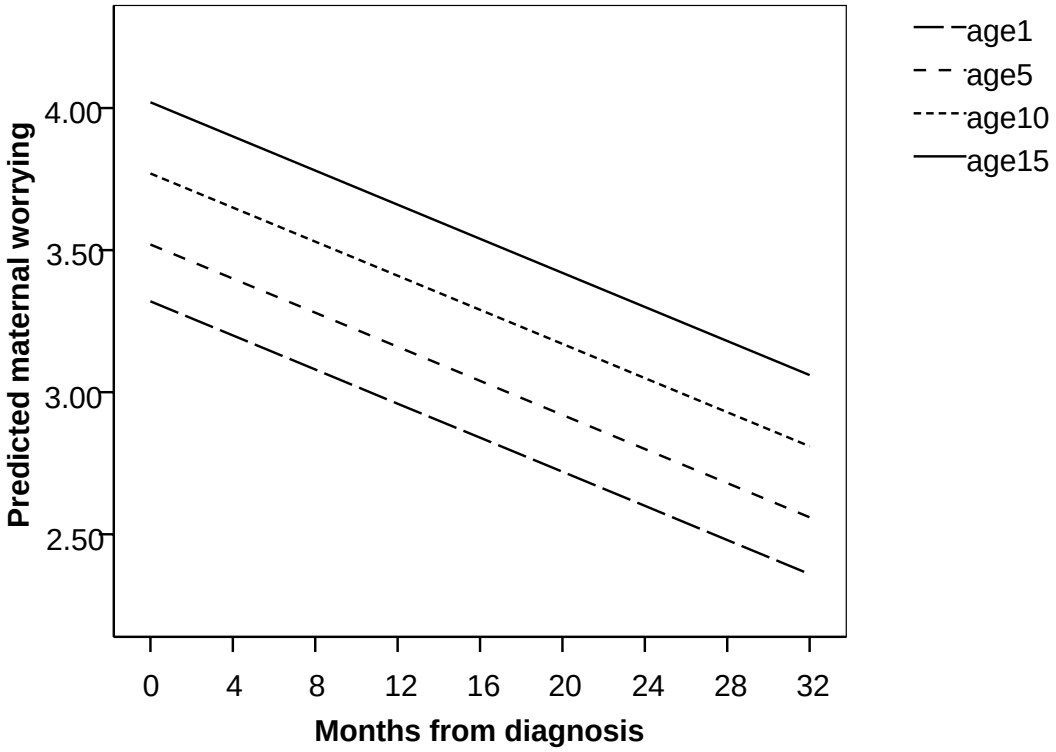
As predicted, maternal worrying was positively associated with the child's age and the severity of his illness, and negatively associated with the time from diagnosis (see Table 1 and Figure 1; in Figure 1, medical severity is set at its average level). In an attempt to rule out potentially confounding variables such as maternal education, family income, number of siblings, birth order, ethnicity, child's sex, and marriage duration, these variables were added to the model. The addition of these variables resulted in no significant change to the model; therefore it seems that they did not confound the study results. Table 1 and Figure 1 show the results of the final model, including only the significant variables.

Table 1. Summary of general linear mixed model analysis for variables predicting maternal worrying and change in direct care from diagnosis to +32 months (standardized values)*

Variable	Worrying	Change in Direct Care
	Coefficient (99% CI)	Coefficient (99% CI)
Intercept	-0.08 (-0.25 to 0.08)	0.04 (-0.12 to 0.19)
Linear change since diagnosis	-0.20** (-0.29 to -0.10)	-0.17** (-0.30 to -0.04)
Severity	0.35** (0.18 to 0.51)	0.36** (0.20 to 0.51)
Child's age	0.22** (0.07 to 0.37)	-
Mother's age at childbirth	-	0.26** (0.09 to 0.42)
Marriage duration	-	-0.17** (-0.32 to -0.02)
Variance between individuals in intercept	0.62 (0.42 to 0.81)	0.38 (0.21 to 0.56)
Variance between individuals in slope	0.07 (0.01 to 0.14)	0.14 (0.02 to 0.26)
Covariance of intercept and slope	-0.01 (-0.09 to 0.07)	0.04 (-0.06 to 0.13)

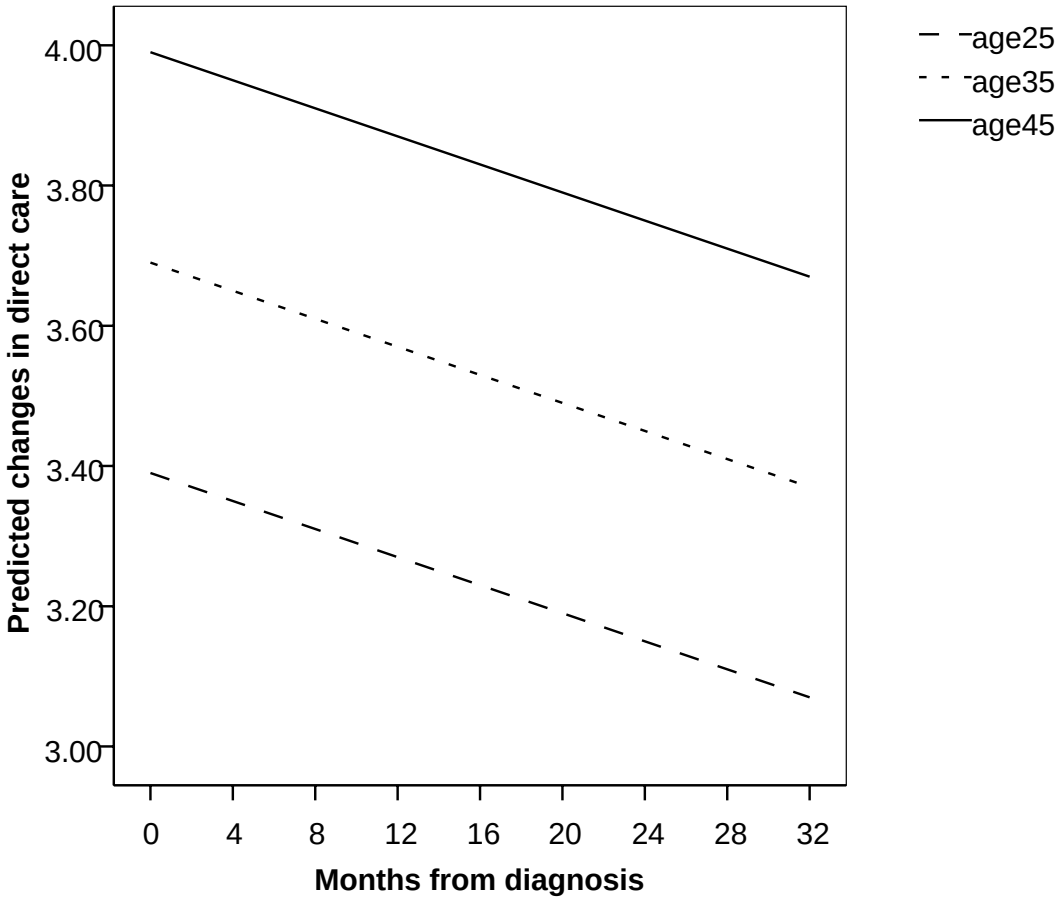
* Table 1 shows the results of the final model, including only the significant variables.
** $p < .01$.

Figure 1. Predicted maternal worrying by time from diagnosis, medical severity, and child's age



As predicted, change in direct care was positively associated with maternal age at childbirth and illness severity, and negatively associated with time from diagnosis (see Table 1 and Figure 2; in Figure 2 medical severity and marriage duration are set at their average level). In contrast to the hypothesis, child's age had no effect on changes in maternal direct care. The duration of marriage had an additional negative effect on the amount of change in direct care. The addition of other potentially confounding variables (number of siblings, birth order, maternal education, family income, and the child's sex) resulted in no significant change to the model. Table 1 and Figure 2 show the results of the final model, including only the significant variables. At the time of the first measurement (T1) maternal worrying was correlated with the reported change in direct care ($r = .41$, $p < .01$) even after controlling for illness severity ($r = .29$, $p < .01$).

Figure 2. Predicted changes in direct care by time from diagnosis, medical severity, marriage duration, and maternal age at childbirth



Discussion

The purpose of this study was to assess the effect of the child's age and the mother's age at childbirth on maternal investment in children with chronic illness. Specifically it was hypothesized that mothers will report higher emotional investment in older children, since these children have a higher RV, and therefore they should be more cherished. As hypothesized it was found that for mothers of children with adverse neurological conditions, there is a direct relationship between the age of the child and the degree of worrying about his health. This result is concordant with past research showing that parents make more extensive emotional investments in older children (Crawford et al., 1989; Littlefield and Rushton, 1986).

There are two possible explanations for this age effect. One explanation is that mothers interpret the child's age as an indicator of RV, which is the basis of their emotional investment strategy to invest more in children with higher RV. A second explanation has been suggested by Archer (1999, p. 158) who claims that the age effect may be a result of a longer interaction with older children, causing stronger attachments to them. These two explanations are not necessarily mutually exclusive. Growing attachment over years may be regarded to as a proximate mechanism of differential parental investment (p. 161). In referring to grief, Archer (p. 161) suggested that although the link between grief and attachment is always strong, the link between grief and RV may become loose in societies with low mortality rates and low birthrates, such as modern societies. However, if this adaptation emerged in the EEA, it could still operate in modern societies, since low infant mortality is a fairly new phenomenon (De Flora, Quaglia, Bennicelli, and Vercelli, 2005).

Contrary to the hypothesis, mothers with younger children did not report higher increases in direct care. Two explanations are proposed for this result. In general, as the child ages we expect an increase in investment due to the increase in RV and a decrease in investment due to the decrease in II. We hypothesized that the RV effect would be expressed in emotional investment and the II effect would be expressed in direct care. However, it is possible that in the case of direct care these two effects cancelled each other out. Another possibility is that changes in direct care are not affected by age as hypothesized, and may be a general tendency that is less discriminative, and is activated in response to cues of need, regardless of the child's RV or II.

While maternal age at childbirth did not affect maternal worrying, it did affect changes in direct care. The onset of the child's neurological problems created a greater increase in the burden of childcare for mothers who were relatively older. This result is congruent with life-history theory predicting that older parents, with less opportunity for future reproduction, should be selected to make greater parental investment. While one study found contradictory results, reporting no correlation between the mother's age at childbirth and the timing of weaning (Quinlan, Quinlan, and Flinn, 2003), most human studies have found that older parents make greater parental investment. Older parents show lower levels of infanticide (Bugos and McCarthy, 1984; Daly and Wilson, 1988, p. 63) and post-partum depression (Hagen, 2002).

Both worrying and change in direct care decreased as time passed. This effect is understandable since the period of diagnosis is emotionally intensive, including diagnostic testing and initial neurosurgery. Thus, it is expected that both direct care and maternal worrying will be higher at this time. A decline in maternal distress over time has been documented in the past (Hoekstra-Weebers et al., 2001; Steele, Long, Reddy, Luhr, and Phipps, 2003). A decrease in stress over time may also be attributed to an increase in familiarity and predictability with respect to the child's illness and treatment, since familiarity and predictability are known to decrease stress levels (Ludwick-Rosenthal and Neufeld, 1988). This may also explain the unexpected result that mothers who had been married for a relatively longer length of time experienced a smaller increase in the burden of childcare. As family life becomes more stable and predictable, fewer resources may be required for its maintenance.

Both measures of parental investment (worrying and changes in direct care) were closely related to the child's illness severity. Mothers of severely sick children were expected to worry more over their health status, and to spend more time and money in their medical treatment. It is suggested that future studies include parental investment measures that are not inherently related to the child's severity, such as warmth (as conceptualized by MacDonald, 1992). Severity may have a semi-bell-shaped effect on maternal warmth, i.e., medium warmth for healthy children, high warmth for moderately sick children and low warmth for very sick children with severe visual symptoms. Such a non-linear effect may reflect the trade off between RV and II. Similarly, Hrdy (2000, p. 462) suggests that infants should signal distress at an optimal level, since signaling too little distress will not trigger a maternal response, but signaling too much distress may cause the mother to view her infant as unworthy of further investment.

Direct care is a classical case of parental investment. It can be argued, however, that maternal worrying is not an accurate proxy of parental investment as defined by Trivers (1972), since it is not clear whether worrying (a) "increases the offspring's chance of surviving (and hence reproductive success)" and (b) if it does so "at the cost of the parent's ability to invest in other offspring" (p. 139). It has been suggested in the past that parental anxiety can increase the offspring's chance of surviving by prompting the parent to seek interventions (Cassidy, 2000, p. 88). Taylor et al. (2000) claim that while males react to stress by fight or flight, women react by tend and befriend. A recent study found that indeed maternal preoccupation with the infant's health, safety and future predicted maternal behavior (Feldman, Weller, Zagoory-Sharon, and Levine, 2007). In the exploratory phase of the present study a number of mothers were interviewed. An excerpt of an interview with a mother of a child with hydrocephalus demonstrates how her worries are translated into action, showing that stress and worrying may indeed drive the mother to tending and attending more to her child.

> "I constantly live with fear, my hand is always on the pulse, Even when I leave her, it stays with me, it follows me to work, it follows me back home, and in everything I do, this thing goes with me, and runs inside my head… if she has a fever, at that moment I need to get an answer what's causing it.

> I can't wait. I feel that something inside me is burning when she isn't feeling well. I'm half a person when she isn't feeling well; I feel that a part of me at that moment just shrivels. I have this constant feeling that I want to be sufficient, to work more with her, to do more exercises with her. Today she is eight months old, and just recently she began to turn over, but I'm working with her, I don't withdraw, I don't withdraw at all, and even if one of the exercises irritates her, or makes her mad, I don't withdraw."

It is more difficult to demonstrate that (b) mothers' worrying over a sick child can be at the expense of other siblings. Worrying may be regarded to as a stress response, as such; it may indeed reduce the mothers' ability to invest in other offspring. Studies show that maternal stress impairs fertility (Boivin and Schmidt, 2005; Smeenk et al., 2005), and pregnancy (Pike, 2005) and therefore may diminish the chances to give birth to additional children. However, perhaps a more suitable term for maternal worrying would be "parental care" defined by Clutton-Brock (1991, p. 8) as "any form of parental behavior that appears to increase the fitness of a parent's offspring."

The present study has a number of limitations. First, the sample was somewhat biased. Mothers of severely sick children were under-represented since their response rate was relatively low. The second limitation is the attrition of mothers from the study, although this was a result of the study design and was not associated with the outcome variables. Third, the study was based on maternal self-reports, and common method variance may have inflated the correlations between variables. The medical data are an exception, since they were collected through the pediatric nurse. Fourth, the study population was mothers of children with chronic illness, and the measures of parental investment, such as the Child's Health Worry Scale were aimed at health concerns. As such, the study generalizability to healthy populations is limited and warrants further research. A final issue is related to the measure of direct care. The objective burden scale does not measure direct care absolutely; instead it measures the changes in direct care since the child's illness was diagnosed. Since the initial caregiving burden of infants may have been higher than that of older children, we may have underestimated the effect of the child's age on direct care. Hence, using an absolute measure of parental care, instead of a relative one, may have resulted in finding that direct care is indeed higher for younger children.

Very few studies have examined the effect of child and mother age on parental investment. The few studies that have been conducted on grief had notable methodological limitations, including a hypothetical research design (Crawford et al., 1989) or a retrospective design (Littlefield and Rushton, 1986). The present study was prospective and utilized the general linear mixed model which distinguishes between the effect of the child's age, the mother's age, and the duration of the illness. The present study also adds to the generalizability of our understanding of parental investment by testing maternal worrying in addition to changes in direct care, and by showing similarities between our sample of Israeli mothers and previously studied samples of American mothers. The Israeli sample provided a perspective on families of diverse ethnic backgrounds, with relatively large families.

Part of our role as parents is to care for and worry over our children, as parental caring and worrying appear to increase inclusive fitness. The present study shows that mothers of children with chronic health problems worry more over the health of older children than over that of younger ones. Due to their higher reproductive value, older children are more highly valued by their mothers and therefore mothers are more anxious if their health is afflicted. The mother's age is also significant. The onset of the child's neurological problems creates a greater increase in the burden of childcare for mothers who are relatively older at childbirth. Older mothers have fewer opportunities to bear additional offspring; therefore they are expected to invest more in a sick child than a young mother, who can give birth to future children. These results show that child and maternal age have distinct effects on parental investment, depending on the investment category. They also highlight the interplay between RV and II regarding the effect of the child's age on parental investment. Age appears to be a meaningful variable in determining parental investment; as such it should not be neglected in future research.

Acknowledgements: We thank Ada Lampert and Robert O. Deaner for their comments on earlier drafts.

Received 23 August 2007; Revision submitted 11 December 2007; Accepted 13 December 2007

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