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# The genetic-environmental etiology of parents' perceptions and self-assessed behaviours toward their 5-month-old infants in a large twin and singleton sample

**Michel Boivin,[1] Daniel Pérusse,[2] Ginette Dionne,[1] Valérie Saysset,[1] Mark Zoccolillo,[3] George M. Tarabulsy,[1] Nathalie Tremblay,[1] and Richard E. Tremblay[2]**

[1]Université Laval, Canada; [2]Université de Montréal, Canada; [3]McGill University, Canada

**Background:** Given the importance of parenting for the child's early socio-emotional development, parenting perceptions and behaviours, and their correlates, should be assessed as early as possible in the child's life. The goals of the present study were 1) to confirm, in two parallel population-based samples, including a large sample of twins, the factor structure of a new self-administered questionnaire assessing both parents' specific parenting perceptions and behaviours toward their 5-month-old infants (i.e., parental self-efficacy, perceived parental impact, parental hostile-reactive behaviours and parental overprotection), 2) to identify the specific risk factors associated with the negative side of these parenting dimensions, 3) to document the genetic-environmental etiology of these parenting dimensions through the twin method. **Methods:** Parents (2,122 mothers and 1,829 fathers) of 5-month-old infants, and parents of 5-month-old infant twins (510 families) completed the questionnaire (28 items). The data were submitted to a series of confirmatory factor analyses. The contribution to parenting of a variety of risk factors was examined in the two samples using regression analyses. A series of quantitative genetic analyses were performed to quantify the different sources of variation in parenting. **Results:** A consistent factor structure was found across informants and across samples. There were significant mean differences in parenting between mothers and fathers, as well as between parents of twins and parents of singletons. A differentiated pattern of association with risk factors was found for each dimension of parenting. The twin analyses revealed that shared environment accounted for each parenting dimension. Maternal hostile-reactive behaviours were also moderately related to genetic factors in the child and this association was mainly mediated by the infant difficultness. **Conclusions:** The overall pattern of results was consistent with Belsky's (1984) view of parenting as multiply determined. The longitudinal follow-up of these families should provide the means for testing developmental models about the determinants and outcomes of these parenting dimensions. **Keywords:** Parenting, infancy, twins, questionnaires.

Parenting behaviours are generally perceived as the cornerstone of socio-emotional development in early childhood. Accordingly, various theories have been proposed to describe the mechanisms through which these behaviours contribute to early child development (Parke & Buriel, 1998; Thompson, 1998). For instance, maternal sensitive responsiveness, namely the caregiver's ability to detect the infant's needs and respond to them appropriately, has been posited to contribute to a secure parent/child attachment relationship, thereby creating a positive context for the child's later socio-emotional adjustment (Bowlby, 1982; Bretherton & Waters, 1985; De Wolff & Van IJzendoorn, 1997; Isabella, 1995). In contrast, insensitive parental care, as reflected by inconsistencies in parental responses and a tendency to adopt hostile, strongly restrictive and punitive child-rearing behaviours, has been associated with the development of an insecure attachment and future externalising problems in the child (Crittenden, 1988; Lyons-Ruth, Connell, Grunebaum, & Botein, 1990; Patterson, Reid, & Dishion, 1992). Parenting behaviours are also involved in the emergence of internalising problems; parental intrusiveness and overprotection have been linked with anxiety in the child (Chorpita & Barlow, 1998), and a cold and controlling rearing style may play a role in the development of depression, agoraphobia and social phobia (Arrindell et al., 1989; Parker, 1984; Parker & Lipscombe, 1981). In brief, many aspects of parenting behaviours are involved in the infant's socio-emotional development, and specific practices, especially those involving punishment and overprotection, may be associated with a variety of developmental problems.

Parents' beliefs concerning their capacity to care for their child, and expectations as to the impact of their actions, seem at the core of parenting competence and parent–child dynamics in early childhood (Bornstein, 2002; Parke & Buriel, 1998; Teti &


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Gelfand, 1991; Thompson, 1998). Indeed, parental self-efficacy has emerged as a significant predictor of parenting skills and behaviours, such as the capacity to understand and respond to infant signals (Donovan, Leavitt, & Walsh, 1990), as well as sensitive, stimulating and non-punitive parenting behaviours (Donovan & Leavitt, 1985; Teti & Gelfand, 1991; see Coleman & Karraker, 1997, for a review). Conversely, parents who have low self-efficacy have been found to perceive the infant as being difficult, and become irritated and use punitive strategies when they interact with a child who responds unexpectedly to stimulation (Bugental, Blue, & Cruzcosa, 1989; Bugental & Cortez, 1988; Bugental & Shennum, 1984; Halpern, Anders, Coll, & Hua, 1994). Outcome expectancies, i.e., the beliefs that specific behaviours will result in a desired outcome (see Bandura, 1997), are also likely involved; parents who believe their parenting behaviours are important for the development of their child provide a more stimulating environment, and have children with fewer behaviour problems (Benasich & Brooks-Gunn, 1996; Estroff, Yando, Burke, & Snyder, 1994), especially among low SES families (see Parks & Smeriglio, 1986). Parental perceptions and behaviours are thus likely to conspire through complex ways with the infant's characteristics in shaping the early social environment of the developing child.

Only a few studies on small samples have examined the stability and change of parental perceptions in the months following the birth of a new child (see Coleman & Karraker, 1997). The available evidence suggests that on average, parental self-efficacy, or analogous constructs, improves in the first four months after birth (Froman & Owen, 1989; Hudson, Elek, & Fleck, 2001; Reece & Harkless, 1998), but then tends to decline between age 1 and age 2 (Gross, Conrad, Fogg, & Wothke, 1994). However, despite these normative changes over time, individual differences in parental self-efficacy appear stable during that period, especially when measurement error is taken into account (i.e., T1–T2 shared variance of about .50–.60 over a one-year period; see Knauth, 2000; Gross et al., 1994; Gross & Rocissano, 1988; Schneewind, 1995).

The early determinants of parenting perceptions and behaviours are multifaceted as they are embedded in a complex social system (Bornstein, 2002). Belsky (1984) has proposed an ecological model of parenting according to which the quality of parenting is influenced by three main classes of factors: parent characteristics, contextual stress and supports, and child characteristics. Indeed, parents bring their personality and personal history to their early interacting with the young child, and this background, as well as more immediate environmental constraints, may influence their beliefs and expectations about parenting, as well as their actual parenting practices (see also Grusec, Hasting, & Mammone, 1994).

Parenting is a heterogeneous phenomenon likely to be influenced by, or interact with, many risk factors operating at multiple levels, such as parent mental health (Conger, Ge, Elder, Lorenz, & Simons, 1994; Dix, 1991; McLoyd, 1998), teenage parenthood (Brooks-Gunn & Chase-Landsdale, 1995), economic hardship and negative life experiences (Conger et al., 1992, 1993; Dix, 1991; McLoyd, 1998), as well as temperamental factors in the child (Bell, 1968; Kendler & Eaves, 1986; Lytton, 1990). For example, economic hardship and stressful life experiences, such as conjugal dissatisfaction and divorce, have been associated with restrictive, punitive, and emotionally distant parenting behaviours, as well as behavioural problems in children (Conger et al., 1992, 1993; Dix, 1991; McLoyd, 1998; Patterson & Capaldi, 1991). Teen motherhood has also been linked to problematic parenting behaviours, such as a lack of control over affect and low emotional availability (Brooks-Gunn & Chase-Landsdale, 1995; Osofsky, Hann, & Peebles, 1993). Psychological distress, maternal depression in particular, has been correlated with physical abuse, coercive strategies, and a lack of maternal sensitivity (Conger et al., 1994; Gross et al., 1994; McLoyd, 1998), perhaps because depressed mothers tend to attend less to their infant's requests for attention, who may then increase the intensity of their demands (Cox, Owen, Henderson, & Margand, 1992; Dix, 1991).

Finally, there is increasing recognition, based on growing empirical evidence, that a child's behavioural characteristics may influence parenting perceptions and behaviours (Bell, 1968; Bell & Harper, 1977; Gross et al., 1994; Lytton, 1990; O'Connor, 2002), although researchers disagree about the importance and meaning of these 'child effects' (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000; Dodge, 1990). Perhaps the most investigated determinant of parenting behaviour is child temperament (Kochanska, 1993; Parke & Buriel, 1998), and more specifically, distress-related temperamental traits such as irritability and difficultness (Putnam, Sanson, & Rothbart, 2002). In general, more difficult infants elicit more negative arousal and distress from caregivers (Lee & Bates, 1985; Van den Boom & Hoeksma, 1994). However, this general assertion needs to be qualified. Results linking difficult temperament in young infants to parenting behaviours have yielded mixed results compared to more consistent results with older children (Dunn & Plomin, 1990; (Rothbaum & Weisz, 1994). Indeed, some studies have reported an absence of association between temperament and parenting (e.g., Daniels, Plomin, & Greenhalgh, 1984; Rothbart, 1986), or even positive parenting with temperamentally difficult infants, the latter perhaps reflecting a persistent positive parental investment toward a young infant perceived as vulnerable (Crockenberg, 1986).

Thus, as suggested by Belsky (1984), it is clear that a comprehensive study of parenting perceptions and behaviours should take into account a variety of factors related to the infant, the parent and the family context (see also Bornstein, 2002). Furthermore, bi-directional effects between some of these risk factors, e.g., those associated with child characteristics, and parenting, are likely. Given this, and the fact that parenting perceptions and behaviours are deemed important for the child's development, relevant dimensions of adverse parenting and their associated risk factors should be assessed as early as possible in the child's life.

Although many studies have used direct observations of mother–infant interactions to study various aspects of early parenting, this type of approach is difficult in large-scale population-based studies where parent-reports or child-reports about parenting are the norm. Many self-administered questionnaires have been used to measure parenting perceptions and behaviours (e.g., Abidin, 1986; Dumka, Stoerzinger, Jackson, & Roosa, 1996; Kendler, 1996; Thomasgard, Shonkoff, Metz, & Edelbrock, 1995; Parker, 1984). However, these instruments have important limitations: they often center on parental behaviours toward older children, generally targeting a wide range of ages and focusing on dimensions that are general and heterogeneous; further, when older children are reporting about their parent's past behaviour, they usually do so retrospectively, their recollection sometimes extending over decades (Kendler, 1996). The empirical basis on early parenting is also limited by the reliance on small samples based on convenience and the lack of information about fathers' parenting perceptions and behaviours.

In the present report, parenting was examined in two large-scale epidemiological samples using a new parental self-report scale of specific perceptions and behaviours that reflect the quality of mothers' and fathers'contemporaneous interactions with their 5-month-old infant. The first study was based on a representative sample of families having given birth to a child in the province of Quebec, Canada. The second study was based on a representative sample of twins born in the greater Montreal area, province of Quebec. This twin sample enabled the analysis of parenting from a genetic-environmental standpoint (see below). Four dimensions of parenting were considered; parental self-efficacy and perceived parental impact centred on the parents' beliefs about their role in caring for the baby, while parental hostile-reactive behaviours and parental overprotection, reflected self-reported unfavourable behavioural tendencies. In line with Belsky's (1984) view, the study also examined the contribution to variation in parenting of a variety of risk factors associated with the infant (e.g., difficultness), with the parents (e.g., teenage motherhood, low educational level, depressed mood) and with the family context (e.g., insufficient income, single-parenthood, low spousal/partner support).

There are good theoretical and empirical reasons for examining parenting both within families of singletons and families of twins. Indeed, results stemming from genetically informative studies often suggest substantial genetic effects, as well as unique environmental effects, on a variety of infants and children behavioural phenotypes (see Plomin, DeFries, McClearn, & McGuffin, 2001). These studies generally derive small effects for environmental factors shared by siblings, a finding that is often wrongly interpreted as evidence for a lack of parental influence on children's development. Because many of these studies do not provide a direct assessment of these shared environmental factors, but rather infer them from the observed pattern of covariation of children phenotypes, it is not possible to conclude as to the role of specific factors in the family environment. Specifically, it is typical in genetic analyses to tease out the covariance among twins on a given child phenotype into components reflecting genetic influence and environmental influence. However, the main limitation with this type of analysis is that it focuses on the patterns of covariance in the outcome of interest rather than on a putative family factor accounting for the outcome. Attributing environmental effects on the basis of twins sharing the same family, without measuring specific family environments, is a crude and incomplete assessment of family factors (see Hoffman, 1991; Maccoby, 2002; Stoolmiller, 1999).

Adding to this limitation in assessment is the possibility that parenting may impact differently on children of the same family, thus contributing to the non-shared environmental effects generally observed in genetically informative studies (see Rutter, 2002). It is thus important to examine parenting as it varies as a function of specific infants in the same family (i.e., assessing within-family variation in parenting). Only then will we be able to evaluate the extent to which these parenting dimensions are shared, or uniquely experienced, within the family unit. When this is done, twin studies not only provide information about shared and non-shared environments provided by parents, but they also tell us, through the comparaison of MZ and DZ covariances, whether parenting dimensions vary as a function of the infant's genotype. This type of analysis is as a first step in examining the gene–environment dynamics involved in early socioemotional development.

In the present study, the twin design was used to document the potential sources of variance in parenting, and to examine further the association between the infant difficult temperament and unfavourable parenting. Specifically, we examined the extent to which the parenting dimensions covaried among co-twins and evaluated whether this covariance varied as a function of zygosity (i.e., the degree of genetic relatedness between twins). Using

quantitative genetic modelling, we estimated three potential sources of variance to parenting: 1) variance in parenting associated with the infant genotype (i.e., additive genetic contribution), 2) variance in parenting shared by the co-twins (i.e., shared environment contribution) and 3) variance in parenting uniquely experienced by each infant (i.e., nonshared environment contribution). Finally, to the extent that the variance in parenting was associated with infant genotype, we evaluated whether it was mediated by the infant difficultness.

Since twins, however, represent a special challenge with respect to parental care, it is important to determine whether the pattern of results found in families of twins can be generalised to single-birth families. Parenting a newborn infant is economically, mentally, physically and emotionally demanding, and may differentially challenge parental resources in the case of twins. It is therefore important to compare parental perceptions and behaviours in twins and singletons in order to make inferences that can be applied to the general population. Differences in parenting twins versus singletons would also suggest that contextual effects are at work. Thus, in addition to documenting the genotype–environment etiology of parenting, the twin design was also used to document the role of the family context (i.e., having to care for two infants instead of one) in explaining unfavourable parenting perceptions and behaviours.

The present study had four specific goals. The first goal was to evaluate, in these two parallel samples, and through confirmatory factor analyses, the cross-informant, cross-sample stability in the factor structure of a new scale assessing both mothers' and fathers' parenting perceptions and behaviours toward their 5-month-old infant or twin-infants. The second goal of the study was to examine mother–father differences in parenting, as well as differences in parenting singletons versus twins in the two parallel population-based samples. The third goal of the study was to examine the contribution of known risk factors to the negative side of the four dimensions of parenting. Finally, the last goal of the study was to investigate the genetic-environment etiology of these parenting dimensions through the twin method. To our knowledge, the current study is the first that examines mother's and father's parenting cognitions soon after birth, both within a genetically informative methodology and in two parellel population-based samples of families of twins and families of singletons.

## Materials and methods

### *Participants*

This report is based on data drawn from the Longitudinal Study of Child Development in Quebec (LSCDQ) and the Quebec Newborn Twin Study (QNTS). The LSCDQ is a prospective longitudinal study of children starting at the age of 5 months, who were sampled to be representative of the population of infants born in the province of Quebec, Canada. All singleton infants between 59 and 60 gestational weeks of age in 1998 with mothers living in the province of Quebec were targeted, with the exception of: 1) infants in the far North administrative region, Cree or Inuit regions, or living on aboriginal reservations; 2) infants for whom the duration of gestation could not be determined from the birth record; and 3) infants born at less than 24 weeks gestation and infants born at greater than 42 weeks gestation, the latter because of the delay in receiving and processing birth record data from hospitals. A total of 2,940 infants were selected through a region-based stratified sampling design, of which 2,223 families (75.6%) participated in the study when the infant was aged 5 months between the months of March and November, 1998. In 99.6% of these families, the mother was the primary caregiver and considered as the 'person most knowledgeable about the child' for the purpose of the data collection (see below).

The Quebec Newborn Twin Registry was established from all twin births occurring in the Province of Quebec between 1 April, 1995 and 31 December, 1998 (Pérusse, 1995). All parents living in the Greater Montreal Area were asked to enroll with their twins in the Quebec Newborn Twin Study (QNTS; Forget-Dubois & Pérusse, 1997). Parents were contacted by letter and by phone and laboratory appointments were scheduled for when the twins were aged five months (corrected for gestational duration). During the 4–5-hour morning laboratory visit, the mother and her twins were assessed on a number of psychophysiological, cognitive and behavioural measures. Two weeks later, the families were also visited at home, where the mother was interviewed and both parents asked to fill out questionaires. A total of 989 families were contacted, of which 672 agreed to participate (68%). These families were seen in the laboratory and in their home between June, 1996 and November, 1998.

Twin zygosity was ascertained by physical similarity for all pairs through aggregation of independent tester ratings based on the live assessment of physical similarity of twins using the short version of the Zygosity Questionnaire for Young Twins (Goldsmith, 1991). In addition, DNA was extracted through mouth swabs collected by mothers for 31.3% of the pairs selected at random. DNA-based zygosity was determined using 8–10 polymorphic micro-satellite markers. A comparison of the two methods indicated a concordance of 92%.

In both samples, the assessments were done in French or English, according to the language of the respondent. A broad range of social, demographic, health, and behavioural data was obtained. Only the data analysed for this study will be described in detail below.

### Instruments and procedure

The Parental Cognitions and Conduct Toward the Infant Scale (PACOTIS) is a self-report measure of parental perceptions and behavioural tendencies toward a recently born infant. Specific dimensions of parental perceptions and behaviours are assessed, dimensions that presumably reflect the quality of parents' involvement vis-a-vis their 5-month-old infant. Two dimensions, parental self-efficacy and perceived parental impact, centre on parents' beliefs about their role as a parent, with the three others, parental hostile-reactive behaviours, parental overprotection and parental warmth, reflecting behavioural tendencies. Parental self-efficacy refers to the perceived ability to carry out tasks asssociated with the role of a parent, specifically within the context of caring for a particular infant. Perceived parental impact relates to the parent's evaluation of the effect of his or her behaviour on the developing child. Parental hostile-reactive behaviours include hostile and restrictive responses to difficult behaviours in the baby. Parental warmth pertains to the pleasure and affection felt and shown by the parent when interacting with the infant. Finally, parental overprotection refers to behaviours reflecting excessive concern for the safety and protection of the child.

*Scale construction.* An initial list of 52 items was produced. Those related to parental self-efficacy were adapted from the scale created by Teti and Gelfand (1991) to make them more relevant to the context of 5-month-old infants. The content validity of the items was evaluated by 15 experts, clinical and developmental psychologists, with considerable experience in parent–infant interactions in the first year of life. They assessed the relevance of the contents of each item for the expected dimensions. Only those with a clear content were kept. A first version of 37 items was then administered to more than 500 mothers in a pilot study (Boivin et al., 1998). A factor analysis confirmed the presence of the anticipated dimensions. A new, shorter, version containing 28 items was then developed for the actual study. As indicated previously, this version included five items relating to parental warmth/affection. However, because the scores of parental warmth were extremely skewed (i.e., more than 60% of the mother had a maximum score of 10), and because parental warmth/affection did not emerge as a distinct factor on factor analysis, they were not considered in the present paper.

The parents had to indicate on an eleven-point scale (i.e., on a scale of 0 to 10) to what extent each statement accurately described their actions, their thoughts or their feelings in the context of their interacting with their 5-month-old infant(s). The 28 items were filled out separately by both parents of the 5-month-old infant after the home visit in the LSCDQ. These items are listed in Table 1. Overall, 2,146 mothers and 1,855 fathers in the LSCDQ completed the PACOTIS. Because 24 mothers and 26 fathers had more than 5 missing values on the questionnaire, they were excuded from the analyses, leaving a total 2,122 mothers and 1,829 fathers for the following analyses.

In the twin sample, the mother was requested to complete the PACOTIS separately for each twin. To moderate potential carry-over effects, she was asked to fill out the first half of the questionaire for twin A and the second half for twin B. Then, a few weeks later, at home, she did the reverse. A total of 601 mothers were asked to fill out the two parts of the PACOTIS. However, only the data for 510 mothers of twins were considered ($n = 1{,}020$ twins), as 11 mothers did not fill out either form of the PACOTIS and 80 mothers only filled out the first form of the questionnaire. For the genetic analyses, this number was further reduced to 475 (185 pairs of MZ twins and 290 pairs of DZ twins for a total of 950 twins), because zygosity status was undecided for 35 pairs. Fathers in the QNTS were also asked to fill out the two forms of the PACOTIS, but due to logistic problems, only those of the last 349 families were requested to do so. Only 238 fathers of twins did so ($n = 476$ twins) because 74 fathers did not fill out either form of the PACOTIS and 37 fathers only completed the first form.

*Other measures.* The other measures, which are described and justified herein, have been previously identified as risk factors associated with the quality of parenting and the development of behaviour problems in children. Four family characteristics were considered in the analysis of LSCDQ, as reported by the 'person most knowledgeable about the child' (PMK), in this case the mother: insufficient income, single-parenthood, spousal/partner support and birth order. Insufficient income was calculated as the low-income cut-off (LICO) set by Statistics Canada for the reference year 1997. This index takes into account the size of the household and the region where it is located. Nearly 23% (22.9%) of the families in the LSCDQ had insufficient income according to this criteria. Single-parenthood distinguished single-parent versus intact two-parent and stepfamilies. The families in the LSCDQ were composed of 7.4% of single-parent household.[1] A

[1] These figures may be compared to estimates taken from the younger cohort of Canada's National Longitudinal Study of Children and Youth (NLSCY; Landy & Tam, 1995); 27.3% of these NLSCY families had insufficient income, and 12.3% were single-parent household. However, the reader should bear in mind that 1) the LSCDQ is restricted to the population of Quebec, whereas the NLSCY provides estimates for Canada; 2) LSCDQ includes families that were more homogeneous with respect to the child's age (i.e., between 59 and 60 gestational weeks of age) than families of NSLCY (i.e., the child was between 0 and 23 months of age)

**Table 1** Dimensions and items of the Parental Cognitions and Conduct Toward the Infant Scale

| Dimensions | Items |
|---|---|
| Parental self-efficacy | I feel that I am very good at keeping my baby amused. |
| | I feel that I am very good at calming my baby down when he/she is upset, fussy or crying. |
| | I feel that I am very good at keeping my baby busy while I am doing other things. |
| | I feel that I am very good at attracting the attention of my baby. |
| | I feel that I am very good at feeding my baby, changing his/her diapers, and giving him/her a bath. |
| | In general, do you think you are 'a good mother/a good father'? |
| Perceived parental impact | My behaviour has little effect on the personal development of my baby.(R)[a] |
| | Regardless of what I do, my baby will develop on his/her own.(R) |
| | My behaviour has little effect on the intellectual development of my baby.(R) |
| | My behaviour has little effect on the development of emotions (for example, happiness, fear, anger) in my baby. (R) |
| | My behaviour has little effect on how my baby will interact with others in the future. (R) |
| Parental hostile-reactive behaviours | I have been angry with my baby when he/she was particularly fussy. |
| | When my baby cries, he/she gets on my nerves. |
| | I have raised my voice with or shouted at my baby when he/she was particularly fussy. |
| | I have spanked my baby when he/she was particularly fussy. |
| | I have lost my temper when my baby was particularly fussy. |
| | I have left my baby alone in his/her bedroom when he/she was particularly fussy. |
| | I have shaken my baby when he/she was particularly fussy. |
| Parental overprotection | I insist upon keeping my baby close to me at all times, within my eyesight and in the same room as I am. |
| | I consider myself a 'real mother hen.' |
| | I prefer that my baby sleeps in the same room as me at night. |
| | When I leave my baby with a baby-sitter, I miss him/her so much that I cannot enjoy myself. |
| | I can never bring myself to leave my baby with a baby-sitter. |

[a]Reverse coding.

five-item scale measured the mother's perception of spousal/partner support in the context of having a newborn infant, more specifically with respect to emotional aid, taking care of the baby and doing household chores. A factor analysis of the five items clearly indicated that they converged on the same factor. The mean of the five items was thus taken as an index of perceived spousal/partner support (Cronbach alpha = .89, M = 8.1, SD = 1.9). Finally, families were categorised by whether the infant was or was not the first born in the family, which was the case in 41.7% of the families.

Three risk characteristics of the mother were retained: teenage motherhood, low educational level of the mother, and self-reported depression measured by the CES-D depression scale. Mothers were divided into two age groups – under 20 years of age (2.8% of the target population) versus 20 years of age and over. Educational level of the mothers was defined by using the highest level of education attained as the base category. Two categories were considered – no high school diploma (15.2% of mothers and 17.3% of fathers) versus high school diploma or higher diploma obtained. To assess symptoms of depression, a 13-item abridged version of the Depression Scale (CES-D, Radloff, 1977) of the Center for Epidemiological Studies of the National Institute of Mental Health (US) was used. The scale was developed to measure the frequency of symptoms of depression in the general population. More specifically, it measured the presence and severity of symptoms associated with depression in the week preceding the survey. In the present study, the scores on the CES-D ranged from 0 to 36 (M = 5.4, SD = 5.1), with a high score indicating a high degree of depression (Cronbach alpha = .82). Because an abbreviated version of the CES-D scale was used, it was not possible to derive a clinical cutoff. However, using a score of 13 or above, as in Canada's NLSCY (Landy & Tam, 1995), we found that 8% of the sample showed signs of moderate to severe depression (9.2% in the NLSCY, but see note 1).

Finally two characteristics of the infant were considered, gender and difficult temperament. Given the evidence that the early parenting of boys and girls is similar (Leaper, 2002; Lytton & Romney, 1991; Tarabulsy et al., 2003; Teti & Gelfand, 1991), we did not have any a priori hypotheses regarding potential gender differences in parenting dimensions. Infant difficultness was considered a temperamental risk factor given previous reports of significant associations with negative parenting perception and behaviours (Bates, 1987; Lee and Bates, 1985; Teti & Gelfand, 1991; Van den Boom and Hoeksma, 1994).

Infant difficultness was assessed through both parents' ratings of 7 questions of the Infant Characteristics Questionnaire (ICQ, Bates, Freeland, & Lounsbury, 1979). The items were selected on the basis of Bates' (1992) recommendations and included questions such as: 'How many times per day, on average, does your baby get fussy and irritable – for either short or long periods of time?', 'How much does he/she cry and fuss in general?', and 'When he/she gets upset (e.g., before feeding, during diapering, etc.), how vigorously or loudly does he/she cry and fuss?'. Evidence of convergent validity of the ICQ infant difficultness scale, notably with other parent-report temperament scales and

with direct observations of the infant behaviours, has been reported (Bates et al., 1979; Hagekull, Bohlin, & Lindhagen, 1984). In the present study, principal component factor analyses revealed a consistent one factor solution accounting for 46% and 50% of the variance for both mother and father ratings respectively, with factor loadings ranging between .49 and .85. The evaluations of the mother (Cronbach alpha = .77) and father (Cronbach alpha = .82) were both reliable. The correlation between parent ratings was $r = .59$, $p < .001$, which is consistent with previous reports (Bates et al., 1979; Bates & Bayles, 1984; Diener, Goldstein, & Mangelsdorf, 1995; Stevenson & Fielding, 1985). Mother and father ratings were averaged when father ratings were available that is, in 85% of the cases, and as recommended by Stevenson and Fielding (1985), the mean rating was taken as an indication of the infant's difficult temperament. The scores varied from 0 to 33 (M = 11.6, SD = 5.9).

## Results

### *Factor structure*

We were first interested in examining whether the scale would reveal a similar structure across informants and across samples, that is, whether the presumed best-fitting four-factor structure could be generalised across informants and samples. Accordingly, we performed a series of confirmatory factor analyses using the maximum-likelihood method under EQS (Bentler, 1992). The basic model postulated 4 non-independent factors with significant, but moderate, correlations between factors (e.g., parental self-efficacy and parental hostile-reactive behaviours were expected to be negatively correlated). Specifically, the factor loadings of each item and their associated error-uniqueness were estimated only under the latent factor they were hypothesised to represent, with the other loadings being fixed to 0. In addition, the covariances between latent factors were estimated (i.e., set free) in order to allow correlations between factors. The fit of this model was compared to two other models, one positing complete independence between the latent dimensions (i.e., the covariances between latent factors were set to 0), the other postulating a second-order latent factor emerging from the convergence of the four latent factors. Each test was run separately for mother and father ratings in both the LSCDQ and the QNTS, where these analyses were performed separately for the two twins. This yielded 6 factor solutions: 1) mothers in LSCDQ, 2) fathers in LSCDQ, 3) mothers for twin A in QNTS, 4) mothers for twin B in QNTS, 5) fathers for twin A in QNTS, and 6) fathers for twin B in QNTS. Finally, to evaluate whether these solutions varied as a function of informants and samples, a test of invariance was performed.

According to a series of fit indexes (Chi square, Confirmatory Fit Index or CFI, and Root Mean Square Error of Approximation or RMSEA), the best fitting model was, in all six cases, the postulated four non-independent factor model: the CFI was above .90 (CFI varied from .90 to .93), with the RMSEA generally below .05 (RMSEA varied from .03 to .06). The model positing complete independence between the latent dimensions and that postulating a second-order latent factor both had worse fit than the four non-independent factor model, as indicated by the significant differences in chi-square and lowest RMSEA. As shown in Table 2, the estimated loadings were all significant and generally high. In addition, significant convergence was found between the latent factors, but these estimates were always low to moderate, ranging in magnitude from .10 to .41. As expected, the highest association was found between parental self-efficacy and hostile-reactive behaviours (from −.26 to −.41). More importantly, these estimated parameters, factor loadings and correlations, did not vary across samples and informants. A test of invariance of this best fitting model across the 6 sources of information indicated that the structure did not vary significantly (CFI = .90).

The fact that the best-fitting factor structure was similar across the 6 sources suggests the scale revealed the same type of information across samples and informants, an important first step in examining further the potential differences between samples and informants.[2] High degrees of internal consistency were obtained for all four scales across samples and informants (all *p*s > .75). The results derived from these informants and samples could thus be reliably compared. Factor-derived scales (mean scores) were used in the following analyses.

### *Mother–father comparisons*

In both samples, parental self-efficacy scores and perceived parental impact scores were positively skewed, whereas scores of parental hostile-reactive behaviours were negatively skewed; that is, both mothers and fathers perceived themselves as rather effective parents, believed their behaviours were having a significant impact on the development of their child, and reported that they only rarely resorted to hostile-reactive behaviours. Parent ratings of overprotection were more normally distributed. The means for mothers and fathers in the LSCDQ are displayed in Table 3. Significant differ-

[2] The items were formulated in one direction only. This decision was motivated by our desire to simplify and unify as much as possible the response format in order to minimise error in the use of the scale by parents less familiar with this type of assessment, and because some dimensions (e.g., hostile-reactive parenting) were not conceived as bipolar. This may have resulted in higher convergence between items designed to measure the same dimension, partly accounting for the resultant factor structure.

**Table 2** Factor loadings of items from the Parental Cognitions and Conduct Toward the Infant Scale (PACOTIS)

| | | Factor loadings | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mother ratings LSCDQ | | | | Father ratings LSCDQ | | | | Mother ratings QNTS-Twin A | | | | Mother ratings QNTS-twin b | | | | Father ratings QNTS-Twin A | | | | Father ratings QNTS-Twin B | | | |
| Item summary | Scale[a] | F1 | F2 | F3 | F4 | F1 | F2 | F3 | F4 | F1 | F2 | F3 | F4 | F1 | F2 | F3 | F4 | F1 | F2 | F3 | F4 | F1 | F2 | F3 | F4 |
| Keeping bb amused | PSE | .69 | | | | .73 | | | | .61 | | | | .61 | | | | .75 | | | | .74 | | | |
| Calming bb down | PSE | .63 | | | | .52 | | | | .61 | | | | .61 | | | | .61 | | | | .60 | | | |
| Keeping bb busy | PSE | .53 | | | | .58 | | | | .58 | | | | .58 | | | | .60 | | | | .60 | | | |
| Attracting the attention of bb | PSE | .65 | | | | .69 | | | | .60 | | | | .60 | | | | .75 | | | | .75 | | | |
| Feeding, changing, giving bath | PSE | .60 | | | | .37 | | | | .62 | | | | .61 | | | | .43 | | | | .43 | | | |
| Good mother/good father? | PSE | .56 | | | | .61 | | | | .57 | | | | .57 | | | | .63 | | | | .63 | | | |
| Personal development of bb | PPI | | .50 | | | | .53 | | | | .61 | | | | .61 | | | | .61 | | | | .60 | | |
| Bb will develop on his own | PPI | | .40 | | | | .43 | | | | .47 | | | | .47 | | | | .52 | | | | .52 | | |
| Intellectual development of bb | PPI | | .67 | | | | .66 | | | | .74 | | | | .74 | | | | .63 | | | | .63 | | |
| Development of emotions of bb | PPI | | .65 | | | | .65 | | | | .67 | | | | .67 | | | | .70 | | | | .69 | | |
| How bb will interact with others | PPI | | .60 | | | | .64 | | | | .67 | | | | .67 | | | | .62 | | | | .61 | | |
| Angry with my bb | PHRB | | | .68 | | | | .76 | | | | .77 | | | | .77 | | | | .79 | | | | .79 | |
| Bb gets on my nerves | PHRB | | | .62 | | | | .62 | | | | .70 | | | | .70 | | | | .67 | | | | .67 | |
| Raised voice or shouted | PHRB | | | .75 | | | | .76 | | | | .74 | | | | .74 | | | | .76 | | | | .76 | |
| Spanked bb | PHRB | | | .23 | | | | .19 | | | | .30 | | | | .30 | | | | .43 | | | | .42 | |
| Lost my temper | PHRB | | | .55 | | | | .55 | | | | .68 | | | | .68 | | | | .57 | | | | .56 | |
| Left bb alone | PHRB | | | .37 | | | | .39 | | | | .39 | | | | .40 | | | | .38 | | | | .38 | |
| Shaken bb | PHRB | | | .35 | | | | .27 | | | | .25 | | | | .25 | | | | .24 | | | | .24 | |
| Bb close to me at all times | PO | | | | .49 | | | | .47 | | | | .50 | | | | .50 | | | | .45 | | | | .45 |
| « Real mother hen» | PO | | | | .55 | | | | .48 | | | | .55 | | | | .55 | | | | .46 | | | | .46 |
| Bb sleeps in the same room | PO | | | | .32 | | | | .35 | | | | .39 | | | | .39 | | | | .40 | | | | .40 |
| Miss bb cannot enjoy myself | PO | | | | .73 | | | | .77 | | | | .78 | | | | .78 | | | | .73 | | | | .73 |
| Cannot leave bb with baby-sitter | PO | | | | .61 | | | | .67 | | | | .65 | | | | .65 | | | | .63 | | | | .63 |

[a]PSE = parental self-efficacy; PPI = perceived parental impact; PCB = parental hostile-reactive behaviours; PO = parental overprotection.

ences were found between mothers and fathers through a series of *t*-tests for paired samples. In general, the mothers felt more effective as parents than did the fathers. The fathers were somewhat more prone to hostile-reactive behaviours than the mothers, who, in contrast, were more worried about the health and safety of their infants than were the fathers. The two parents did not differ with respect to perceived parental impact.

Mother–father congruence was evaluated for each dimension by calculating product–moment correlations between mother and father ratings in the LSCDQ. Only families where both biological parents were present and had completed the PACOTIS were considered for these mother–father analyses ($n$ = 1,803 to 1,816 families; the number may vary slightly depending on the dimension). Through this selection, we excluded family contexts that were more difficult, for example, single-parent families, or families in transition, such as when one of the spouse was a step-parent. These correlations were all statistically significant. The correlation was weak ($r = .18$, df = 1803, $p < .0001$) for parental self-efficacy, but moderate for perceived parental impact ($r = .30$, df = 1816, $p < .0001$), parental hostile-reactive behaviours ($r = .32$, df = 1803, p < .0001), and parental overprotection ($r = .44$, df = 1812, $p < .0001$).

**Table 3** Mean ratings (and standard deviations) and differences in parenting of mothers and fathers in the LSCDQ, and of mothers of singletons and mothers of twins

| | Parental self-efficacy | Perceived parental impact | Parental hostile-reactive | Parental overprotection |
|---|---|---|---|---|
| Mothers in the LSCDQ | 8.97 (.95) | 8.45 (1.81) | 1.08 (1.23) | 4.64 (2.17) |
| Fathers in the LSCDQ | 7.92 (1.45) | 8.37 (1.80) | 1.42 (1.44) | 3.66 (2.17) |
| *t*-value | 27.60*** | 1.50 | –9.35*** | 18.15*** |
| Eta squared | .30 | .00 | .05 | .15 |
| Mothers of twins | 8.47 (1.15) | 8.17 (1.74) | 1.68 (1.50) | 3.64 (2.09) |
| Mothers of singletons | 8.90 (.95) | 8.24 (1.97) | 1.16 (1.30) | 4.77 (2.21) |
| *t*-value | 7.91*** | .63 | 7.10*** | 9.77*** |
| Eta squared | .04 | .00 | .03 | .05 |

***$p < .0001$.

### *Parenting twins versus singletons*

Differences in parenting between parents of twins and parents of singletons were also examined. For these series of analyses, a subsample of families living in the Greater Montreal Area was selected from the LSCDQ. This subsample (1,165 families) was composed of households that were geographically located in the same area (i.e., the same postal codes) as the families of twins. The mother ratings of these families were then compared to those of the mothers of twins ($n = 510$ mothers; ratings were averaged over the two twins). Because there were much fewer fathers than mothers who rated the twins, father figures are not reported here. The mean ratings of mothers of singletons and mothers of twins are reported in the bottom part of Table 3. In general, compared to mothers of singletons, mothers of twins felt less effective as parents ($t = 7.91$, df = 1673, $p < .0001$), they were more likely to behave in a hostile-reactive manner toward their infants ($t = 7.10$, df = 1673, $p < .0001$), and they were less concerned about the health and safety of their infants ($t = 9.77$, df = 1673, $p < .0001$). Mothers of twins and mothers of singletons did not differ with respect to perceived parental impact ($t = .63$, df = 1670, ns).

### *Correlates of parenting dimensions in the LSCDQ*

The contribution of the various risk factors to unfavourable parenting was assessed in separate regression analyses for each of the four dimensions in the LSCDQ. The analyses were first performed for mothers. Then, to evaluate whether the contributing risk factors differed between fathers and mothers, gender of the parent was dummy coded (father = 1, mother = 0) and the contribution of each risk factor was examined for possible interactions with gender of the parent. These interaction scores were introduced as a block in the last step of a hierachical regression model, after the main effects had been considered. When this block had a significant contribution, the unique contribution of each interaction term was examined further, i.e., decomposed, if it had a *p*-value of at least .001. The summary of the main effects in these analyses are presented in Table 4.

Together, the risk factors accounted for 11% of the variance in parental self-efficacy. The significant predictors were infant difficultness (squared semi-partial correlation, or $sr^2 = .05$), perceived spousal support ($sr^2 = .03$), and more marginally, maternal depression ($sr^2 = .01$). Mothers who felt less effective as parents had an infant who was seen as more difficult, perceived less support from their spouse, and reported more symptoms of depression. There was one significant interaction involving parent gender: perceived spousal support had a more important contribution for fathers (Beta = .29, $sr^2 = .08$) than for mothers (Beta = .18, $sr^2 = .03$), contributing to an increased 15% of the variance in parental efficacy for fathers (compared to 10% for mothers). Overall, 8% of the variance in perceived parental impact was explained by the risk factors. Mothers in low income families ($sr^2 = .02$), who had low education ($sr^2 = .02$) and reported more symptoms of depression ($sr^2 = .01$) perceived they had less impact on the development of their child. The same trends were found for fathers, i.e., there was no interaction with sex of the parent. Ten percent of the variance in hostile-reactive behaviour by the mother was explained by the risk factors: mothers who had an infant who was perceived as difficult ($sr^2 = .04$), and who reported more symptoms of depression ($sr^2 = .04$), and whose infant was their first child ($sr^2 = .005$) were more likely to use hostile-reactive parenting behaviours. There were two significant interactions involving the sex of the parent: 9% of the variance in father hostile-reactive behaviours was accounted for by the risk

**Table 4** Significant contributions of risk factors to the four dimensions of parenting for mothers in the LSCDQ and mothers in the QNTS

| | LSCDQ | | | QNTS | | |
|---|---|---|---|---|---|---|
| Dimensions | $R^2$ | Predictor | Beta | $R^2$ | Predictor | Beta |
| Parental self-efficacy | .11 | Temperament | −.27*** | .10 | Temperament twin 1 | −.16*** |
| | | Spousal support | .18*** | | Temperament twin 2 | −.16*** |
| | | Mother depression | −.09** | | Mother depression | −.18*** |
| Perceived parental impact | .08 | Income | .15*** | .06 | Income | .26*** |
| | | Mother education | .15*** | | | |
| | | Mother depression | −.10** | | | |
| Parental hostile-reactive beh. | .10 | Temperament | .20*** | .14 | Temperament twin 1 | .12* |
| | | Mother depression | .21*** | | Temperament twin 2 | .12* |
| | | Infant as first born | .09** | | Mother depression | .28*** |
| | | | | | Infants as first born | .13** |
| Parental overprotection | .07 | Income | −.18*** | .06 | Income | −.23*** |
| | | Mother education | −.11*** | | | |
| | | Mother depression | .11** | | | |
| | | Infant as first born | −.06** | | | |

factors (10% for mothers), but, in contrast to mothers (Beta = .21, $sr^2$ = .04), depression did not contribute to hostile-reactive behaviours in fathers (Beta = .05, ns), and infant difficultness had a more important contribution to hostile-reactive behaviours for fathers (Beta = .27, $sr^2$ = .07) than for mothers (Beta = .20, $sr^2$ = .04). Finally, 7% of the variance in parental overprotection was explained by the risk factors. Many factors made unique contributions: mothers in low income families ($sr^2$ = .03), as well as those who had low education ($sr^2$ = .01), who reported more symptoms of depression ($sr^2$ = .01), and, more marginally, those whose infant was their first child ($sr^2$ = .004), were more likely to worry about the health and safety of their infant. These figures did not vary as a function of the sex of the parent.

It could be argued that, through common method variance, mother ratings accounted for the main contribution of infant difficultness to maternal self-efficacy and mother hostile-reactive behaviours. Consequently, we ran the same regression analyses for the 4 dimensions of parenting (i.e., among mothers) using only father ratings of difficultness ($n$ varied from 1,731 to 1,732). In all cases, the results were very similar to those using the father–mother average ratings of infant difficultness; i.e, the same risk factors still had significant contributions. Specifically, father-assessed infant difficultness was uniquely associated with maternal self-efficacy (Beta = −.18, $p < .001$), as well as to mother hostile-reactive behaviours (Beta = .17, $p < .001$), but not to perceived parental impact nor to maternal overprotection. The contributions of father-rated infant difficultness to maternal self-efficacy and mother hostile-reactive behaviours were lower than with the average ratings (especially in the case of maternal self-efficacy), but still significant.

### *Correlates of parenting dimensions in the QNTS*

The contribution of risk factors to unfavourable parenting was also assessed in the QNTS, the twin design allowing for an in-depth analysis of both betwen-family and within-family variance in parenting. However, with the exception of sex and difficultness of the twins, the risk factors were assessed at the parent or family level of analysis and, by definition, did not vary within family. Therefore, in a first look at the between-family correlates of parenting in the QNTS, the mother parenting scores were averaged within family (i.e., across twins), for each of the four dimensions (i.e., mothers only because of the low response rate of the fathers). Then, as in the singleton sample, the contribution of risk factors to each of these parenting dimensions was assessed in separate regression analyses. Unfortunately, because we did not have complete information about single parenthood, perceived conjugal support and age of the mother in the QNTS, these variables were not considered.

Most of these results confirmed the findings of the singleton study (see Table 4). For instance, the risk factors accounted for 10% of the variance in maternal self-efficacy, and here again, the significant (negative) predictors were maternal depression ($sr^2$ = .03), and the infant twins difficultness ($sr^2$ = .02 and .03). The risk factors accounted for 14% of the variance in between-family variance in parental hostile-reactive behaviours, with maternal depression ($sr^2$ = .07), the difficultness of each of the twins ($sr^2$ = .01 and .01), and the twins being the first born in the family ($sr^2$ = .02) having unique contributions. Interestingly, the difficultness of each infant had a unique contribution to both maternal self-efficacy and general maternal hostile-reactive behaviours. In other words, the more depressed was the mother and the more each infant was reported as difficult, the more likely the mother of twins felt less effective and used hostile-reactive behaviours. Low family income was again uniquely associated with both low perceived parental impact ($sr^2$ = .06) and parental overprotection ($sr^2$ = .05) in the mother, but mother's education and mother's depression were not.

Here again, to alleviate the possible carry-over effects due to mothers rating both their infants difficultness and their parenting (i.e., the common method variance problem), we ran the same regression analyses using only father ratings of difficultness. Only 389 families were considered for these analyses due to missing data among fathers. The patterns of results were again quite similar. Both mother depression (Beta = −.19, $p < .001$) and father assessed infant difficultness (Twin 1: Beta = −.08, $p < .1$; Twin 2: Beta = −.19, $p < .001$) were uniquely associated with maternal self-efficacy, although marginally so for twin 1. For mother hostile-reactive behaviours, the significant factors were mother's depression (Beta = .29, $p < .001$), the twins being the first born in the family (Beta = −.14, $p < .01$), and father assessed infant difficultness (Twin 1: Beta = .10, $p < .05$; Twin 2: Beta = .16, $p < .001$).

### *The genetic epidemiology of parenting using the QNTS*

We then moved to the genetic-environmental analysis of parenting. For this purpose, the mother's ratings of parenting were examined for each twin separately. First, we examined the pattern of MZ and DZ twin pair intraclass correlations for each of the four PACOTIS dimensions. These correlations are presented in Table 5. In general, the intraclass correlations were high in magnitude (ranging from .65 to .87). The value of the correlation did not vary as a function of zygosity for parental self-efficacy, perceived parental impact and parental overprotec-

**Table 5** Intraclass correlations for the four maternal assessments of parenting in the QNTS

| Dimensions | MZ twins | DZ twins |
|---|---|---|
| Parental self-efficacy | .71 | .81 |
| Perceived parental impact | .68 | .70 |
| Parental hostile-reactive beh. | .83 | .66 |
| Parental overprotection | .86 | .86 |

*Note*: All correlations are significant at $p < .001$.

tion. The pattern of results for these three dimensions suggested strong shared environmental effect, mainly associated with the mother's similar ratings of her perceived self-efficacy, parental impact and overprotection toward the two twins. In other words, the three dimensions mainly characterised the mother.

In contrast to the other parenting dimensions, the pattern of twin correlations for parental hostile-reactive behaviours was more differentiated, with higher intraclass correlation for MZ twins than for DZ twins. A series of univariate quantitative genetic models were then tested to quantify the different sources of variation for parental hostile-reactive behaviours. These models were derived from the standard additive ACE approach (Neale & Cardon, 1992) and fitted to the data using MX. In the ACE model, three potential sources of variance are considered and estimated: additive genetic factors (A), reflecting the association with the genotype; common or shared environmental factors (C), reflecting environmental factors shared or experienced similarly by members of the same family (i.e., co-twins); and unique environmental factors (E), which reflect environmental factors that are uniquely experienced by the individual. Simpler models (e.g., AE, CE) may consider only a combination of factors to account for the pattern of data. When these simpler, more parsimonious, models were tested, the best-fitting model was selected using the maximum-likelihood criterion of fit and Aikaike's Information criterion (AIC) for parsimony (i.e., maximum fit with minimum number of factors/parameters). Model testing through structural equation modelling is very sensitive to deviation from normal distribution. Because hostile-reactive behaviour scores were highly skewed, these scores were transformed through a logarithmic transformation (Lg10 [hostile-reactive +1]) and then standardised.

Table 6 shows the estimates derived from the various models tested for hostile-reactive behaviours. The best-fitting model for the general analysis was an ACE model, with 31% of the variance in hostile-reactive behaviours accounted for by child additive genetic effects (A), 53% by common environmental effects (C), and 16% by unique environmental effects (E). In other words, mother's hostile-reactive behaviours were mainly shared by twins of the same family. However, there was also

**Table 6** Estimates derived from the various univariate models tested for maternal hostile-reactive behaviours

| | | | | Proportion of variance for each parameter in the model | | |
|---|---|---|---|---|---|---|
| Model | Chi-square | *p*-value | AIC | $A^2$ | $C^2$ | $E^2$ |
| ACE | .43 | $p = .94$ | −5.57 | .31 | .53 | .16 |
| AE | 44.40 | $p < .001$ | 36.40 | .84 | | .16 |
| CE | 25.39 | $p < .001$ | 17.39 | | .74 | .26 |

*Note*: A = additive genetic factors, C = shared environment factors, E = unique environment factors, AIC = Aikaike's Information Criterion.

significant within family variation in mother's hostile-reactive behaviours, and this variation was significantly associated with the infant genotype, as reflected by the difference in the covariance beween MZ and DZ twins.

We then conducted a series of bivariate analyses to examine further the role of difficultness as a risk factor for maternal hostile-reactive behaviours. To control for the shared method variance, we only used father ratings as the index of difficultness.[3] The first step in this analysis considers the genetic-environment etiology of difficult temperament through the standard additive ACE approach.

At the univariate level, examination of MZ and DZ correlations for difficultness suggested strong heritability, as well as a sibling interaction effect: the intraclass correlation for MZ twins was $r = .51$ ($p < .001$, for father ratings; $r = .45$, $p < .001$ using mother–father mean score), but it was non-significant for DZ twins ($r = .08$ for father ratings; $r = -.08$ using mother–father mean score). When non-significant correlations for DZ twins are coupled with moderately high correlations for MZ twins, this suggests there may be a sibling interaction effect. There is a sibling interaction effect when one twin's score is dependent on the co-twin's score. The fact that the variance among DZ twins (father ratings: $s = .99$; mother ratings: $s = .1.26$) was higher than the variance among MZ twins (father ratings: $s = .67$; mother ratings: $s = .86$) was consistent with a sibling contrast effect (see Neale & Cardon, 1992), perhaps reflecting rater biases. In other words, parents' ratings generated more extreme scores on the scales in the case of DZ than MZ twins. Consequently, a series of ACE+ s, sibling interaction models and their nested models were compared for father assessed

[3] We also performed the same series of analyses using the mother–father mean scores of temperament. The results were very similar to those using only the father assessments. For exemple, the correlation was .28 ($p < .001$) overall between difficult temperament and maternal hostile-reactive behaviours at the phenotypic level.

difficultness scores. The resulting best-fitting solution was a AE+ s model (Chi-square = 6.98, df = 3, $p > .05$; AIC = −13.98), with 78% of the variance associated with additive genetic effects, 22% with unique environment effects, and a sibling interaction effect of s = −.19 (i.e., the estimated difference between similarity in difficultness ratings of MZ and DZ twins).

We then turned our attention to the bivariate analyses proper. There was a significant positive correlation of .25 ($p < .01$) overall between father ratings of difficultness and maternal hostile-reactive behaviours at the phenotypic level. To specifically examine the etiological factors that account for the relation between infant difficultness (i.e., father ratings) and maternal hostile-reactive behaviours, we performed a bivariate shared-etiology model (Loehlin, 1996). The aim of the bivariate shared-etiology analysis is to evaluate whether the phenotypic association between difficultness and mother hostile-reactive behaviours can be explained by the same etiological factors (i.e., A or C). We first examined the cross-phenotype correlations, that is the correlation between twin A difficultness and hostile-reactive behaviours toward twin B, and vice versa, as a function of zygosity. The average cross-phenotype correlation for MZ twins was .19 ($p < .01$) compared to .10 ($p < .05$) for DZ twins. This initial MZ–DZ difference in correlation suggested a low to moderate bivariate heritability (i.e., the relative contribution of child genetic factors to the covariation between child difficultness and maternal hostile-reactive behaviours).

A correlated factors model was then fitted for difficultness and maternal hostile-reactive behaviours through MX to assess possible shared variance structures between the two phenotypes. However, univariate models had already indicated that the C component to difficultness was non-significant, and that there was a significant sibling interaction effect. Therefore, a bivariate C could not be estimated, and a bivariate AE+s / ACE model was tested for difficultness (AE+s stands for a model in which there is a significant additive genetic component -A-, and a unique environment component −E-, taking into account a significant difference in variance between MZ and DZ twins −s-) and parental hostile-reactive behaviours (ACE). The full correlated AE+s / ACE model with estimates of genetic correlation and unique environment correlation, and simpler nested models of difficultness and maternal hostile-reactive behaviours were tested. The genetic correlation reflects the proportion of the covariance between difficultness and mother behaviours simultaneously accounted for by the infant genes. A strong unique environment correlation may suggest correlated measurement error, and is thus technically undesirable. Cross-phenotypic paths used to assess genetic correlation and nonshared environment correlation respectively were dropped successively to assess their significance. A parameter was considered non-significant if it could be dropped without significantly worsening the fit of the model. The resulting best-fitting model was the full AE+s /ACE of difficultness and maternal hostile-reactive behaviours, Chi-square = 10.02, df = 12, $p > .05$, AIC = −13.98. The genetic correlation was .55 (95% CI: .39−.73), whereas the unique environment correlation was .06 (95% CI: −.10−.21).

In summary, the univariate analysis revealed that mothers' hostile-reactive behaviours were mainly shared by the twins (i.e., significant univariate C), but also that a significant 31% of the variance in those behaviours were accounted for by the infant genes (i.e., significant univariate A). Adding infant difficultness in the bivariate analyses indicated that a little more than half of the genetic variance in maternal hostile-reactive behaviours (i.e., 55% of 31%, or 17%) was associated with the genes underlying child difficultness. In other words, the infant genes responsible for difficultness also partly accounted for hostile-reactive behaviours in the mothers.

## Discussion

The purpose of this study was to examine the factor structure, the correlates, and the genetic-environment etiology of parenting perceptions and behaviours toward 5-month-old infants, as measured by the new PACOTIS in two parallel population-based samples. The focus on very young infants is relatively rare in the study of parental perceptions, and the present study offered the advantage of examining parenting in a context where experience with the child is limited in comparison to previous reports. Additionally, the inclusion of a large representative sample, as well as a large sample of families of twins, homogeneous with respect to age, provided the opportunity for addressing a number of new questions, not yet examined in the scholarly literature. Analyses revealed a number of important results: 1) a consistent structure of parenting perceptions and behaviours was found across informants and across samples, 2) a differentiated and congruent pattern of risk factors was obtained for each dimension of parenting, with the twin design providing evidence for a shared genetic influence partly accounting for the association between infant difficultness and maternal hostile-reactive behaviours, and 3) significant mean differences in parenting were revealed between mothers and fathers, as well as between parents of twins and parents of singletons. We will now briefly comment on the more salient features of these results.

### *The structure of parenting perceptions and behaviours*

Overall, the postulated four-factor structure of parenting perceptions and behaviours was consistent

across samples and informants. The correlations among the four latent factors were low, with the exception of parental self-efficacy and parental hostile-reactive behaviours, which were negatively associated, a relation consistent with previous findings (Teti & Gelfand, 1991). This cross-informant, cross-sample stability in the structure of parenting perceptions and behaviours has rarely been tested in previous studies (for an exception, see Kendler, 1996), and never at such an early age. In the present study, not only could mothers and fathers be used as reliable informants about their parenting perceptions and behaviours toward their 5-month-old infants, but these self-reports yielded the same type of information in both the singleton and twin samples, a prerequisite to examining further the correlates of parenting in the two samples.

### *The etiology of parenting perceptions and behaviours*

There was also substantial convergence in the findings from the two samples regarding the etiology of parenting perceptions and behaviours. A rather clear-cut and unsurprising pattern was found for perceived parental impact and overprotective behaviours; in the twin study, the mothers evaluated similarly each of their twins, and this pattern did not vary as a function of zygosity. This was also the case for parental self-efficacy (but see below). The mother clearly appeared at the source of the shared environmental influence, to the point where these dimensions could be seen as characteristics of the mother. This is consistent with previous work by Kendler (1996) who reported that both father's and mother's retrospective account of their parenting style toward their twins showed strong shared component and very little genetic variance. Also coherent with this view was the fact that both perceived parental impact and parental overprotection were associated with between-family risk factors, such as socio-economic conditions (family income and education) and parent mental health. Infant difficultness was not associated with any of these parental dimensions. This systematic and coherent pattern of associations suggests that perceived parental impact and parental overprotection are accounted for by parent and family characteristics, rather than by the infant negative emotionality, at least in the case of young infants.

In contrast to this pattern of findings, the configuration of risk factors associated with the other two dimensions of parenting was more differentiated. Both parental self-efficacy and hostile-reactive parenting behaviours were associated with a combination of infant, parental and family risk factors, including infant difficultness, parent depression, and low spousal support. The results linking infant difficultness and parent's hostile-reactive behaviours are noteworthy because previous reports have revealed conflicting results with young infants (Crockenberg, 1986; Daniels et al., 1984; Rothbart, 1986). In both the twin and singleton studies, the results were consistent with the view that infant difficult temperament could partly contribute to, or evoke, hostile-reactive parenting behaviours.

### *The genetic-environmental etiology of hostile-reactive parenting behaviours*

The genetic-environmental etiology of hostile-reactive parenting behaviours, and of its association with infant difficultness, was examined through the twin design. This analysis revealed that, over and above the hostile-reactive behaviours shared by twins within the same family (i.e., a substantial shared environmental effect), hostile-reactive behaviours also significantly varied as a function of the twins' genetic similarity. Such a pattern suggests that an infant characteristic, under genetic influence, may partly account for the measured variation in hostile-reactive parenting behaviours. Further bivariate genetic analyses indicated that a substantial portion of this genetic effect was shared with the infant difficultness. In other words, a moderate, yet significant, part of the variance in hostile-reactive parenting behaviours was associated with the infant genotype, and accounted for by the genes underlying infant difficultness.

The present study is not the first to find an association between appraisals of the family environment and the child genotype (see Dunn & Plomin, 1986; Rowe, 1981, 1983; Lytton, 1977, 1980), but it is the first to find evidence of heritability at such an early age. This is likely to result from an evocative genotype–environment correlation phenomenon (O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998) whereby the infant's difficultness, partly under genetic influence, would impinge on the mother's behaviour toward him or her, thereby affecting the nature of the child's early social environment and later behaviour problems. The findings of the present study are quite consistent with those of other studies pointing to an evocative genotype-environment process linking child aversive behaviours and negative parenting (e.g., Deater-Deckard, 2000; Deater-Deckard & O'Connor, 2000; Ge et al., 1996; O'Connor et al., 1998). Still, the present study provides unique evidence for the early initiation of this form of process, i.e., in the initial stage of the developing parent–child relationship.

However, we should bear in mind that the present twin study only provides indirect evidence for the presence of an evocative gene–environment process. For instance, the pattern of findings could also result from a purely genetic transmission possibly yielding a passive gene–environment process (Scarr, 1992). Indeed, the same genes responsible for hostile-reactive behaviours in the mother, an adverse environment for the infant, may also be responsible for the infant

difficultness. To rule out this possibility, it would be important to show, e.g., through an adoption design, that the association between hostile-reactive parental behaviours and infant difficultness do not vary as a function of parent–child genetic relatedness.

Furthermore, causality and process should not be interpreted too hastily given the correlational nature of the research design and the absence of a temporal sequence in these data. It will be important to evaluate whether this pattern of findings is maintained or aggravated as the infants grow up, especially between 18 and 30 months of age when the children increased 'negativity' will likely exercise an increased strain on the parents' felt competence and disciplinary behaviours. Indeed, the strenght of the associations at 5 months of age were modest, but it is possible that the infants' characteristics, as well as parental perceptions and behaviours, have not yet crystallised. A significant proportion of the mothers were still at home, and therefore in a very different context from the one they will be in when they have returned to work. Consequently, we may expect a shift in the quality of parental investment with the infant's age: as suggested by Crockenberg (1986), parents may be more tolerant and positively responsive to irritable infants in the early stage of infancy, but progressively turn to more negative means of control as the infant develops. Transactional processes could also be involved: there could be an initial modest contribution of genetic effects to infant difficultness, and a cumulative effect of bidirectional processes between child behaviours and parenting behaviours over time (Bell & Chapman, 1986; Collins et al., 2000; Harrist & Waugh, 2002). Specifically, the putative evocative G-E correlation could reflect the early phase of a family coercive process as described by Patterson et al. (1992). The coercive family process refers to a pattern of reciprocal exchanges in which poor family management practices such as inconsistent, ineffective and punitive parental responses, and the child's aversive behaviour are mutually reinforced, providing for the early training of young children's antisocial behaviour. According to Patterson et al. (1992), these aversive interactional patterns may originate from a combination of factors such as a difficult child, low parental competence and environmental stressors. These negative exchanges are often trivial in their early stages, but they may be aggravated by recurrent negative reinforcements, as the actors are prompted to accentuate the punitive aspect of their behaviour in order to control or coerce the other. The longitudinal follow-up of these families should provide the means to evaluate these developmental processes more decisively.

### *The case of parental self-efficacy*

Although self-efficacy and hostile-reactive behaviours were negatively associated and shared similar risk factors, the results of the genetic analyses suggest that these relations are not genetically mediated. Indeed, parental self-efficacy was clearly not linked to infant genetic variance, although it was uniquely associated with infant difficultness (as well as with parent depression, and low spousal support). These correlates of parental self-efficacy confirm previous reports (e.g., Gross et al., 1994; Teti & Gelfand, 1991). Findings by Teti and Gelfand (1991) suggest that parental self-efficacy mediate the effect of these risk factors on parenting competence, which would be consistent with an environment mediated relation. However, longitudinal information is necessary to test this possibility more clearly.

### *Father and mother differences in parenting*

The present study also documented parenting in fathers, information that is rarely collected in studies about early parenting. Significant differences in parenting were found between mothers and fathers, all of which could be expected by what is known about fatherhood and motherhood at this early age. In general, the mothers felt more effective as parent and worried more about the health and safety of their infants than were the fathers, who were more likely to use hostile-reactive parenting behaviours. The difference in perceived parenting efficacy between mothers and fathers is congruent with previous reports (e.g., Froman & Owen, 1989; Reece & Harkless, 1998). It is also consistent with previous findings indicating that fathers spend less time with their infants (Lamb, 1987) and are less involved in caregiving toward their infants than mothers (Belsky & Volling, 1987). It also relates to the view that, at least in North America, mothers perceive themselves as the primary caregiver of their infant, with fathers having a more discretional role (Beitel & Parke, 1998; Parke, 1996).

Also consistent with this view was the fact that depression contributed to hostile-reactive behaviours in mothers, but not in fathers, who were more inclined than mothers to adopt hostile-reactive behaviour if they perceived the child as being difficult. In other words, it is as if the father were more inclined to blame the infant for reacting with hostility whereas the mother's negative behaviours were explained by her internalised problems. However that may be, paternal contribution in a supporting role seems important as suggested by the unique contribution of spousal support to both mother and father self-efficacy. It is noteworthy that the mother's perception of conjugal support was associated more to the father's parental self-efficacy than to the mother's, a finding that could reflect some fathers' active and self-reliant participation in caregiving. However, the process underlying this relation is not clear. As suggested by Beitel and Parke (1998), father involvement in the family system is multifaceted and multidetermined: both paternal and

maternal attitudes and beliefs with respect to paternal competence likely interact in predicting fathers' involvement in caregiving. Future studies should examine more closely the evolution and determinants of fathers' involvement, specifically in relation to both paternal and maternal perceptions and attitudes, as well as with respect to the infant's adjustment.

Although mothers and fathers differed with respect to the parenting dimensions, some degree of convergence was observed between the parents, in particular with regard to hostile-reactive behaviours and overprotection. It may thus be possible to reliably characterise some *family* environments along these dimensions. However, the limited magnitude of this convergence also indicates that it is important to gather information on both parents if we are to understand the nature of the child's social experience within his or her family.

### *Parenting twins versus singletons*

Examination of the parenting dimensions as a function of single versus twin births revealed significant differences in mean levels, indicating that parenting twins was a challenging and demanding task: parents of twins felt less effective as parents, were more likely to use hostile-reactive behaviours and showed less concern about the health and safety of their infants than parents of singletons. These mean differences are consistent with the finding that the difficultness of each child combined additively to predict both hostile-reactive behaviour and self-efficacy, pointing to the fact that simultaneously providing for the care of two infants is a demanding task that may tax parental resources. These differences should be of concern, although it is too early to see whether they will result in more negative effects for twins versus singletons.

### *Limitations of this study*

This study is the first of its kind to provide for an in-depth investigation of the etiology of specific dimensions of parenting among mothers and fathers, as well as for epidemiologically informative estimates of these dimensions at such an early age. The use of two samples not only provides a solid basis for comparing families of twins with families of singletons, but the population-based representative character of the LSCDQ and QNTS also insures for epidemiologically valid estimates of relevant aspects of parenting and their associated risk factors.

However, the present findings are limited and some caveats should be underscored. First, as discussed earlier, the results of the present study were obtained at a single time point, thus making any inferences about processes somewhat speculative. Future longitudinal and prospective studies are needed in order to provide a more direct evaluation of the developmental processes discussed here. Second, the parental hostile-reactive behaviours were assessed in a context presented as hard to manage ('…when your child is fussy'), which might explain the observed trends to some extent. For instance, Lytton (1977) compared the similarity of such 'child-initiated' parental responses to 'parent-initiated' actions toward two-year-old DZ and MZ twins. He found that mothers responded to MZ twins more similarly than to DZ twins, but did not differ in their rate of parent-initiated actions. It will thus be useful to verify whether these trends are confirmed when examining 'parent-initiated' behaviours. Third, given that the present study relied on self-report data, albeit from two different sources (i.e., mothers and fathers), it is likely to be affected by biased measurement errors. Specifically, these self-report measures may be influenced by social desirability, especially when they target behaviours that parents may feel uncomfortable to reveal (e.g., hostile-reactive behaviours). As indicated previously, measures were taken to minimise potential social desirability effects attached to revealing these negative behaviours by contextualising their expression. Scores of hostile-reactive behaviours were very low, and their distribution highly censured, but nevertheless, the pattern of findings was consistent with previous research. However, we cannot rule out the possibility that social desirability could partly account for the pattern of findings. If only for this reason, we need to know the extent to which these parental cognitions and self-reported behaviours are translated into, or predict, observable parenting behaviours and/or behaviour problems in the child. Fourth, the present research was limited in its efforts to tap characteristics of the child which may directly contribute to parenting experiences. For instance, the focus has been on infant difficultness, but other dimensions of temperament/behaviours (e.g., behavioural inhibition) may prove to have an impact on different dimensions of parenting (e.g., overprotection), especially at a later age when infant signals may become more differentiated and perhaps more likely to influence parenting. As infants grow older, future studies should try to assess a variety of positive and negative behaviours likely to interact with parenting cognitions and behaviours. Finally, it is also important to acknowledge that only a limited, but significant, portion of the overall variance in parenting was accounted for in the present study. Even if evocative genotype–environment process are shown to operate, parents behaviours do not occur only in response to child characteristics: they may also be influenced by other family processes (e.g., marital relationship), as well as being bidirectional and transactional. Thus, additional processes and contributing factors are likely to be operative and should be explored in future research.

## Conclusion

Using two large-scale population-based samples, homogeneous with respect to age, we showed that parenting perceptions and behaviours could be distinctively and reliably assessed through the PACOTIS when infants were 5 months old. There was substantial convergence in the findings concerning the correlates of parenting, and the overall pattern of results was consistent with Belsky's (1984) view of parenting as multiply determined. The adverse dimensions of parenting were associated with a variety of family-, parent- and child-related risk factors. The genetic-environment analyses indicated that each parenting dimension mainly reflected shared environment, with maternal hostile-reactive behaviours being associated with the infant genotype through the mediation of the infant difficultness. Expected mean differences between mothers and fathers, as well as between parents of twins and parents of singletons were also revealed. The longitudinal follow-up of these families will enable the evaluation of stability and change in these parenting dimensions, as well as of their capacity to predict the child's futur adjustment. It will also provide the means for testing more decisively various developmental models about the determinants and outcomes of these parenting dimensions.

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## Correspondence to

Michel Boivin, École de psychologie, Université Laval, Québec, Canada, G1K7P4; Tel: 418-656-2131#2825; Fax: 418-656-3646; Email: michel.boivin@psy.ulaval.ca

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