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*Year : 2012*

## Parent-offspring similarity for childhood behavioral inhibition and associations between inhibition and parental care

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TERCIER Dominique, 2012, Parent-offspring similarity for childhood behavioral inhibition and associations between inhibition and parental care

Originally published at : Thesis, University of Lausanne

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**UNIVERSITE DE LAUSANNE - FACULTE DE BIOLOGIE ET DE MEDECINE**

Département de Psychiatrie  
Centre d'Epidémiologie Psychiatrique et de Psychopathologie

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**Parent-offspring similarity for childhood behavioral inhibition and  
associations between inhibition and parental care**

THESE

préparée sous la direction du Professeur associé Martin Preisig

et présentée à la Faculté de biologie et de médecine de  
l'Université de Lausanne pour l'obtention du grade de

DOCTEUR EN MEDECINE

par

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Lausanne

2012

# *Imprimatur*

*Vu le rapport présenté par le jury d'examen, composé de*

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*intitulée*

*Parent-offspring similarity for childhood behavioral  
inhibition and associations between inhibition and parental  
care*

*Lausanne, le 3 juillet 2012*

*pour Le Doyen  
de la Faculté de Biologie et de Médecine*



*Madame le Professeur Stephanie Clarke  
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## Rapport de synthèse

L'article constituant le présent travail de thèse décrit une recherche évaluant les similarités entre l'inhibition comportementale chez des enfants et leurs parents respectifs durant l'enfance, ainsi que l'association éventuelle entre l'inhibition et les attitudes parentales.

L'inhibition comportementale - définie comme une prédisposition de l'enfant à réagir avec réticence et angoisse à des situations inhabituelles - est une caractéristique de tempérament qui apparaît tôt dans la vie et est relativement stable dans le temps. L'intérêt qui y est associé repose sur son association avec des conséquences développementales négatives pour l'individu: risque accentué chez les enfants d'inadaptation scolaire, de dysfonctionnement social et de sentiments de détresse; facteur de risque en ce qui concerne le développement ultérieur de troubles psychiatriques de l'adulte, dont les troubles anxieux en particulier. Nous avons dès lors investigué dans cette recherche 1) la présence d'une association entre l'inhibition comportementale actuelle des enfants et celle rétrospective de leurs parents, dans ses deux dimensions spécifiques, soit sociale (« peurs à l'école ») et non-sociale (« peurs générales »), et 2) si ces dimensions d'inhibition étaient associées au niveau de chaleur, d'affectivité et de soutien prodigués par les parents.

C'est à partir de la récolte d'auto-questionnaires remplis dans le contexte d'une vaste étude initiée à Lausanne en 1994, que nous avons extrait un échantillon de 453 enfants scolarisés en 6/7<sup>ème</sup> années et 741 de leurs parents biologiques respectifs. Les analyses ont porté sur les auto-questionnaires évaluant, chez les enfants, leurs degrés d'inhibition comportementale, de symptomatologie psychiatrique actuelle et de perception de chaleur, d'affectivité et de soutien reçu de la part des parents, et, en ce qui concerne les parents, des auto-questionnaires évaluant rétrospectivement leurs degrés d'inhibition comportementale durant l'enfance et de symptomatologie psychiatrique actuelle.

La comparaison des scores des enfants avec ceux de leurs parents sur les échelles de l'inhibition comportementale (CSRCI-Child version of the Self-Report of Child Inhibition - et RSRI - Retrospective Self-Report of Inhibition -), montre la présence d'une similarité significative pour chacune des dimensions spécifiques, suggérant que les enfants de parents ayant présenté une inhibition comportementale dans l'enfance sont plus à risque d'en développer une à leur tour.

Nous avons par ailleurs pu établir, au cours d'analyses complémentaires, que cette association se maintenait après l'ajustement des degrés de symptomatologie psychiatrique respectifs des enfants et de leurs parents, ce qui a permis d'écarter ce facteur confondant potentiel.

Bien que la nature de cette association ne puisse être élucidée par cette recherche, le fait que la taille de l'effet soit modeste suggère qu'un rôle important dans le développement de l'inhibition soit joué par des facteurs environnementaux non partagés dans une famille. Un de ceux-ci semble suggéré par l'association négative qui apparaît dans cette étude entre le degré d'inhibition dans sa dimension « peurs à l'école » et l'attitude parentale: un bas niveau de chaleur, d'affectivité et de soutien perçu par l'enfant de la part de ses parents aurait ainsi une influence sur le développement de peurs en situations sociales en particulier. Alternativement, cette association négative pourrait suggérer que les peurs de l'enfant aient une influence négative sur le développement d'une attitude parentale de soutien ou, du moins, sur la perception de celle-ci par l'enfant. Il est aussi bien évidemment envisageable que ces processus interagissent dans une boucle de rétroaction. Seules des études longitudinales pourraient nous éclairer sur la nature de cette association. Quoi qu'il en soit, ce résultat présente un intérêt clinique pour orienter des interventions de prévention du développement de troubles psychiatriques chez des enfants inhibés, en proposant d'agir, soit directement sur les attitudes parentales, soit sur les peurs de l'enfant ainsi que sur les caractéristiques perçues par l'enfant de l'attitude parentale.

Des études longitudinales sur les ressemblances entre les parents et leurs enfants concernant l'inhibition comportementale, incluant des études de jumeaux, d'enfants adoptés et de familles, sont nécessaires pour mieux comprendre les interactions entre les facteurs génétiques, familiaux et environnementaux dans le développement de l'inhibition comportementale des enfants.

## Parent–offspring similarity for childhood behavioral inhibition and associations between inhibition and parental care

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(Received 26 January 2011; final version received 15 April 2012)

Few studies have assessed whether offspring resemble their parents regarding behavioral inhibition (BI) and whether inhibition is associated with parenting attitudes. The goals of this article were (1) to establish the associations between retrospectively assessed childhood BI features in parents and current reports of BI in their 12 year-old offspring from a large community sample and (2) to determine whether parental and offspring BI dimensions were associated with the level of parental care. The sample included 453 adolescents (mean age: 12 years) and their 741 biological parents. Analyses of the BI, 'general fears' and 'fears at school', dimensions showed that there was specific parent–offspring similarity for each dimension, although the effect sizes were modest, which suggests an important role of nonshared environmental factors in the development of BI. A modest but significant negative association was found between parental care and the fears at school dimension in offspring.

**Keywords:** behavioral inhibition; general fears; fears at school; parent–offspring resemblance; parental care; CSRCI; RSRI

### Introduction

Behavioral inhibition (BI) is a well-characterized temperamental characteristic (Kagan, Reznick, Snidman, Gibbons, & Johnson, 1988) that has gained increasing interest as a factor with negative developmental consequences for the individual (Caspi, Elder, & Bem, 1988; Kerr, Lambert, & Bern, 1996). BI refers to an individual's persistent tendency to become physiologically aroused, quiet, or withdrawn and behaviorally restrained when faced with unfamiliar situations and people (Kagan, Reznick, & Snidman, 1988). BI is posited to emerge early in life (Kagan et al., 1988). Inhibited children are more distant and are less prone to talk (Kagan, 1989). Socially withdrawn children have been reported to be more depressed and lonely during their first school years and have more negative feelings about themselves (Rubin, Hymel, & Mills, 1989). Their social contacts including peer relationships tend to be poorer, suggesting that these children may be at higher risk of school maladjustment, social dysfunction, and distress (Biederman et al., 1990). Their cognitive functions have also been found to be more easily impaired under task-related stress (Kagan, 1989). They exhibit high levels of neuroticism and low levels of attention control (Muris & Dietvorst, 2006).

BI traits have been shown to be relatively stable over time. Indeed, both prospective and retrospective studies have suggested consistency of BI from childhood to early adulthood (Gest, 1997; Reznick, Hegeman, Kaufman, Woods, & Jacobs, 1992). BI has been shown to have a long-term impact on an individual's trajectory. Indeed, two longitudinal studies found that shy boys were more likely than their peers to delay entry into marriage, parenthood, or stable careers (Caspi et al., 1988; Kerr et al., 1996), whereas shy girls were more likely than nonshy girls to follow a conventional pattern of marriage, homemaking, and childbearing (Caspi et al., 1988) or to attain lower levels of education (Kerr et al., 1996).

Twin studies suggest heritability of temperament dimensions with estimates ranging from 0.20 to 0.60, whereas adoption studies suggest lower heritability for offspring temperament (Saudino, 2005). Although family studies cannot contribute to determining whether resemblance for temperament in offspring and their biological parents is due to genetic or shared family environmental factors, they provide a means to establish the extent of parent–offspring similarity for temperament. However, few such studies assessing parent–offspring resemblance for temperament dimensions in families with young offspring

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(Plomin, Coon, Carey, DeFries, & Fulker, 1991; Plomin, Corley, Caspi, Fulker, & DeFries, 1998; Rettew, Stanger, McKee, Doyle, & Hudziak, 2006) have provided inconsistent results. Two studies, using a sample of one- to seven-year-old (Plomin et al., 1991) and nine- to 16-year-old offspring (Plomin et al., 1998), documented low parent-offspring correlations for the temperamental dimensions of emotionality, activity, sociability, and impulsivity across ages and traits ( $0.0-0.12$ ,  $p < 0.05$ ). In contrast, a third study using a sample of 11-year-old offspring reported somewhat higher correlations ( $0.03-0.30$ ,  $p < 0.001$ ) for the self-reported parent and self-reported offspring temperament dimensions of novelty seeking, harm avoidance, reward dependence, and persistence (Rettew et al., 2006). Although these studies did not directly assess BI, these dimensions may be considered to be conceptually related to BI.

To our knowledge, parent-offspring similarity for BI traits in particular has not yet been established for young adolescents and this study proposes to fill this gap. Similar to the study of Rettew et al., which used young adolescent offspring and their parents, we expected to find modest yet significant associations between BI dimensions in our sample of young offspring and their parents.

Different methods have been used to measure BI in offspring, according to the age of the children. In older adolescents and young adults, BI has been measured using interviews, context assessments (Gest, 1997), or self-rating questionnaires including the Retrospective Self-Report of Inhibition (RSRI) (Reznick et al., 1992), whereas in younger children, scores have essentially been computed according to parental/teacher observational ratings of children's behaviors (Essex, Klein, Slattery, Goldsmith, & Kalin, 2010; Kagan, 1989; Kagan et al., 1988; van Brakel, Muris, & Bögels, 2004). However, studies using self-reports of BI in young adolescents, which avoid the potential bias related to parental observations of BI, are scarce. This study uses self-reports of BI in our young adolescent sample.

BI has been shown to increase the risk for psychiatric disorders (Kagan et al., 1988; Reznick et al., 1992). In fact, many studies have described BI to act as a developmental pathway to psychopathology, and to anxiety disorders and social phobia in particular (for a review, see Hirshfeld-Becker, Micco, Simoes, & Henin, 2008). Recent studies have shown that the link between BI and the risk for developing anxiety disorders may be modulated by a number of factors including parenting attitudes (for a review, see Lahat, Hong, & Fox, 2011). Mothers of children with BI are usually anxious and practice overprotective and critical child-rearing without warmth (Hornbuckle, 2010). Children with high BI may be particularly vulnerable to maternal anxiety, which could lead to ambivalent attachment (Stevenson-Hinde, Shouldice, &

Chicot, 2011) and childhood anxiety at a later age (Hudson, Dodd, Lyneham, & Bovopoulos, 2011). A recent follow-up study showed that internalizing problems at age 4 were greatest among behaviorally inhibited children who were most exposed to permissive versus authoritative parenting (Williams et al., 2009). Therefore, parenting could be an important mediating factor between early BI and subsequent internalizing problems.

Beyond these studies that assessed parenting attitudes as possible mediators in the relationship between BI and later anxiety disorders, little is known about the associations between BI and parental care. Indeed, the question arises as to whether parents with high childhood BI provide higher or lower levels of care and whether offspring with high BI report higher or lower parental care. Given that high parental care received during childhood has been shown to be positively related to positive health outcomes in adults (Gladstone & Parker, 2005) and young adolescents (Rigby, Slee, & Martin, 2007), a working hypothesis is that parents with higher levels of BI would provide lower levels of care and that offspring with higher BI would receive or perceive lower levels of parental care.

BI has, in fact, been shown to be a heterogeneous concept. A recent study on social and nonsocial BI traits in preschool-aged children showed that the two types of BI traits were differentially associated with parental reports of temperament and anxiety in the children (Dyson, Klein, Olino, Dougherty, & Durbin, 2011). Indeed, social BI was associated with parent-reported shyness, inhibition with peers, adults, and in performance situations, as well as with social and separation anxiety, whereas nonsocial BI was associated with fear and negative affect as well as with specific phobia. The authors concluded that distinguishing between different forms of BI could perhaps help account for the variation in outcomes exhibited by children with BI. This study proposes to assess parent-offspring similarity for two separate dimensions of BI, namely general fears (nonsocial) and fears at school (social). Moreover, given the differential associations of social and nonsocial BI with various psychological factors (Dyson et al., 2011), it is possible that the two BI dimensions we measure show different associations with parental care.

Regarding sex-specific effects in the development of BI, one twin study showed heritability of inhibition in monozygotic twins to be higher for boys than for girls at 20 months of age (Robinson, Reznick, Kagan, & Corley, 1992). Moreover, Dyson et al. (2011) found significant associations between social BI and parent-reported temperament variables among preschool-aged boys, but not among girls. It is still unclear whether sex differences can be found for BI in young adolescents, and this study proposes to assess such differences. A series of interpersonal factors have been postulated to play a significant role in explaining potential sex differences for BI: (1) differential

exposure to parental/familial factors, such as expressed criticism of anxious mothers (Hirshfeld, Biederman, Brody, Faraone, & Rosenbaum, 1997; Hornbuckle, 2010) or positive fathering attitudes (Belsky, Hsieh, & Crnic, 1998), (2) the children's behavioral gender modeling according to the observed fear reactions of their parents (Rickman & Davidson, 1994), and (3) cultural factors including the higher acceptance of BI in girls (Gest, 1997; Hirshfeld et al., 1992).

The goals of this study are (1) to establish the associations between two retrospectively assessed childhood dimensions of BI in parents and current self-reports of the same dimensions in their 12-year-old offspring in a large sample recruited from the general population and (2) to determine whether the two parental and offspring BI dimensions were associated with the level of parental care. Given the evidence of sex-specific effects for the development of BI from a twin study (Robinson et al., 1992) as well as from a study on preschool-aged children (Dyson et al., 2011), we also tested for sex-specific effects in similarity for BI in the parents and offspring.

## Methods

### Subjects

The present sample was drawn from a population-based study conducted in four communities of the Lausanne area in Switzerland on schoolchildren in the sixth/seventh grades and their biological parents. Offspring and their parents were asked to complete several self-report questionnaires, at school for the offspring and at home or during questionnaire completion sessions for the parents. Participation rates were 67% for offspring, 48% for mothers, and 34% for fathers.

Prior to the intergenerational comparisons, analyses on the psychometric properties of the self-rating instruments were conducted in the whole study population of parents ( $N = 1346$ ; 42% males, mean age = 41.7 years, standard deviation (SD) = 5.44) as well as in all adolescents from the sixth/seventh grades ( $N = 618$ ; 47.6% males, mean age = 12.2 years, SD = 0.83).

Analyses on parent-offspring resemblance were conducted on parent-offspring pairs when the child and at least one of his/her biological parents had participated. A total of 453 adolescents (49% boys; age range = 9–14 years, mean age = 12.1 years, SD = 0.80) and their 741 biological parents (44% fathers; mean age = 43.1 years, SD = 5.0) were included. On average, fathers were two years older than mothers. Seventy-two percent of parents were of Swiss nationality and the native language of 71% of them was French, although all participants had sufficient knowledge of the French language to complete the questionnaires. French was the native language of 80% of the adolescents. Sixty-three percent of fathers and 33% of

mothers held managerial or professional specialty positions, which was indicative that the sample was of a relatively high socioeconomic status. Eighty-nine percent of the parents were married and most of them had either two (53%) or three (26%) children.

## Instruments

### Behavioral inhibition

The study included self-report instruments to measure BI in children, using the Child version of the Self-Report of Child Inhibition (CSRCI), as well as retrospectively assessed childhood BI in parents, using the RSRI (Reznick et al., 1992). Exploratory factor analysis of the original 30-item version in adults revealed two orthogonal factors (Reznick et al., 1992). The first factor (general fears) included questions on nonsocial fears and real or imagined illness, whereas the second factor (fears at school) consisted of questions on social fears that referred to school and other contexts requiring social skills.

The original English RSRI scale was tested in young adult college and undergraduate students and their parents as well as in psychiatric outpatients (Reznick et al., 1992). Self-ratings of childhood BI in students and reports of childhood BI by the students' parents were shown to be in strong agreement for the overall scale as well as for the two subscales (Reznick et al., 1992). Students with higher BI reported more mental health problems, and higher scores on the RSRI were also associated with depressive and particularly panic syndromes in the sample of treated adults (Reznick et al., 1992).

Our research group established French translations of the CSRCI and the RSRI. The final versions of these translations were back-translated into English to control for any linguistic problems by bilingual psychologists who were blind to the original version. Using these translations, confirmatory factor analyses did not reveal a satisfactory fit of the postulated orthogonal two-factor structure (Reznick et al., 1992) in either parents or children, but a satisfactory fit was achieved when the two factors were allowed to intercorrelate (oblique solutions). As the Unweighted Least Squares (ULS) procedure for non-normally distributed data does not calculate the chi-square index, the goodness-of-fit of the models was assessed using the parsimonious goodness-of-fit index (PGFI) > 0.80 (Mulaik, James, Van Alstine, & Bennett, 1989) and the standardized root-mean-square residual (SRMSR) < 0.080 (Hu & Bentler, 1998). The fit of the model indicated PGFI = 0.87 and SRMSR = 0.070 in adults and PGFI = 0.84 and SRMSR = 0.063 in children. The resulting interfactor correlations were 0.26 in mothers, 0.35 in fathers, 0.22 in girls, and 0.25 in boys. The Cronbach's alpha coefficients of the two factors 'general fears' and 'fears at school' were 0.77 and 0.84 for parents and 0.66 and 0.64 for children, respectively.

*Parenting attitudes*

Parenting attitudes were measured using the parental bonding instrument (PBI) (Parker, Tupling, & Brown, 1979), which has been shown to be a valid measure of parental behavior (Parker, 1989). This self-report instrument allows participants to retrospectively score each of their parents on 25 attitudinal and behavioral items during the first 16 years of life. Using a factor analytic approach, the originators of the instrument described a two-factor structure of the scale, namely the dimensions of care and overprotection. The care factor referred to ‘affection and warmth’ (‘was affectionate to me’, ‘appeared to understand my problems and worries’), and the overprotection factor referred to encouragement of ‘psychological autonomy’ (‘gave me as much freedom as I wanted’, ‘invaded my privacy’) (Parker, 1989). However, more recent findings revealed a three-factor structure rather than a two-factor structure to be appropriate (Gomez-Beneyto, Pedros, Tomas, Aguilar, & Leal, 1993; Murphy, Brewin, & Silka, 1997), with the further partitioning of the overprotection factor into a positive (encouragement of behavioral freedom) and a negative pole (denial of psychological autonomy).

In this study, we used the French translation of the PBI established by our research group, where the postulated three-factor structure was confirmed in adults (Mohr, Preisig, Fenton, & Ferrero, 1999). We further validated the three-factor solution of our French version in adolescents assessing maternal and paternal parenting attitudes using a confirmatory factor analytic approach. The goodness-of-fit indices for an oblique solution using the ULS procedure were as follows: PGFI = 0.86 and SRMSR = 0.066 for maternal attitudes and PGFI = 0.85 and SRMSR = 0.075 for paternal attitudes. Analyses for this article relied solely on the care dimension for maternal and paternal attitudes, which revealed Cronbach’s alpha coefficients of 0.88 and 0.90 for maternal and paternal attitudes, respectively.

*Psychiatric symptomatology*

In adults, the presence of psychiatric symptomatology during the past week was assessed using the symptom checklist 90 items revised version (SCL-90-R) (Derogatis, Rickels, & Rock, 1976), a 90-item self-report inventory of symptomatic complaints. We used the French translation of Pariente and Guelfi (1990). The testing of the postulated 10-factor structure of the original SCL-90-R (somatization, obsession, sensitivity, depression, anxiety, hostility, phobia, paranoid traits, psychotic traits, and other symptoms) has provided conflicting results (Cyr, McKenna-Foley, & Peacock, 1985). Pariente et al. (1989) suggested a three-factor structure (depression, somatization, and panic–agoraphobia subscales) based on a French outpatient

sample. This structure was successfully replicated in our data using confirmatory factor analysis. In this article, results were based on the positive symptom total (PST) score, which represents the sum of positive items of the whole scale, regardless of the item severity (0–4). The Cronbach’s alpha coefficient for the PST score was 0.96.

In children, the presence of psychiatric symptomatology was assessed using an adapted version of the second scale of the widely used Child Behavior Checklist (CBCL) (Achenbach, 1978), which assesses emotional and behavioral problems over the past six months in four- to 16-year-old children, as observed by their parents. The psychometric properties of this scale, which groups eight syndromes into the major dimensions of internalizing and externalizing disorders, were established by its originator (Achenbach, 1978; Achenbach & Edelbrock, 1979). We used the French translation of this adult version of the CBCL (Fombonne et al., 1988), which we adapted for use with children. Similar to the adult version, this translated version contains 112 items related to emotional and behavioral symptoms which the children rated for themselves. The results of this article were based on the overall score which yielded a Cronbach’s alpha coefficient of 0.94 in our offspring sample.

*Statistical analyses*

Comparisons of BI scores by sex were performed using analysis of variance. Associations between the two BI dimensions (sum scores) in spouses as well as in parents and offspring, between BI dimensions and psychopathology, and between BI dimensions and parental care in mothers/fathers and offspring were assessed using Spearman correlation coefficients.

In order to test the parent–offspring similarity for BI dimensions as well as for the simultaneous effects of parental care on BI dimensions in offspring, multiple regression models were applied. General fears and fears at school in offspring were specified as the dependent variables in the models. As the BI general fears, PST, and CBCL psychopathology scores were not normally distributed, we applied logarithmic transformations to these scores. In addition, the overall scores for parental care were computed using the average scores from both maternal and paternal care dimensions. In the case where only one parent had participated in the study, the overall score was determined using the score from the corresponding parent. In order to test for sex-specific effects of BI dimensions as well as for the effects between parental BI dimensions and care, two-way interactions were specified. All models were adjusted for sex of parents and offspring as well as for the effects of psychopathology in both parents and offspring.



## Results

### BI scores in parents and offspring

Regarding the mean score differences for the two temperament dimensions in parents, mothers had higher scores than fathers for both dimensions (general fears: 21.2 (SD = 6.1) for mothers versus 19.0 (SD = 5.2) for fathers,  $p < 0.0001$ ; fears at school: 29.5 (SD = 7.7) for mothers versus 28.3 (SD = 6.9) for fathers,  $p < .05$ ). In offspring, girls had higher scores for general fears than boys (20.1 (SD = 4.9) for girls versus 18.6 (SD = 4.6) for boys,  $p < 0.001$ ), although scores for fears at school did not differ significantly (25.2 (SD = 5.4) for girls versus 24.5 (SD = 5.1) for boys,  $p = ns$ ).

### Parent-offspring correlations for BI dimensions

Table 1 shows interspouse and parent-offspring correlations for the two BI dimensions by sex of parents and offspring. Regarding interspouse associations, the maternal and paternal school dimensions revealed a significant positive correlation. Regarding parent-offspring correlations, there was some evidence of correlations for each specific BI dimension. Indeed, general fears in mothers and general fears in both girls and boys were significantly associated. For fears at school, there were significant correlations among mothers and offspring of both sexes as well as between fathers and girls. Regarding nonspecific associations across BI dimensions, fears at school in mothers was also correlated with general fears in boys. This correlation coefficient was within the 95% confidence intervals of the corresponding father-boy coefficient, suggesting no significant differences between these correlations. However, this correlation coefficient also was outside of the 95% confidence intervals of the corresponding mother-girl and father-girl correlation coefficients, suggesting significant differences between parent-boy and parent-girl dyads.

### Correlations between BI dimensions in parents and offspring and parental care

Table 2 reveals the correlations between BI dimensions in parents and offspring and parental care by sex of parents

and offspring. Regarding parental scores, there was a significant negative correlation between fears at school in fathers and care for fathers as rated by offspring. Regarding the correlations between BI dimensions in girls and boys and care scores rated for parents, there were significant negative correlations between fears at school in boys and girls and care for both mothers and fathers.

### Correlations between BI dimensions and psychopathology in parents and offspring

Table 3 reveals the correlations between BI dimensions and psychopathology in parents and offspring by sex of parents and offspring. Regarding parental psychopathology, the overall PST score correlated significantly with both BI dimensions of mothers and fathers. Furthermore, psychopathology in mothers was associated with general fears in boys. Regarding offspring psychopathology, the overall CBCL score was positively correlated with both BI dimensions in girls as well as boys. In addition, there were significant parent-offspring associations between general fears in mothers and psychopathology in girls, and between fears at school in mothers and psychopathology in boys. These associations showed that it is important to adjust for parental and offspring psychopathology in the regression models in order to control for potential confounding across variables.

### Multiple regression models

In a first step, multiple regression models with two-way interactions, specified between BI dimensions in parents and sex of parents and offspring as well as between BI dimensions in parents and care, were tested for general fears and fears at school in offspring (dependent variables). As none of the interactions were significant in either model, models assessing only main effects were tested in a second step. Table 4 reveals the beta estimates and standard errors of these final models. There was significant parent-offspring similarity for general fears, and parental care was significantly associated with general fears in offspring but with a very small effect size. There

Table 1. Spearman correlation coefficients (95% confidence intervals) for BI dimensions in parents and offspring.

	Fathers		Girls		Boys	
	General fears	Fears at school	General fears	Fears at school	General fears	Fears at school
Mothers						
Fears	0.09 (−0.02; 0.20)	0.05 (−0.06; 0.16)	0.21** (0.08; 0.33)	0.05 (−0.08; 0.18)	0.23*** (0.10; 0.35)	0.04 (−0.10; 0.17)
School	0.08 (−0.03; 0.18)	0.16** (0.05; 0.27)	0.03 (−0.11; 0.16)	0.20** (0.07; 0.32)	0.19** (0.06; 0.32)	0.16* (0.03; 0.29)
Fathers						
Fears	–	–	0.05 (−0.10; 0.20)	−0.04 (−0.19; 0.11)	0.06 (−0.09; 0.21)	0.04 (−0.11; 0.19)
School	–	–	−0.02 (−0.17; 0.13)	0.19* (0.04; 0.33)	0.08 (−0.07; 0.23)	0.14 (−0.01; 0.28)

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Table 2. Spearman correlation coefficients (95% confidence intervals) between BI dimensions in parents and offspring and parental care.

	Mothers		Fathers		Girls		Boys	
	General fears	Fears at school	General fears	Fears at school	General fears	Fears at school	General fears	Fears at school
PBI parental care								
Mothers	-0.00 (-0.10; 0.09)	-0.09 (-0.18; 0.01)	-	-	0.02 (-0.11; 0.15)	-0.21** (-0.33; -0.08)	-0.01 (-0.15; 0.12)	-0.29*** (-0.41; -0.17)
Fathers	-	-	0.04 (-0.07; 0.14)	-0.14** (-0.25; -0.04)	-0.08 (-0.21; 0.05)	-0.21** (-0.33; -0.08)	-0.00 (-0.14; 0.13)	-0.25*** (-0.37; -0.12)

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Table 3. Spearman correlation coefficients (95% confidence intervals) between BI dimensions and psychopathology in parents and offspring.

	Mothers		Fathers		Girls		Boys	
	General fears	Fears at school	General fears	Fears at school	General fears	Fears at school	General fears	Fears at school
SCL-90-R psychopathology in parents								
Mothers	0.30*** (0.21; 0.38)	0.38*** (0.30; 0.46)	-	-	0.05 (-0.08; 0.18)	0.06 (-0.08; 0.19)	0.18** (0.04; 0.31)	0.12 (-0.02; 0.25)
Fathers	-	-	0.29*** (0.19; 0.39)	0.40*** (0.31; 0.49)	0.07 (-0.08; 0.22)	0.07 (-0.08; 0.22)	0.07 (-0.09; 0.22)	0.06 (-0.10; 0.21)
CBCL psychopathology in offspring								
Girls	0.14* (0.01; 0.27)	0.13 (-0.00; 0.26)	-0.03 (-0.18; 0.12)	0.09 (-0.08; 0.23)	0.40*** (0.29; 0.51)	0.33*** (0.20; 0.44)	-	-
Boys	-0.02 (-0.16; 0.12)	0.16* (0.03; 0.29)	-0.04 (-0.19; 0.11)	0.08 (-0.08; 0.22)	-	-	0.42*** (0.30; 0.52)	0.37*** (0.25; 0.48)

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Table 4. Associations between parental BI and care dimensions and offspring BI dimensions according to multiple regression models.

Independent variables	Dependent variables					
	General fears (offspring) <sup>a</sup>			Fears at school (offspring) <sup>b</sup>		
	$\beta$ Estimate	SE	<i>p</i>	$\beta$ Estimate	SE	<i>p</i>
Sex of offspring	0.07	0.01	<0.0001	0.71	0.36	<0.05
Sex of parents	-0.01	0.01	ns	-0.26	0.36	ns
Parental fears	0.16	0.04	<0.0001	-0.34	0.93	ns
Parental school	0.00	0.00	ns	0.14	0.03	<0.0001
Parental care	0.01	0.00	0.0002	-0.16	0.04	<0.0001
Offspring psychopathology	0.19	0.01	<0.0001	2.85	0.34	<0.0001
Parental psychopathology	0.02	0.01	ns	-0.28	0.28	ns

Notes:  $\beta$  Estimate, beta parameter estimates; SE, standard error; ns, not significant.

<sup>a</sup>Overall model, adjusted  $R^2 = 0.27$  ( $p < 0.0001$ ).

<sup>b</sup>Overall model, adjusted  $R^2 = 0.17$  ( $p < 0.0001$ ).

was also significant parent-offspring similarity for fears at school, whereas parental care was more strongly associated with fears at school in offspring. In contrast, there were no associations between fears at school in parents and general fears in offspring, or between general fears in parents and fears at school in offspring, therefore revealing specificity of parent-offspring similarity for each BI dimension.

## Discussion

This study, based on a sample of schoolchildren and their parents from the community, provides evidence that current BI features of offspring assessed at the age of 12 years resembled the childhood BI features of their parents assessed retrospectively. Indeed, according to the correlation analyses, there was significant similarity for each BI dimension. This association remained in the regression models after adjustment for psychopathology in both parents and offspring, although the size of the effects was modest. Nevertheless, parent-offspring resemblance for BI indicates that offspring of parents with high BI are at risk to develop BI themselves. The fact that general fears and fears at school in parents were each associated with the corresponding dimension in offspring supports the specificity of each of the two dimensions and provides additional evidence for their validity. In fact, our data suggest that general fears and fears at school are distinct forms of BI with little overlap. The fact that parent-offspring similarity for BI dimensions does not occur across subtypes of BI is compatible with the recent findings of Dyson et al. (2011) that showed differential associations between social and nonsocial BI and parental reports of temperament and anxiety in preschool children. This study also revealed significant interspouse resemblance for the BI dimension of fears at school, which however was lower than the parent-offspring correlation for this dimension.

The parent-offspring correlations observed in this study for both general fears and fears at school were still modest, but in a similar range to those documented for the temperamental dimensions of harm avoidance and mother-child reward dependence (Rettew et al., 2006), which can be considered to be conceptually related to BI, in children of the same age range. However, the correlations in this study were stronger than those documented for the dimensions of temperament in the two studies of Plomin et al. (1991, 1998), which could be attributable to the type of measured temperamental dimensions and, at least in one study, to the younger age of offspring (Plomin et al., 1991). Given the similar age range and assessment methods (self-ratings) in the second study of Plomin et al. (1998) and in our research, the higher parent-offspring correlations for BI dimensions in our study indicate stronger parent-offspring similarity for these traits during young adolescence when compared with other temperamental aspects such as activity or impulsivity. The regression models, which assessed the effects of all variables considered simultaneously, essentially confirmed the observed correlations and the total variance of the model explained was 27% for general fears and 17% for fears at school, respectively.

Although this study does not allow us to elucidate the mechanisms underlying parent-offspring similarity for BI, whether they are genetic or due to common familial processes, the relatively modest effect size of the parent-offspring associations for BI dimensions suggests an important role of nonshared environmental factors in the development of BI. The modest but significant negative association between parental care and the fears at school dimension in offspring in particular provides some support for this hypothesis. There was no interaction between BI traits in parents and parental care contrary to our expectations, which suggests that parents who rated themselves as having had higher BI during childhood were perceived no

differently to parents with lower childhood BI by offspring regarding parental care. However, low care was associated with fears at school in offspring as expected, although to a lesser extent with general fears in offspring. Therefore, it appears that low parental care, which is a relationship issue, may have an impact on the development of fears in social situations in offspring in particular. Hence, the question arises as to whether low parental care favors the development of fears at school in offspring or whether high fears at school in offspring obstructs the development of parenting attitudes of high care. Only prospective studies could assess the direction of this association, which is of high clinical interest and relevance. The clinical implications of such a finding would be to help parents provide higher care to their offspring, as this could perhaps help buffer the development of fears at school in offspring. However, we cannot exclude that this association was partially due to the children's own perceptions as both offspring fears at school items and items relating to maternal and paternal received care were rated by the offspring. Therefore, it is possible that offspring who scored higher on fears at school also perceived their parents as lower providers of care, irrespective of whether parents were themselves providers of high or low care. In this case, intervention efforts that focus on improving fearful children's negative subjective experiences of parenting attitudes could enhance well-being in these children.

Our findings do not support sex-specific parent-offspring similarity for BI dimensions, which precludes the existence of possible gender modeling processes for BI traits to the same or opposite sex parent in our adolescents at age 12. However, regarding sex differences for levels of BI in offspring, our mean score comparisons showed girls to have higher scores for general fears than boys. This finding is in contrast to the findings from two other American studies, which suggested higher scores of BI in boys compared with girls at a very young age (Dyson et al., 2011; Robinson et al., 1992). Although the results from these three studies are difficult to compare, given the different study designs and measures of BI, it is still possible that levels of BI vary in boys and girls from early to middle childhood. We also cannot exclude the influence of cultural factors that include the higher acceptance of BI in girls (Gest, 1997; Hirshfeld et al., 1992). Additional prospective studies, starting in early childhood, on the stability or change of BI over time are still warranted.

The strength of our study is the use of a large community sample of children and their parents and the application of similar self-report instruments in both parents and young adolescents, which circumvents the parental bias postulated to play a role in studies using parental ratings of temperament. The major limitations of this research include (1) the relatively low participation rate of fathers and the overrepresentation of families with high socioeconomic status, which may hinder the generalizability of

our results, (2) the relatively low reliability estimates found for the two factors of the CSRCI in offspring, and (3) the cross-sectional assessment that did not allow us to conclude on the direction of the effects for similarity between parents and their offspring. However, given that the parents reported on childhood BI independently to their offspring (self-reports in both parents and offspring) and that childhood BI in parents preceded that of offspring, it is more likely that offspring resembled their parents rather than parents resembled their offspring through biased recall of parental BI features during childhood.

Longitudinal studies of parent-offspring resemblance for BI, including twin, family, and adoption studies, which follow young children into adulthood, are needed in order to understand the complex interplay between genetic or familial components and, especially, factors from the non-shared environment in the development of inhibited temperament in offspring.

### Acknowledgements

This work was supported by the Swiss National Foundation (grant number: 32-40677.94). The authors thank the administrations of the participating schools as well as the parents and children who completed the questionnaires.

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