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Investigating sensitivity through the lens of parents: validation of the parent-report version of the Highly Sensitive Child scale

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Abstract

Children differ in their Environmental Sensitivity (ES), which can be measured observationally or by self-report questionnaire. A parent-report scale represents an important tool for investigating ES in younger children but has to be psychometrically robust and valid. In the current multi-study, we validated the parent-report version of the Highly Sensitive Child (HSC-PR) scale in Italian children, evaluating its factorial structure (Study 1, *N* = 1857, 6.2 years, age range: 2.6 - 14 years), and exploring differences between preschoolers (*n* = 1066, 4.2 years) and school-age groups (*n* = 791, 8.8 years). We then investigated the HSC-PR relationship with established temperament traits (Study 2, *N* = 329, 4.3 years), before exploring whether the scale moderates the effects of parenting stress on children's emotion regulation (Study 3, *N* = 112, 6.5 years). A bi-factor structure was supported in the school-age group. In the preschoolers sample, support was found for a three-factor as the bi-factor did not converge given estimation problems for one item. Furthermore, the HSC-PR does not fully overlap with common temperament traits and moderates the effects of parenting stress on emotion regulation. Finally, the HSC-PR performs well and appears to capture ES in children. Minor adaptations are suggested for preschoolers.

Keywords: environmental sensitivity; differential susceptibility; children; parent-report; highly sensitive child scale

Introduction

Over the last two decades, empirical evidence has been showing that children and adults differ in the degree they react to their rearing and surrounding environments, both negative and positive ones (for review, see Greven et al., 2019; Obradovic & Boyce, 2009; Pluess & Belsky, 2010; Slagt et al., 2016). More recently, the meta-framework of Environmental Sensitivity (ES; Pluess, 2015) has been proposed to integrate several theoretical models developed to capture these individual differences in response to environmental factors (Aron & Aron, 1997; Belsky et al., 1998; Belsky & Pluess, 2009; Boyce & Ellis, 2005; Pluess & Belsky, 2013), and a series of markers of increased sensitivity to the environment have been identified at different levels of analysis, including genetic, physiological, and psychological ones (Aron & Aron, 1997; Aron et al., 2012; Belsky & Pluess, 2009; Belsky & van Ijzendoorn, 2017; Boyce & Ellis, 2005; Keers et al., 2016; Lionetti et al., 2019; Pluess & Belsky, 2013). Pertaining to the psychological level of analysis, questionnaires are popular because they are relatively easy to administer, with potential to be also used in clinical settings (de Villiers et al., 2018; Greven et al., 2019).

Regarding the assessment of ES in children, the self-report Highly Sensitive Child (HSC) scale has been developed for school-age children, and validated with UK resident children aged 8-18 years (Pluess et al., 2018). Subsequently, it has been adapted into a parent-report format for a Dutch sample involving parents of 3 to 7 years old children (Slagt et al., 2018). While the HSC self-report psychometric proprieties and convergent validity with related temperamental traits have been extensively explored (Pluess et al., 2018), the same is lacking for the HSC parent-report form. With the current paper we aim to fill this gap, examining the Highly Sensitive Child scale parent-report version's (HSC-PR; Slagt et al., 2018) psychometric properties and bivariate associations with established and related temperament traits. We then test the moderating role of HSC-PR with parenting stress's (a marker of the emotional climate in the parent-child relationship experienced at home) impact on children's emotion regulation competences (for similar studies see Mathis & Bierman, 2015; Spinelli et al., 2020).

The meta-framework of Environmental Sensitivity

Environmental sensitivity is the name of a meta-framework as well as of a basic trait – with genetic, neurophysiologic and behavioural correlates – found in most organisms, and capturing and explaining individual differences in registering, processing, and responding to internal and external stimuli, both negative and positive ones (Pluess, 2015). In short, individuals tend to differ in their sensitivity to the environment, with some being significantly more sensitive than others (Aron et al., 2012). Across populations, a continuum from low to high sensitivity to the environment has been observed, with a majority (around 40% of the general population) having a medium sensitivity, and two substantial minorities characterised by particularly high (31%) and low (~29%) sensitivity (Lionetti et al., 2018).

Traditionally, psychological concepts that focused on individual differences in sensitivity to environmental influences have been framed within a Diathesis-Stress model (Monroe & Simon, 1991; Zuckerman, M., 1999), according to which heightened sensitivity is seen primarily as vulnerability for the development of dysfunctional outcomes when exposed to negative environments. The central understanding of this framework is that more reactive or sensitive individuals are more vulnerable to the impact of dysfunctional environments, while less reactive or sensitive people are more resilient when facing adversities. In contrast to this traditional diathesis-stress model, new concepts and theories moved beyond a psychopathology perspective by considering the possibility that sensitivity may extend to positive environments and adaptive outcomes too (Pluess & Belsky, 2013). These theories include Differential Susceptibility (DS; Belsky et al., 1998; Belsky & Pluess, 2009), Biological Sensitivity to Context (BSC; Boyce & Ellis, 2005), Sensory Processing Sensitivity

(SPS; Aron & Aron, 1997). Specifically, according to the DS theory, individuals differ in their sensitivity to both negative and positive environments. DS is based on an evolutionary perspective, positing that such differences in susceptibility are related to low or high developmental plasticity and represent alternative developmental strategies maintained by natural selection. Secondly, BSC posits that differences in sensitivity reflect differences in physiological reactivity (e.g., arterial pressure, cortisol reactivity) developed in response to either very negative or very positive environments, starting from early in life (Del Giudice et al., 2011; Ellis & Boyce, 2011; Hartman & Belsky, 2018; Hartman et al., 2018). Consistent with the notion of conditional adaptation, BSC emphasizes the role of early environmental influences in shaping these differences at a physiological level. Finally, SPS (Aron & Aron, 1997; Aron et al., 2012) posits that individual differences in ES are due to heightened sensory sensitivity and deeper processing of sensory input at the level of the central nervous system (for a review see Acevedo, 2020). The trait perspective of SPS suggests that it is possible to measure an individual's sensitivity to environmental influences behaviourally, including observational measures (Davies et al., 2021; Lionetti et al., 2019), self-report for adults and children (Aron & Aron, 1997; Pluess et al., 2018; Pluess et al., 2020), and parent-report for preschoolers (Slagt et al., 2018). Though each of these theories provided a unique contribution to the study of the interaction between the environment and the individual, all three agree that sensitive individuals differ not only in their response to environmental adversities but also in response to nurturing and positive environments. Further, the more recent framework of Vantage Sensitivity (VS; Pluess & Belsky, 2013) focuses and captures the bright side of sensitivity in contrast to the "dark" side posited by the Diathesis-Stress model with important implications for intervention programs (de Villiers et al., 2018). Unique to VS is the understanding that attributes that make some people more sensitive to the benefits of supportive experiences, do not make them necessarily also more susceptible to the negative effects of adverse conditions (although that may be the case for many identified sensitivity markers).

Psychological Assessment of Environmental Sensitivity

A reliable psychological marker that captures sensitivity to both negative and positive stimuli in children and adults is the biologically based individual trait of SPS (Aron & Aron, 1997; Aron, 2002; Aron et al., 2012; Assary et al., 2020; Keers et al., 2016; Slagt et al., 2018). According to the literature on SPS, the core mechanism underlying sensitivity is an in-depth processing of environmental stimuli, associated with heightened sensory sensitivity, emotional/physiological reactivity, and behaviour inhibition with a pause to check approach when exploring new environments (Aron et al., 2012). SPS has been shown to increase the risk for negative outcomes in children, particularly externalising symptoms in early childhood and internalising symptoms in middle childhood, when the quality of the environment is low (Lionetti et al., 2019, Lionetti et al., 2021; Slagt et al., 2018). Importantly, it has also been reported to contribute to an increased sensitivity to positive environmental conditions, including prevention and intervention programs (Kibe et al., 2020; Nocentini et al., 2018; Pluess & Boniwell, 2015; Pluess et al., 2017).

The first psychological measure specifically developed to assess sensitivity was the Highly Sensitive Person (HSP) scale for adults (Aron & Aron, 1997). The HSP scale has been developed based on a series of qualitative interviews with individuals that self-identified as “highly sensitive” (Aron & Aron, 1997). Further testing resulted in the 27-item self-report scale, systematically validated over several studies (for a review see Greven et al., 2019), and then adapted to the more recent 12-item version (HSP-12; Pluess et al., 2020). Building on SPS theory and on the original HSP scale, a range of self-report and observational measures have been developed to assess sensitivity in children, including the 12-item Highly Sensitive Child (HSC) scale (Pluess et al., 2018), that is a self-report questionnaire for children aged 8-

18 years subsequently adapted for use with younger children in a parent-report format (Slagt et al., 2018), the observational and laboratory based Highly Sensitive Child-Rating System (HSC-RS; Lionetti et al., 2019), and an observational coding scheme aimed to specifically capture the dove temperament trait (Davies et al., 2021). Recently, a measure consisting of a series of ad-hoc laboratory procedures based on items derived from the HSC scale, and applicable in the early years of primary school, has been also proposed (Moscardino et al., 2021). In the current paper, we will specifically focus on the HSC scale parent-report version (HSC-PR), which has not yet been psychometrically validated, and whose association and divergent validity with other temperament traits are still unknown.

The HSC scale, in its self-report format (Pluess et al., 2018), consists of 12 items which capture in children broader sensory processing of information as manifested in an increased appreciation for positive environmental stimuli and subtleties (e.g., some music can make me really happy; I notice when small things have changed in my environment, loading on a common factor labelled Aesthetic Sensitivity (AES)), in a stronger feeling of getting overwhelmed when exposed to potentially adverse experiences (e.g., I am annoyed when people try to get me to do too many things at once, reflecting the Ease of Excitation (EOE) factor), and in lower sensory threshold which reflects unpleasant sensory arousal (e.g., Loud noises make me uncomfortable, reflecting the Low Sensory threshold (LST) factor) (Pluess et al., 2018). The scale has been shown to capture sensitivity to both negative and positive environmental factors across several independent studies (Nocentini et al. 2018; Pluess & Boniwell, 2015; Pluess et al., 2017) and it has been validated, with some adaptations, in several languages, including Italian (Nocentini et al., 2017), German (Konrad & Herzberg, 2017; Tillmann et al., 2018), Turkish (ŞengülİnaI & Sümer, 2017), Japanese (Kibe et al., 2018), Icelandic (Þórarinsdóttir, 2018), and Dutch (Weyn et al., 2021). The scale also features partial measurement invariance across age, gender, and country based on Dutch and UK versions (Weyn et al., 2021).

The psychometric investigation of the HSC, self-report version, showed the scale to fit a bi-factor structure with items loading onto three individual factors that capture different aspects of sensitivity – AES, EOE and LST discussed above – as well as one general sensitivity factor (Pluess et al., 2018), bringing together the single factor structure as initially proposed for the HSP adult version (Aron & Aron, 1997) with the three-independent factor solution identified in subsequent studies (Booth et al., 2015; Liss et al., 2008; Smolewska et al., 2006; Sobocko & Zelenski, 2015). This result is consistent with what identified with the HSP self-report scale in adult samples (Lionetti et al., 2018; Pluess et al., 2020).

Besides having good psychometric proprieties, the self-report HSC scale correlates with related temperament traits but is not fully captured by these: negative affect, positive affect, effortful control, behaviour inhibition, and behaviour activation explain in total 34% of the variability in the HSC score in children (Pluess et al., 2018). Meta-analytic data further reported that HSC total score correlates with negative (r = .29) and positive (r = .21) affect only moderately (Lionetti, Pastore, Moscardino et al., 2019). Recently, an analysis of longitudinal data on the parent-report version in a Dutch sample of preschoolers (Slagt et al., 2018) showed that the HSC total score captures increased sensitivity to the environment but, to the best of our knowledge, no studies have yet explored the factorial structure of the parent-report version, nor have associations with related temperamental traits been investigated.

Considering that children scoring high in sensitivity are more at risk of experiencing externalizing behavioural problems in childhood (Lionetti et al., 2019; Slagt et al 2018), as well as internalizing behavioural problems, including depression and rumination from middle childhood and pre-adolescence (Lionetti et al. 2019; Lionetti et al., 2021; for similar findings with adults see Booth et al., 2015 and Liss et al., 2005), having a reliable parent-report version can be particularly important for the early identification of children who might be more at risk for negative outcomes, especially when the quality of the environment is low. At the same time, because highly sensitive children tend to flourish exceptionally when the environment is positive (e.g., see Lionetti et al., 2018; Nocentini et al. 2018, Pluess & Boniwell, 2015), the identification of individual differences in sensitivity in preschool years might also allow to raise awareness among parents and teachers regarding resources and strengths that may allow sensitive children to flourish when supported by optimal rearing environments.

Overview of the current paper

The current paper aims to contribute to the validation of the parent-report version of the Highly Sensitive Child scale (HSC-PR), previously used in a Dutch study (Slagt et al., 2018), but not yet empirically tested for its psychometric properties and associations with related individual temperament traits. Specifically, we address three objectives across three studies. First, in Study 1, we explore the factorial structure of HSC-PR applying a series of Confirmatory Factor Analyses (CFA), testing and comparing competing models derived from the literature, on a total sample size of N = 1857 children living in Italy (age range: 2.6 – 14 years) recruited through flyers at schools over a period of three months. Afterwards, the factorial structure is tested separately in preschoolers (n = 1066) and school-age children (n = 791). Second, in Study 2, we examine bivariate associations between the HSC-PR and an established measure of temperament in a convenience subsample of n = 329 preschoolers (age range: 2.6 – 5.9 years). Third, in Study 3, we investigate in an independent sample of N = 112 school-age children (age range: 5 – 8 years) whether HSC-PR moderates the effects of parenting stress in the prediction of children emotion regulation, exploring whether the parent-report measure does capture individual differences in sensitivity to environmental influences. The studies involving human participants were reviewed and approved by Department of Neuroscience, Imaging and Clinical Sciences. The patients/participants provided their written informed consent to participate in this study. These studies were not preregistered.

Study 1

The aim of Study 1 was to explore the factorial structure of the Highly Sensitive Child scale parent-report (HSC-PR), testing and comparing competitive models with a series of Confirmatory Factor Analyses (CFA) on the total sample, and exploring potential differences between preschoolers and school-age children.

Methods

Participants

Participants were 1,857 families in Italy. Children's mean age was 6.2 years (range: 2.6 – 14 years; *SD* = 2.8) and 50.3% were female. Of these, *n* = 1066 were preschoolers (mean age = 4.23; *SD* = .90; 48.83 % were female) and *n* = 791 were school-age children (mean age = 8.83; SD = 2.13; 52.33% were female). The sample was recruited in two regions of central Italy. We recruited parents at kindergartens and primary schools with flyers over a period of 3 months, aiming to reach a sample as big as possible.

Measures

Environmental sensitivity was assessed with the 12-item Highly Sensitive Child scale parent-report (HSC-PR), adapted from the self-report version (Pluess et al., 2018) and previously used in a Dutch sample (Slagt et al., 2018). For the current study, the original Italian HSC self-report translation was adapted (Nocentini et al., 2017) by replacing in each item the original "I" with "My child". In the HSC -PR version, items capture exactly the same information as the self-report format for children (Pluess et al., 2018), such as an increased appreciation for positive environmental stimuli and great attention for subtleties (e.g., “some music can make my child really happy”; “my child notices when small things have changed in his/her environment”, reflecting a common factor labelled Aesthetic Sensitivity (AES)), a lower sensory threshold related to unpleasant sensory arousal (e.g., “loud noises make my child feel uncomfortable”, reflecting Low Sensory Threshold (LST) factor), and a stronger feeling of getting overwhelmed when exposed to potentially adverse experiences (e.g., ″my child gets nervous when he/she has to do a lot in little time”, reflecting Easy of Excitation (EOE) factor). Each item was rated on a 7-point Likert scale ranging from “1 = Not at all” to “7 = Extremely”, with higher scores indicating higher levels of sensitivity.

Data analysis

We first explored the percentage and distribution of missing values across the 12 items of the HSC-PR scale. Then, in order to evaluate the scale’s psychometric properties, we applied a series of Confirmatory Factor Analyses (CFA), comparing three competing models in the total sample in line with the extant literature on the HSC, self-report scale (Pluess et al., 2018). More specifically, we considered the following models, also depicted in Figure 1: (a) a one-factor model, (b) a three-factor model, and (c) a bi-factor model. In the one-factor model, all items were allowed to load on one general sensitivity factor (Aron & Aron, 1997); in the three-factor model (identified in Smolewska et al., 2006), each item loaded only on one of three specific factors, and factors were allowed to correlate; in the bi-factor model (Pluess et al., 2018; Lionetti et al., 2018) a general sensitivity factor was added in addition to the three separate factors, which were constrained to be orthogonal (i.e., uncorrelated). In the bi-factor model each item was allowed to load both on one of three specific factors and on a general factor. The maximum likelihood estimation method was used to estimate model parameters. The three competing models were compared according to the following three criteria: (a) a qualitative evaluation of the fit indices of each model; (b) the CFI Δ criterion, according to which two nested models do not differ if the difference in their CFIs is smaller than |0.01|

(Cheung & Rensvold, 2002); and (c) the widely used scaled χ2 difference test (Satorra, 2000), with lower χ2 reflecting better model fit. For the evaluation of model goodness of fit, two relative fit indices were considered: the comparative fit index (CFI) and the Tucker Lewis index (TLI). Cut-off values for fit are considered adequate if CFI and TLI values are >.95 (Hu & Bentler, 1999). Two absolute fit indices were also used: the root mean square error of approximation (RMSEA) and the standardised root mean square residuals (SRMR). For RMSEA, values ranging from 0.05 to 0.08 reflect adequate fit; for SRMR, values <0.08 are considered a good fit (Schermelleh-Engel et al., 2003).

After having identified the best fitting model, we estimated model parameters separately for preschoolers and school-aged children. All analyses were run using the statistical software R (R Core Team, 2020), with package lavaan (Rosseel, 2016). The fully anonymized dataset is available upon request to the corresponding authors.

- FIGURE 1 AROUND HERE -

Results

Preliminary analyses. Overall, the percentage of missing data in the total sample (*N* = 1857) was very low (.59%). Notably, concerning missing values at an item level, the percentage of missing data per item was lower than 0.6% for all items except for item 7 (“My child doesn’t like watching TV programmes with a lot of violence in them”) where a higher, though overall relatively low number of missing values, was identified (*N* = 28, 1.51%). Of the 28 missing values, 27 were for children aged between 2.6 and 5.9 years. Given the overall low number of missing data, we adopted a listwise deletion approach, resulting in *N* = 1773 subjects available for the analyses. For the total sample, Cronbach’s α for HSC-PR total score was .78 with [.77, .80] as 95% confidence interval, and for EOE, LST, and AES factors Cronbach’s α was .82 with 95% C.I. [.81, .83], .62 with 95% C.I. [.59, .65], and .66 with 95% C.I. [.64, .69], respectively.

Confirmatory Factor Analysis in the total sample. Fit indices of the one-factor model in the total sample (*N* = 1773 after the listwise deletion) were not satisfactory (CFI = .67, TLI = .60, RMSEA = .143, SRMR = .12), whereas comparable and acceptable model fit indices emerged for the three-factor and the bi-factor solution (that is, the solution including a general sensitivity factor). More specifically, values were CFI = .94, TLI = .92, RMSEA = .066, and SRMR = .05 for the three-factor solution, and CFI = .95, TLI = .92, RMSEA = .066, and SRMR = .04 for the bi-factor model. Important to note, the residual variance of item 7 had to be fixed to 20% of its observed variance in order to avoid a negative estimate for this parameter. Although the three-factor and bi-factor model showed comparable goodness of fit, both the χ2DIFF(8) = 76.94, $p < .001$ and the CFI Δ criterion (CFI [DIFF] = .01) provided stronger support for the bi-factor solution as fitting data significantly better than the three-factor model. Furthermore, as the bi-factor solution was previously reported to be the best fitting model for the self-report HSC scale (Pluess et al., 2018), we considered the bi-factor solution as the most plausible model for the HSC-PR as well. All details of estimated parameters are reported in the supplementary documentation, together with estimated parameters and fit indices using the full information maximum likelihood estimation in lavaan package (Rosseel, 2016).

Confirmatory Factor Analysis in the preschool sample. CFA fit indices of the bi-factor model in the preschool sample (*N* = 997 after listwise deletion) were acceptable (CFI = .949, TLI = .921, RMSEA = .065, SRMR = .040), but the variance of item 7 had again to be fixed. This result, taken together with the relatively high number (compared to the other items) of missing values for item 7 in the preschool sample, suggested that item 7 may be problematic or not very well applicable to preschoolers in the context of a bi-factor structure. Parameters of the tested bi-factor model are reported in supplementary documentation. We tested again the factor structure after the removal of item 7. However, the bi-factor model was not able to converge anymore, likely due to the low number of items for the LST factor. Rather, findings provided support for a three-factor structure with CFI = .939, TLI = .921, RMSEA = .065, and SRMR = .045.

Confirmatory factor analysis in the school sample. The bi-factor model was also tested in the school-age sample (*N* = 776 after listwise deletion). According to the results of the CFA, the model was able to converge showing an acceptable fit (CFI = .944, TLI = .912, RMSEA = .067, SRMR = .044) and no negative variances were identified for any item. This suggests that residual variance problems reported in the total sample were mainly driven by data from the preschool sample. Given different structures were found to fit data best in the two groups, i.e. three-factor model for the preschool group and a bi-factor model for the school age group, we did not further explore the scale invariance across samples. Parameters of the tested model are reported in the supplementary documentation.

Discussion

In Study 1, we investigated the factorial structure of the HSC-PR, testing and comparing three competitive models by applying CFAs in a big sample of parents reporting on their children's sensitivity. Before to this, we preliminary explored the internal consistency of the HSC-PR total scale and factors, and results were comparable to that reported for the self-report scale (Pluess et al., 2018) and for the parent-report version (Slagt et al., 2018). Then we tested and compared a series of CFA models derived from the literature (Aron & Aron, 1997; Smolewska et al., 2006; Pluess et al., 2018). Results on the total sample suggested that the HSC-PR fits a bi-factor structure but a follow-up investigation of the scale across groups of different ages suggested that this was the case for school-age children only. Due to estimation problems related to item 7, the bi-factor model in preschoolers did not converge and supports a three-factor solution for younger children.

The bi-factor structure found in school-age children is consistent with recent empirical evidence both from child (Pluess et al., 2018) and adult samples (Lionetti et al., 2018; Pluess et al., 2020) and suggests that the parent-report version of the sensitivity scale for children as young as 6 years old consists both of three independent factors that capture different aspects of sensitivity – sensitivity to sensory stimuli (LST), sensitivity to overstimulation (EOE), and sensitivity to the aesthetic quality of the environment (AES) – and a general sensitivity factor across all items. The bi-factor model supports the reconciliation of the disagreements between unidimensional and multidimensional solutions, and provides statistical justification for the use of the mean score across all items as a measure of general environmental sensitivity.

Pertaining to the preschool sample, a bi-factor model did not converge. We hypothesize that this may be due to the content of item 7 ("My child doesn't like watching TV programmes with a lot of violence in them") which might not apply as much to younger children. Younger children generally will have less exposure to violence in TV programmes, at least in a low-risk samples. Future studies may contribute to clarify this aspect further, providing alternative versions of this item (e.g., considering children's response to conflict with other family members and peers or children's reactions when exposed to cartoon animations with characters fighting or making a fuss) and then test for the invariance across age whether a bi-factor structure will be found across different developmental periods.

Study 2

Study 2 aimed at exploring bivariate associations between the HSC-PR scale and temperament dimensions in a convenience subsample of preschoolers from Study 1. We anticipated the HSC-PR to correlate only moderately with other temperament traits. More specifically, based on the validation of the self-report measure in a UK sample (Pluess et al., 2018), and on meta-analytic data on the associations between sensitivity and temperament dimensions (Lionetti, Pastore, Moscardino et al., 2019), we expected the HSC-PR to correlate positively with effortful control and negative affect, and negatively with surgency/extraversion. For descriptive purposes, we further explored associations including and excluding item 7 (which had estimation problems, see Study 1) from the HSC-PR total score and from the LST factor due to estimation problems found in Study 1.

Method

Participants

Data for Study 2 were obtained from a convenience subsample of Study 1 which completed a broader set of questionnaires, including measures of temperament. Participants were 329 Italian mothers of preschoolers (48.9% were female) with a mean age of 4.26 years (range = 2.6-5.9 years, *SD* = .94).

Measures

Children's environmental sensitivity was assessed using the HSC-PR. In the current sample, good internal consistency was found for the HSC-PR total score (.79 with [.75, .82] as 95% confidence interval) and for EOE factor (.82 with 95% C.I. [.79, .85]) while a slight lower Cronbach's α was found for the AES factor (.63, with 95% C.I. [.56, 69]), in line with other studies featuring the self-report HSC (Pluess et al., 2018). Cronbach's α for LST factor was .67 with 95% C.I. [.60, .73], and increased to .82 with 95% C.I. [.78, .86] when dropping out item 7.

In addition, mothers reported on children's temperament using the 36-item Children's Behaviour Questionnaire - Very Short Form (CBQ-VSF, Putnam & Rothbart, 2006), Italian validated version (Albiero et al., 2007). The very short form of CBQ is composed of three 12-item scales aimed at measuring three superordinate temperamental dimensions: Negative Affect (NA), Surgency/Extraversion (EXTR), and Effortful Control (EC). NA is conceptually similar to Neuroticism and it can be described as the tendency to get easily overwhelmed; it is defined by high positive loadings for Sadness, Fear, Anger/Frustration, and Discomfort and negative loadings for Falling Reactivity/Soothability. EXTR reflects a predisposition to be actively involved with the environment; it is based on high positive loadings on the Impulsivity, High Intensity Pleasure, and Activity Level scales and strong negative loadings on the Shyness scale. Finally, EC reflects the capacity to inhibit a behavioural response and to direct attention; it is based on high positive loadings for Inhibitory Control, Attentional Control, Low Intensity Pleasure, and Perceptual Sensitivity (Putnam & Rothbart, 2006). Items are rated by parents on a 7 point Likert Scale, ranging from "1 = Absolutely False" to "7 = Absolutely True". Parents could also select "Not applicable" as response in case they have never observed their child in the situation described in the items. In the current sample, good internal consistency was found for NA ($\alpha = .81$ with [.77, .84] as 95% confidence interval) and EC ($\alpha = .77$ with 95% C.I. [.73, .81]), and a slightly lower Cronbach's α, though in accordance with international studies, was identify for EXTR ($\alpha = .73$ with 95% C.I. [.68, .77]) (Allan et al., 2012).

Data analysis

Overall missing data in the sample ($n = 329$) were very limited (1.25%), hence we implemented mean imputation for missing values. In order to explore associations between sensitivity and temperament, we computed bivariate correlations between the HSC-PR total score and its three subscales (including and excluding item 7 from the total score and from the LST factor) with the CBQ-VSF dimensions. Further, we calculated the *r* critical correlation value for $n = 329$ for a significance of .05. For interpreting results, we considered the effect size of Pearson's *r*: low if *r* varies around .10 or less, medium if *r* varies around .30, and large if *r* is higher than .50 (Cohen, 1988, 1992). In addition, we ran a multiple regression model with all three temperament dimensions simultaneously included as predictors of the sensitivity total score in order to estimate how much of the variance of the

HSC-PR is accounted by established temperament traits. Finally, we tested all correlations between HSC-PR and the temperament dimensions that were higher than *r* = .50 for divergent validity (i.e., whether traits are distinguishable from each other) by considering the heterotrait-monotrait (HTMT) ratio of correlations in a multitrait-multimethod matrix. This approach includes computing the average of the correlations of items across constructs that measure different dimensions relative to the average of the correlations of items within the same construct. HTMT values equal or lower than .85 are considered to satisfy divergent validity (Henseler et al., 2015). Analyses were run using R package semTools (semTools Contributors, 2016) for estimating divergent validity.

Results

The total score of HSC-PR was moderately and positively correlated with temperament dimensions negative affect (*r* = .36, *r* = .37, including and excluding item 7, respectively) and effortful control (*r* = .35, *r* = .34, including and excluding item 7, respectively). The association between the sensitivity total score and negative affect was mostly driven by the factor EOE (*r* = .44) whereas the associations with effortful control seemed to be mostly due to the strong association with the AES factor (*r* = .51). The AES factor was not associated with negative affect (*r* = .09). EOE was moderately and negatively correlated with Surgency/Extraversion (*r* = - .26), as was the LST factor, with a slightly stronger association when item 7 was excluded (*r* = -.26, *r* = -.29, including and excluding item 7, respectively). The association between LST and AES was *r* = -.00. Finally, the sensitivity total score, both including and excluding item 7, was slightly associated with gender (1 = male, 2 = female; *r* =.15, *r* = .13, respectively), but not with age (*r* = .10, *r* = .09, respectively). Bivariate associations between all sensitivity and temperament dimensions are provided in Table 1. When all temperament dimensions were included simultaneously in a multiple regression model as predictors of the HSP-PR total score, the three temperament dimensions combined explained 28% (29% excluding item 7) of the variance of HSP-PR. Divergent validity between HSP-PR and temperament dimensions was explored in relation to the correlation between AES and effortful control, which was the only correlation with *r* higher than .50. The HTMT ratio value was .69, providing support for divergent validity.

- TABLE 1 AROUND HERE -

Discussion

Study 2 aimed at exploring bivariate associations between sensitivity and established temperament dimensions, providing a picture of how sensitivity assessed with the HSC-PR format is associated with three temperament dimensions. Overall, sensitivity was moderately associated with the three temperament dimensions and this is in line with recent studies and a meta-analysis which showed that sensitivity measured with either the child-report HSC scale or the observational rating system HSC-RS is relatively distinct from other common individual traits (Lionetti et al., 2019; Lionetti, Pastore, Moscardino et al., 2019; Pluess et al., 2018). When excluding item 7 from the sensitivity total score, correlational values remained stable (as expected, given it represented only one item out of 12), and only a slightly stronger negative association was found between LST and surgency/extraversion when excluding item 7. Regarding association with negative affect, a moderate correlation was found, mainly driven by the EOE factor. This association is consistent with the literature reporting positive and moderate associations between sensitivity and neuroticism in adolescent and adult samples, and sensitivity and negative affect in child samples (Lionetti, Pastore, Moscardino et al., 2019). What may account for this association is that high negative emotionality reflects heightened sensitivity to negative experiences, causing intense negative responses, and a sense of feeling overwhelmed, as captured also by the EOE factor (Aron et al., 2012; Ellis et al., 2011; Slagt et al., 2016). The small association between sensitivity and gender in the absence of a correlation with age is consistent with a previous study on observed sensitivity

(Lionetti et al., 2019). The strong association that emerged between the AES factor and effortful control suggests that both factors capture aspects of attention to environmental details and perceptual sensitivity. However, the follow-up test with HTMT provides evidence that AES can be discriminated from the effortful control dimension, suggesting that AES may capture sensitivity to specifically positive experiences. Further, the multiple regression model suggests that the three temperament dimensions in total accounted for only around a third of the variance in HSC-PR, a result comparable to the child-report version of the scale (Pluess et al., 2018). Importantly, these associations are largely consistent with theories of environmental sensitivity, according to which general sensitivity is manifested in increased sensitivity to both negative (i.e., negative affect) as well as positive aspects of the environment (i.e., effortful control) (Aron et al., 2012; Ellis et al., 2011; Pluess, 2015).

Study 3

The different theories of environmental sensitivity all suggest that children may be differentially reactive to the effects of environments, with some individuals showing a stronger response to both negative and positive contexts (Aron & Aron, 1997; Belsky et al., 1998; Belsky & Pluess, 2009; Boyce & Ellis, 2005; Pluess & Belsky, 2013). Several findings have shown that the HSC self-report scale and the HSC observational rating system are able to capture such individual differences in environmental sensitivity. Comparable findings have been reported in the only currently available study on the parent-report version of the HSC scale (Slagt et al., 2018). For example, the HSC self-report scale was found to predict treatment response to a universal school-based resilience-promoting intervention in a sample of 166-UK girls (Pluess et al., 2017; Pluess & Boniwell, 2015), and it moderated the effects of an anti-bullying intervention in a large randomised sample of 2,042 children from Italy (Nocentini et al., 2018). Similarly, the HSC-PR has been reported in a Dutch sample to moderate effects between parenting quality and children's externalizing behaviour problems (Slagt et al., 2018).

Finally, comparable empirical findings have been reported when considering observer-rated sensitivity, moderating the effects of parenting on children's emotional and behavioural adjustment, for better and for worse, in the context of long-term longitudinal studies (Davies et al., 2021; Lionetti et al., 2019, Lionetti et al., 2021). In order to add to this line of research, we tested the HSC-PR's moderating role regarding the association between parenting stress and children's emotion regulation in a sample of school-age children. We considered emotion regulation as the target outcome give that the regulation of emotions might be particularly challenging for highly sensitive individuals who tend to experience stronger emotional responses than less sensitive children (Acevedo et al., 2014; Acevedo et al., 2017; Aron et al., 2012; Lionetti et al., 2018). Among predictors of emotion regulation, parenting stress is a key variable, previously reported to correlate with children's regulation competences (Mathis & Bierman, 2015; Spinelli et al., 2020). Parents reporting greater levels of stress in their caregiving role have been found to have more difficulties in providing appropriate affective and structural bonding and rules in the relationship with their own child (Crnic et al., 2005; Gillis & Roskam, 2019). Interestingly, in highly sensitive children, lower levels of such affective and rule containment have been shown to predict difficulties in regulating emotions and managing negative thoughts (Lionetti et al., 2021). For these reasons, we expected that highly sensitive children, whose parents report more parenting stress, would present more difficulties in the regulation of their emotions.

Method

Participants

The sample of this study included 112 mothers and their school-age children. Children were on average 6.53 years old (range: 5-8 years; *SD* = .58) and 51.8% were female. Data were collected from three different primary schools in central Italy.

Measures

Environmental Sensitivity. Children's environmental sensitivity was assessed using the HSC-PR. For the current sample, Cronbach's α for HSC-PR total scale was .75 with [.74, .78] as 95% confidence interval.

Emotion regulation. Children's emotion regulation was measured using the Emotion Regulation (ER) subscale of the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997), Italian validated version (Molina et al., 2014). The 8 items are rated by parents on a 4-point Likert scale and assess the frequency of behaviours and situationally appropriate affective displays, empathy, and emotional self-awareness with higher scores indicating greater capacity to manage one's emotional arousal (Molina et al., 2014). In the current sample, internal consistency of the ER subscale was low (α = .54 dropping out item 23 with [.39, .66] as 95% confidence interval), but consistent with internal reliability shown in the Italian validation of the measure (α = .59; Molina et al., 2014).

Parenting stress. Parenting stress was assessed using the 36-item Parenting Stress Index-Short Form (PSI-SF; Abidin, 1995), Italian version (Guarino et al., 2008). The scale measures on a 5-point rating scale the parent's perception of insufficient resources to cope and foster everyday demands and their child's demands, as well as the parent-child interaction and factors that may affect parenting practices. For the current sample, internal consistency for PSI total scale was good (α = .90 with [.87-.92] as 95% confidence interval).

Data Analysis

First, we conducted analysis on missing data. Since missing data on the total sample (N = 112) were only a small proportion (.80%), we implemented mean imputation for missing values. Then, we computed bivariate associations among HSC-PR total score, ER subscale, and PSI total score. In order to interpret results, we considered the effect size of Pearson's r: low if r varies around .10 or less, medium if r varies around .30, and large if r is higher than .50 (Cohen, 1988, 1992). Then, we explored the interaction between HSC-PR and parenting stress in the prediction of children's emotion regulation comparing a main effect model (with parenting stress total score and children environmental sensitivity levels as predictors) with an interaction models that included HSC-PR in interaction with PSI total score. In order to evaluate whether inclusion of the interaction term improves predictive capability of the model, we used the Akaike Information Criterion (AIC; Akaike, 1974), the Bayesian Information Criterion (BIC; Schwarz, 1978) and Akaike weights (Burnham & Anderson, 2002). In addition, for descriptive purposes, we also considered the variance explained by the model. According to AIC and BIC criteria, the lower the value the better the model is at predicting new data while for Akaike weights, ranging from 0 to 1, the higher the value, the better the model is at describing data accurately (McElreath, 2016; Vandekerckhove et al., 2015; Wagenmakers & Farrell, 2004). Finally, we followed up the statistically significant interaction by means of a conditional interaction plot with simple slopes to represent the relation between parenting stress and emotion regulation at the 30th and the 70th percentile of HSC-PR (Lionetti et al., 2019 and Pluess et al., 2018) before calculating the Proportion of the Interaction index (PoI; Roisman et al., 2012), according to which values ranging between .20 to .80 (Del Giudice, 2017) are supportive of a Differential Susceptibility effect. All analyses were run using the statistical software R (R Core Team, 2020), with packages stats – for the interaction model – and rethinking (McElreath, 2020) – for model comparison. The fully anonymized dataset is available under request to corresponding authors.

Results

Bivariate associations. Bivariate associations among the HSC-PR total score, ER subscale, PSI total score, gender, and age are reported in Table 2. Associations varied from trivial to low/moderate, with the HSC-PR correlating with gender and age at r = .09 and r = .05, respectively, and with parenting stress at r = .29, but not with emotion regulation ability (r = -.001).

- TABLE 2 AROUND HERE -

Main effect model. The model including only main effects suggested that parenting stress was negatively and significantly related to emotion regulation (B = -.24 (.06), *p* = <.001). No significant associations were identified between HSC-PR and emotion regulation ability (B = .03 (.03), *p* = .30). The model R-square, the AIC, the BIC, and model weighs are reported in Table 3.

- TABLE 3 AROUND HERE -

Interaction effect model. When the interaction term was added to the regression model, values of information criteria decreased, suggesting a better prediction capability of the interaction model compared to the main effect model, and AIC weight increased. More specifically, HSC-PR significantly interacted with parenting stress in predicting emotion regulation ability (B = -.16 (.07), *p* = .01).

Follow-up exploration of the interaction effect. In Figure 2, we provide a conditional interaction plot, with simple slopes to illustrate the relationship between parenting stress and emotion regulation conditioned at the 30th and the 70th percentile of HSC-PR (4.17 and 5.33, respectively). The plot suggested a Differential Susceptibility pattern, for better and for worse, though the response to the benefit of low levels of parenting stress seemed to be less pronounced than the disadvantage when exposed to high levels of stress. The PoI index of .68 was confirming this interpretation, providing support for a Differential Susceptibility effect (Del Giudice, 2017).

- FIGURE 2 AROUND HERE -

Discussion

The aim of Study 3 was to examine whether sensitivity captured with the parent-report measure moderates the association between parenting stress and children's emotion regulation. HSC-PR was found to interact with parenting stress in the prediction of children's emotion regulation with highly sensitive children showing less emotion regulation when parenting stress was high, but more when parenting stress was low. According to the follow-up analysis of the interaction effect, both the conditional plot and the PoI index were supportive of a Differential Susceptibility pattern, suggesting an interaction effect for better and for worse, though the advantage seemed slightly less pronounced than the disadvantage. These results are consistent with previous findings in a Dutch sample where parent-reported sensitivity of children moderated effects between parenting quality and children's externalizing behaviour problems (Slagt et al., 2018). Future studies should continue to investigate if the parent-report version of the HSC also moderates the impact of other environmental influences – such as the emotional climate in the parent-child relationship experienced at home – on children's socio-emotional outcomes considering independent informants and including observed predictors and outcomes on larger samples.

General discussion

A growing number of empirical studies have shown that children differ in their environmental sensitivity with some more reactive to the quality of their rearing environment than others (Belsky & Pluess, 2009; Boyce & Ellis, 2005; Ellis et al., 2011; Pluess, 2015). The first aim of the current paper was to investigate the psychometric properties of the parent-report measure of the Highly Sensitive Child scale (HSC-PR; Slagt et al., 2018). The second aim was to explore associations between the HSC-PR and well-established temperament traits. The third objective aimed at investigate whether environmental sensitivity captured by the parent-report questionnaire would moderate the impact of parenting stress on child emotion regulation.

Psychometric properties of the HSC-PR

Findings of Study 1 suggest that the parent-report version of the HSC has good psychometric properties. Consistent with recent confirmatory factor analyses of the self-report measure for children (Pluess et al., 2018) and for adults (Lionetti et al., 2018, Pluess et al., 2020), the HSC-PR seems to fit best with a bi-factor model which includes the three factors but also a general sensitivity factor across all 12 items for school-age children. Hence, although the scale captures different components of environmental sensitivity – sensitivity to sensory stimuli (LST), sensitivity to overstimulation (EOE), and sensitivity to the aesthetic quality of the environment (AES) – it does also reflect a general sensitivity trait, consistent with the empirical literature and the theoretical definition of the environmental sensitivity. Pertaining to preschoolers, support was found for a three-factor model as the bi-factor did not converge due to estimation problems related to item 7, which refers to exposure to violence on TV, and performed poorly in preschoolers. Besides being the item with the highest number of missing values in younger children, it had a negative variance when tested in the context of a bi-factor model, suggesting that this item might be problematic in this age range. In addition, in Study 2, the internal consistency of the specific factor it belonged to (i.e., LST) increased when the item was removed. Most likely, the low performance of this item is due to the fact that younger children generally are less likely to experience exposure to violent content in TV programs. Hence, an alternative item may need to be developed for this age range, for example considering the exposure to conflict in the family environment or among characters in cartoon animations for children (e.g., “My child doesn’t like watching TV programmes and child movies where characters are fighting and loudly arguing”).

Associations with temperament

The moderate associations with temperament dimensions provide empirical support that the sensitivity trait is relatively distinct from other common individual traits, consistent with recent studies and a meta-analysis (Lionetti et al., 2019; Lionetti, Pastore, Moscardino et al., 2019; Pluess et al., 2018). Further, Study 2 provides in-depth information on how the three sensitivity factors of HSC-PR are associated with temperament dimensions. More specifically, whereas EOE seems to be more strongly associated with traits that reflect sensitivity to negative environmental factors (e.g., negative affect), AES correlates with measures that may confer sensitivity to more positive experiences (e.g., effortful control). These findings fit well with different theoretical models of environmental sensitivity (Pluess, 2015) according to which a heightened sensitivity is for better and for worse. Applied to the parent-report measure of environmental sensitivity, the total score of the scale may capture such general sensitivity to both negative and positive environments as described in the Differential Susceptibility model combining both sensitivity to adversities, as measured with EOE and LST factors, and sensitivity to positive experiences, as reflected in AES factor.

Empirical evidences for the moderating effects of the HSC-PR

Results of a multiple regression model with HSC-PR as a continuous score showed the parent-rated questionnaire for children's sensitivity moderating the associations between parenting stress and children's competence in emotion regulation. According to follow-up analyses with simple slopes (Figure 2), children scoring high in sensitivity were more strongly affected by parenting stress compared to children scoring low. More specifically, highly sensitive children compared to their low sensitive peers showed lower emotion regulation competences when parenting stress was higher, and better emotional competences when parenting stress was low. We can hypothesize that the stronger emotional reactivity found in highly sensitive individuals (Aron et al., 2012; Lionetti et al., 2018; Pluess et al., 2020) might lead to difficulties in regulating emotions when the environment is not positive enough. Similar findings have been found with observational studies, providing evidence that regulatory competences in highly sensitive children are hampered by low parenting quality (Lionetti et al., 2021). Importantly, at the same time, children high in sensitivity were more positively influenced by low levels of parenting stress. Though low levels of stress in caregiving do not necessarily fully capture an enriched positive environment, results suggest that children with high environmental sensitivity were particularly able to benefit from environments characterized by lower levels of negativity, with applied implications for informing parenting programs.

Importantly, although the parent-report version of the HSC scale appears to be a promising and psychometrically sound psychological marker of environmental sensitivity, future studies should continue investigating whether the HSC-PR does predict individual differences (i.e., children social competence, behavioural problems) in response to other environmental influences, such as parenting quality, education, and peer influence, as theory and several empirical studies featuring the self-report measure and the rating system suggest.

Strengths and Limitations

The current multi-study paper is composed of three studies, with a big sample size in Study 1. Findings provide empirical evidences in support of the HSC-PR as a psychometrically robust measure, that captures parent-reported environmental sensitivity in children as an individual trait that correlates to some extent with other temperament traits while also do not completely overlapping with any of these, nor with their combination. Importantly, findings also suggested the need of some rewording for the use of the scale with preschoolers. However, the findings should also be considered in light of some limitations. Most importantly, the samples included parents residing in one single country and all data were based exclusively on the single-informant perspective of the mothers. In addition, while we were able to count on a big sample size for Study 1, the sample in Study 3 was relatively small. Further research should consider the inclusion of observational measures for both the quality of the environment (i.e., parenting quality, parenting stress) and children’s developmental outcomes as well as a bigger sample size.

Conclusion

Theoretical models and empirical studies (Aron & Aron, 1997; Belsky et al., 1998; Belsky & Pluess, 2009; Boyce & Ellis, 2005; Del Giudice et al., 2012; Obradovic & Boyce, 2009; Pluess & Belsky, 2010; Pluess, 2015; Slagt et al., 2016) suggest that children differ in the degree they react to environmental quality, with some more vulnerable when facing adversities but also more likely to flourish when exposed to positive experiences, as a function of individual differences in sensitivity. Such differences in sensitivity can be measured in children and adults with questionnaires. Findings from this paper provides evidence for the good psychometric properties of the parent-report version of HSC scale, and suggests that a revision of the item 7 may be a better option for younger ones. Importantly, the observed associations among the HSC-PR and established temperament dimensions (i.e., Negative Affect and Effortful Control) confirm sensitivity as largely distinct from temperament (Lionetti et al., 2018; Lionetti, Pastore, Moscardino et al., 2019; Pluess et al., 2018). In relation to the measure's ability to capture environmental sensitivity in response to the environment, findings suggested that children scoring high in sensitivity were more negatively impacted by a rearing environment characterized by high levels of parenting stress but, though to a slightly less extent, they also benefited more from low levels of parenting stress. This result is coherent with the literature reporting parenting stress to negatively impact on children's emotional development (Mathis & Bierman, 2015; Spinelli et al., 2020), and it add to these showing that highly sensitive children are more vulnerable in this regard. In relation to the bright side of sensitivity, though we did not consider differences in outcomes for different levels of positive parenting (as low levels of parenting stress do not necessarily capture a highly positive rearing environment), it has to be acknowledged that for low levels of parenting stress an advantage (even if comparatively minor) was present, in line with a Differential Susceptibility pattern. In conclusion, the current paper suggests that it is possible to measure environmental sensitivity reliably in children through the lens of parents using the Highly Sensitive Child scale parent-report version.

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Figures

Figure 1

Study 1. Path diagrams of CFA models. Black lines represent free parameters, grey dotted lines represent fixed parameters.

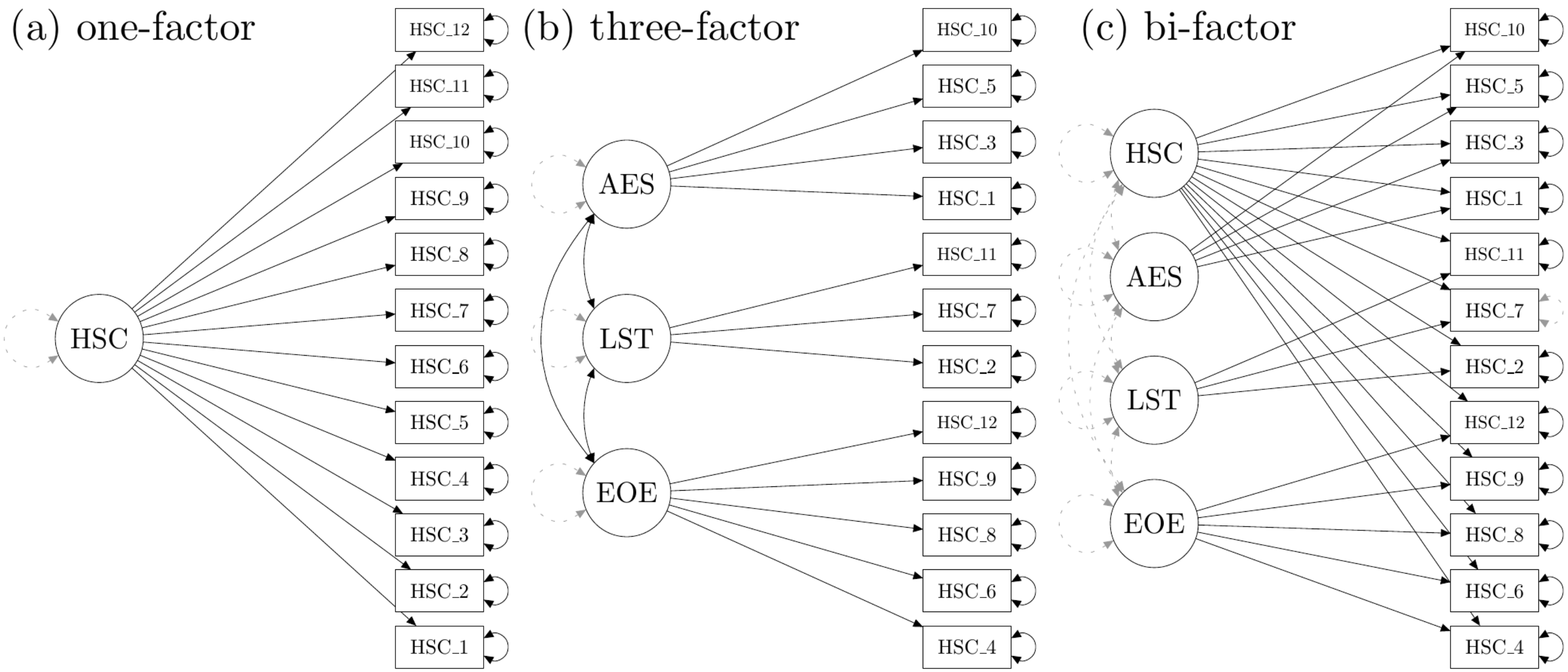
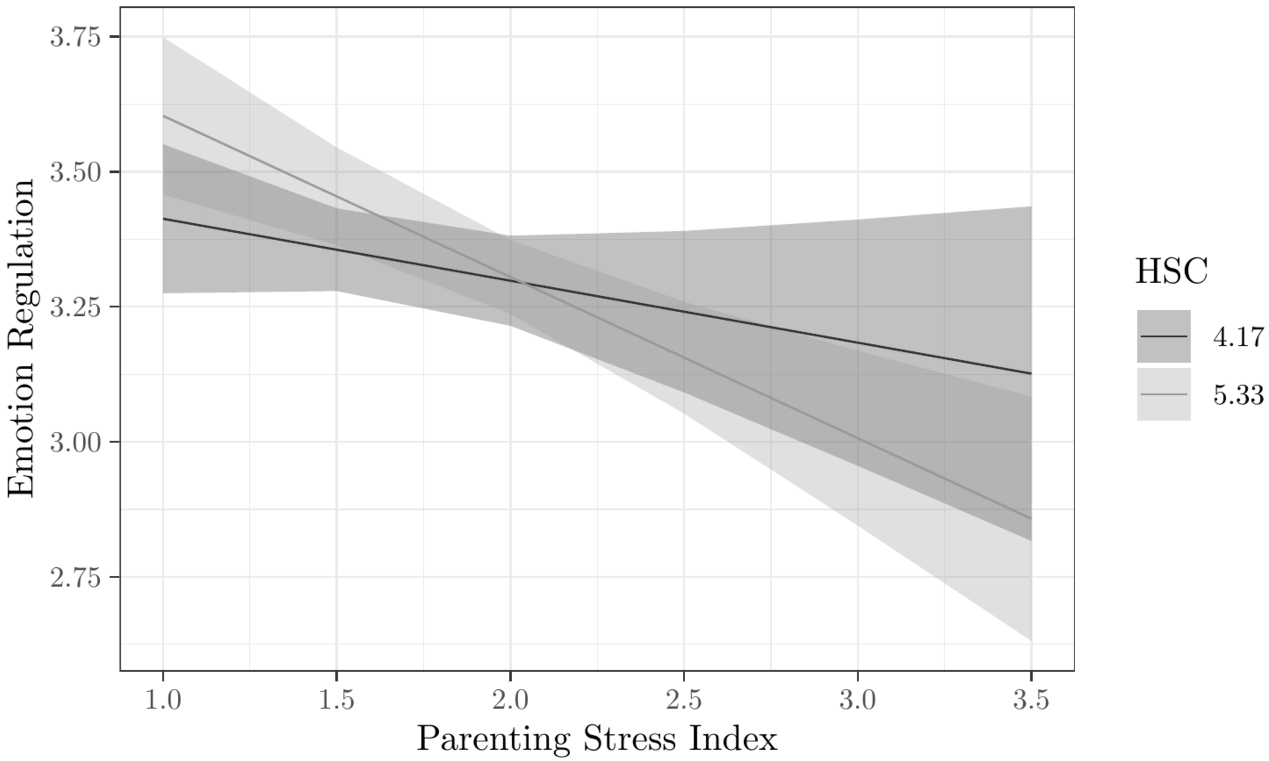


Figure 2

Study 3. Conditional interaction plot. Each line represents the relation between parenting stress and emotion regulation conditioned to the 30th and the 70th percentile of HSC-PR scores (respectively 4.17 and 5.33) bands represent the uncertainty of estimates.



Tables

Table 1

Study 2. Bivariate associations between the HSC-PR total scales and subscales with temperament dimensions (n = 329).

	1	2	3	4	5	6	7	8	9	10
1 HSC-PR	—									
2 HSC-PR – no item 7	.98	—								
3 HSC-EOE	.84	.86	—							
4 HSC-LST	.79	.72	.48	—						
5 HSC-LST – no item 7	.72	.73	.47	.91	—					
6 HSC-AES	.50	.50	.13	.22	.18	—				
7 CBQ-EC	.35	.34	.12	.27	.25	**.51**	—			
8 CBQ-EXTR	-.27	-.27	-.26	-.26	-.29	-.00	-.13	—		
9 CBQ-NA	.36	.37	.44	.17	.16	.09	.07	-.06	—	
10 Gender	.15	.13	.07	.11	.07	.18	.27	-.11	.12	—
11 Age	.10	.09	.06	.13	.12	.03	.15	-.10	.04	.06

Note. HSC-PR = Highly Sensitive Child scale Parent-Report Total Score; HSC-PR - no item 7 = Highly Sensitive Child scale Total Score excluding item 7; HSC-EOE = Ease of Excitation; HSC-LST = Low Sensitivity Threshold; HSC-LST – no item 7 = Low Sensitivity Threshold excluding item 7; HSC-AES = Aesthetic Sensitivity; CBQ-EC = Effortful Control; CBQ-EXTR = Surgency/Extraversion; CBQ-NA = Negative Affect. Given the sample size, n = 329, correlation values greater than .11 are significantly different from zero. According to Cohen (1988, 1992): trivial associations: *r* lower than *r* =.10; moderate associations: *r* = 25-

45; strong association: *r* higher than .50. Association that was tested for divergent validity are marked in bold.

Table 2

Study 3. Bivariate associations between HSC-PR total and subscales, PSI total and ER (N = 112).

	1	2	3	4	5
1 HSC-TOT	—				
2 ER	-.001	—			
3 PSI-TOT	.29	-.31	—		
4 Age	.05	.001	.10	—	
5 Gender	.09	.21	-.17	-0.14	—

Note. HSC = Highly Sensitive Child scale Total Score; ER = Emotion Regulation; PSI-TOT = Parenting Stress Total Score. Given the sample size, N = 112, correlation values greater than .19 are significantly different from zero. According to Cohen (1988, 1992): trivial associations: *r* lower than *r* =.10; moderate associations: *r* = 25-45; strong association: *r* higher than .50.

Table 3

Study 3. Comparison of regression models

Models	R-square	BIC	AIC	delta	Akaike weights
Main effects model	.11	74.02	63.15	3.67	.14
Interaction model	.15	73.07	59.48	.00	.86