



Sensitivity to psychosocial chronic stressors and adolescents' externalizing problems: Combined moderator effects of resting heart rate and parental psychiatric history

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ABSTRACT

From the literature it is not clear whether low resting heart rate (HR) reflects low or high sensitivity to the detrimental effects of adverse environments on externalizing problems. We studied parental psychiatric history (PH), reflecting general vulnerability, as possible moderator explaining these inconsistencies. Using Linear Mixed Models, we analyzed data from 1914 subjects, obtained in three measurement waves (mean age 11, 13.5, and 16 years) from the TRacking Adolescents' Individual Lives Survey population-based cohort and the parallel clinic-referred cohort. As hypothesized, more chronic stressors predicted more externalizing problems in vulnerable individuals with high resting HR but not in those with low resting HR, suggesting high vs. low sensitivity, respectively, to adverse environmental influences. Low sensitivity to adverse environmental influences in vulnerable individuals exposed to high stressor levels was additionally confirmed by high heart rate variability (Root Mean Squared Successive Difference; RMSSD). In adolescents with low vulnerability, in contrast, the association between chronic stressors and externalizing problems did not substantially differ by resting HR and RMSSD. Future research may demonstrate whether our findings extend to other adverse, or beneficial, influences. Notwithstanding their theoretical interest, the effects were small, only pertained to parent-reported externalizing problems, refer to a small subset of respondents in our sample, and are in need of replication. We conclude that HR and RMSSD are unlikely to be strong moderators of the association between stressors and externalizing problems.

1. Introduction

Adolescents' exposure to psychosocial stressors is a well-established risk factor of psychopathology, including disruptive (externalizing) behavior such as aggression and rule-breaking (for an overview, see Grant, Compas, Thurm, McMahon, & Gipson, 2004). However, the strength of this relationship differs greatly across individuals (Jenkins, 2008; Rutter, 2005), suggesting that some individuals are more sensitive to the environment than others. Determining which factors over time influence (i.e., moderate) the association between chronic stressors and externalizing problems may ultimately aid in timely identification of those most in need of intervention. This study investigated two potential moderators simultaneously: resting heart rate (HR), reflecting autonomic arousal; and parental psychiatric history (PH),

reflecting general vulnerability. We hypothesized that the moderator effect of resting HR would be more pronounced in more vulnerable individuals.

Biological Sensitivity to Context theory and the Differential Susceptibility hypothesis (Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2007; Boyce & Ellis, 2005; Ellis & Boyce, 2008; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2011) have proposed individual differences in sensitivity to the environment, for better and for worse. Specifically, whereas sensitive individuals are positively affected by beneficial environmental influences (e.g., parental emotional warmth) and negatively by adverse influences (e.g., parental hostility), less sensitive individuals are less affected by both. Individual characteristics that have been implicated in sensitivity to beneficial and/or adverse environmental influences are thus of interest as

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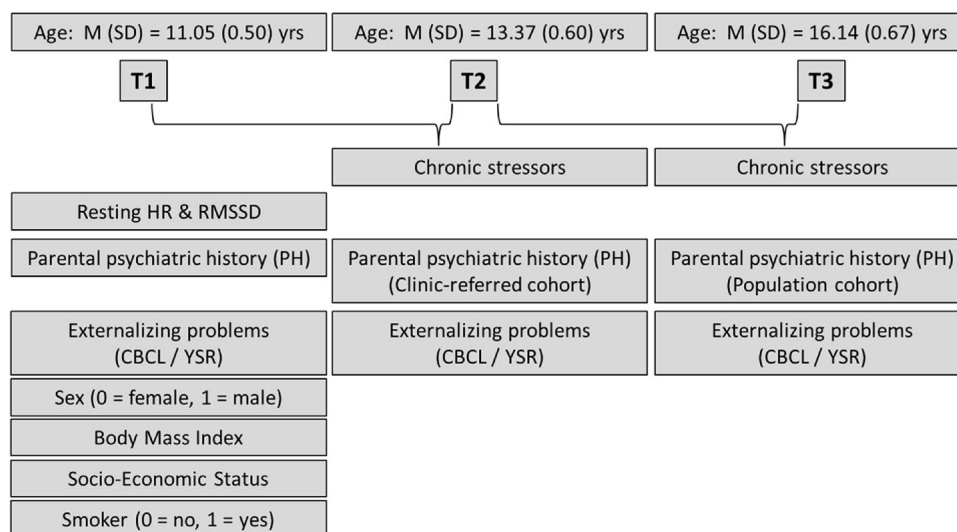


Fig. 1. Variables used in the present study.

Note: HR = Heart rate; RMSSD = Root mean squared successive difference; CBCL = Child behavior checklist; YSR = Youth self report. Chronic stressors refer to the number of long-term difficulties experienced since the previous measurement.

potential moderators of the association between chronic stressors and externalizing problems.

Recent findings suggest that resting HR captures individual differences in sensitivity to beneficial environmental influences on disruptive behavior in youth. There appears to be a positive association between autonomic arousal level, including resting HR, and efficacy of cognitive behavioral therapy (CBT) in reducing antisocial behavior in youth (Cornet, De Kogel, Nijman, Raine, & Van der Laan, 2014). For example, in a sample of 7–12-year olds who had been referred for disruptive behavior and treated with cognitive behavioral therapy, those who showed significant improvement (i.e., decrease in disruptive symptoms) were characterized by relatively high resting HR, whereas those who did not improve were characterized by low resting HR (Stadler et al., 2008). In addition, and with regard to adverse influences, our research group has recently demonstrated that higher chronic stressor levels predicted greater severity of (externalizing and internalizing) mental health problems in preadolescents with high resting HR, but not in those with low resting HR (Oldehinkel, Verhulst, & Ormel, 2008). Together, these findings suggest that resting HR may be reflective of sensitivity to environmental influences, both beneficial (such as cognitive behavioral therapy) and adverse (such as chronic stressors), in line with the Differential Susceptibility hypothesis. That is, youth with high resting HR may experience greater positive effects as a result of beneficial environmental influences and greater negative effects as a result of adverse influences. Conversely, preadolescents with low resting HR may not only be less sensitive to the positive effects of beneficial environments but also to the detrimental effects of adverse environments.

However, in contrast to the latter, there have also been findings that the combination of low resting HR and environmental risk factors such as violence exposure, poor parent-child relationship, low socio-economic status, or prenatal maternal stress, resulted in *increased risk* of externalizing problems (Gao, Huang, & Li, 2017; Raine, 2002; Raine, Fung, Portnoy, Choy, & Spring, 2014; Scarpa, Tanaka, & Haden, 2008). This is consistent with the well-established negative association between resting HR and externalizing problems, that is, low resting HR increases risk (Latvala, Kujala-Halkola, Almqvist, Larsson, & Lichtenstein, 2015; Latvala et al., 2016; Lorber, 2004; Ortiz & Raine, 2004; Portnoy & Farrington, 2015) whereas high resting HR is protective against externalizing problems (Portnoy, Chen, & Raine, 2013; Raine, 2002).

These opposite effects of low resting HR suggest the influence of an additional moderator. A likely candidate is parental psychiatric history

as index of individual differences in general vulnerability, given that genetic risk factors, including those linking low resting HR to externalizing problems (Baker et al., 2009), are more likely present in more vulnerable individuals. The present paper aims to investigate whether resting HR can be confirmed as a biological marker of sensitivity to environmental influences. We examine the hypothesis that the effect of resting HR on the stressors-externalizing association is conditional upon individual differences in general vulnerability. We hypothesize that the moderator effect of resting HR, in terms of sensitivity to chronic stressors, manifests especially in more vulnerable individuals. We expect that, especially in these individuals, higher levels of chronic stressors are associated with higher subsequent externalizing problem levels in individuals with high resting HR, but that chronic stressors are not associated with externalizing problems in individuals with low resting HR.

2. Methods and materials

2.1. Sample

We derived the data used in this study from the two cohort studies of the longitudinal “TRacking Adolescents’ Individual Lives Survey.” TRAILS aims to contribute to the understanding of the determinants of mental health problems by following 10–12 year-old Dutch children into adulthood. TRAILS was approved by the National Dutch Medical Ethics Committee, in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

To obtain a large sample with wide ranges of parental psychiatric history severity, problem severity and chronic stressors, we pooled data from the population-based birth cohort ($n = 2230$) and a parallel clinic-referred cohort ($n = 543$). We included three measurement waves: T1, T2, and T3, with mean ages about 11, 13.5, and 16 years, respectively (see Fig. 1). The sampling procedures, descriptive statistics and response rates of both cohorts are well-documented (e.g., De Winter et al., 2005; Huisman et al., 2008; Ormel et al., 2012). In brief, TRAILS approached 135 primary schools in five municipalities in the Northern Netherlands to build the population cohort. 90.4% of the schools agreed to participate. TRAILS contacted eligible students and their parents, enrolling 76% ($n = 2230$) of those contacted in the study. The three data waves we included in this study were collected from March 2001 to July 2002 (T1), September 2003 to December 2004 (T2), and September 2005 to August 2007 (T3), with response rates consistently

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