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Individual differences in the relationship between temperament and planning ability in adolescents

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Abstract

Identification of genetic and environmental factors of the relationship between temperament and the planning ability is essential for future interventions aimed at self-regulation in adolescents. Participants included 612 twin pairs aged 10 to 14 years. All participants filled out Rothbart's Early Adolescent Temperament Questionnaire and were tested with the “Stocking of Cambridge” test.

A univariate model showed that the scales of Rothbart's questionnaire are largely affected by genetic factors ($A=10-51\%$). The planning ability is affected by both genetic ($A=17\%$) and shared environmental factors ($C=21\%$). A multivariate model was used to estimate the impact of genes and environment in the phenotypic correlation between the measure of planning ability and temperamental characteristics. The results suggest that individual differences in relationship between temperament and planning ability mostly explained by environment factors.

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1. Introduction

The range of individual differences in how we react and feel in everyday social situations is huge. The concept of temperament refers to the biological bases of individual differences in thoughts, feelings, and behavior. The temperamental traits manifest in early childhood and have long lasting consequences for child's development. M. Rothbart discriminate three basic dimensions of temperament: Extraversion/Surgency, Negative Affectivity, and

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Effortful Control (Rothbart, 2011; Rothbart & Derryberry, 1981). Extraversion/Surgency refers to positive emotionality, level of activity, impulsivity, and risk taking. Negative Affectivity is related to fear, sadness, anger, and discomfort. Effortful Control is the ability to perform a voluntary action by inhibiting or activating behaviour. The Effortful Control is important for both learning and social adaptation. The deficit of Effortful Control manifests in internalizing and externalizing behaviours (Eisenberg et al., 2009; Murray & Kochanska, 2002; Oldehinkel, Hartman, Ferdinand, Verhulst, & Ormel, 2007).

The planning ability is another important component of behavioral regulation and cognitive functioning (R. Morris & Ward, 2004). It is a higher order cognitive ability involved in stepwise problem solving. The planning comprises working memory, attention, inhibition, and task switching and usually considered as an executive function which develops in adolescence (Hughes & Graham, 2002). Planning ability is tightly associated with the functioning of the frontal lobes: the frontal lobe pathology, such as depression, schizophrenia, and lesions, is often followed by the deficit of planning (Arnett, Higginson, & Randolph, 2001; Badcock, Michie, & Rock, 2005; R. G. Morris, Ahmed, Syed, & Toone, 1993). At the same time the transcranial stimulation of the dorsolateral prefrontal cortex improves the performance in planning tasks (Dockery, Hueckel-Weng, Birbaumer, & Plewnia, 2009).

There is a conceptual link between temperament and planning ability. The process of planning requires executive control to for making and performing the plan (Garavan, Ross, Murphy, Roche, & Stein, 2002). Negative and positive emotionality may also affect the planning performance through attentional control (Coombes, Higgins, Gamble, Cauraugh, & Janelle, 2009). Planning ability and temperament have also similar structure of individual differences: both are largely affected by person-specific environment and to some extent by genetic effects (Kremen et al., 2008; Rothbart, 2011).

It is becoming increasingly important to consider self-regulation in the context of personality and cognitive abilities in order to reduce the risk of behavioural problems in adolescents. In our study we aimed to study if there is a relationship between temperament and planning ability in adolescence. For the first time we addressed the question whether there are genetic or environmental factors which are responsible for such relationship.

2. Method

2.1. Participants

Participants included 612 twin pairs aged 10 to 14 years (242 MZ and 370 DZ pairs, mean age=12.31, SD=1.46).

2.2. Procedure

The study comprised two waves of data collection. First, the participants filled in Rothbart's Early Adolescent Temperament Questionnaire (EATQ-R). The EATQ-R assesses the following dimensions of temperament (conceptualized as scales): Temperament Scales (Activation Control; Activity Level, Affiliation; Attention; Fear; Frustration; Surgency, High Intensity Pleasure; Inhibitory Control; Perceptual Sensitivity; Pleasure Sensitivity; Shyness), and Behavioral Scales (Aggression; Depressive Mood)

The second wave of data collection implied assessment of the planning ability with the test "Stockings of Cambridge" (SOC) from the computerized battery of neuropsychological tests (CANTAB). All participants were tested individually on a personal computer. The tests of CANTAB are mostly non-verbal that makes it independent of language and culture. CANTAB has been reported to have high applicability in the evaluation of children. Test-retest reliability of CANTAB's test is over 0.60 (Neuropsychological Test Automated Battery (CANTABeclipse) manual, 2006). In the "Stockings of Cambridge" (SOC) test the task requires participant to move an arrangement of coloured balls hanging in "pockets" or "socks" to match a goal arrangement presented at the top of the screen. Participant must move the balls in the lower display to copy the pattern shown in the upper display. The balls may be moved one at a time by touching the required ball, then touching the position to which it should be moved. The time taken to complete the pattern and the number of moves are taken as measures of the participant's planning ability.

Task difficulty increases with the total number of the moves needed (from 2 to 5). The participants' planning ability was characterized by the time spent for planning before the first move (initial thinking time) and time spent

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