



# Effortful control as a moderator in the association between punishment and reward sensitivity and eating styles in adolescent boys and girls



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## ABSTRACT

The reactive traits of Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) are assumed to be involved in the development of Eating Disorders (EDs). Most studies examine whether levels of these traits differ between ED diagnoses, without taking other variables into account. However, vulnerability theories of psychopathology posit that the risk for psychopathology depends on the interaction between reactive traits and self-regulatory traits such as Effortful Control (EC). As such, the present objective was to examine the moderating role of EC in the association between SP, SR and the eating styles restrained eating, emotional eating and external eating as possible ED precursors in adolescents.

To obtain this objective, a community sample of 252 adolescents (54.0% female) between 14 and 19 years old was recruited. Self-report questionnaires were used to measure the level of SP, SR, EC and eating styles. In a subsample ( $n = 46$ , 67.4% female), the Colour-Word Stroop task was conducted as an additional behavioural measure of EC. Hierarchic linear regressions were performed separately for boys and girls to examine the interactions between SP, SR and EC as well as gender differences between these interactions.

There was some evidence for interactions between reactive and regulative traits in explaining restrained and emotional eating in girls. Also, several main effects of SP and SR were found in boys for all eating styles and in girls for restrained eating. The implications of these findings for future research and for screening and prevention programs are discussed.

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## 1. Introduction

Adolescence is known as a vulnerable period for the development of Eating Disorders (EDs) (Bakalar, Shank, Vannucci, Radin, & Tanofsky-Kraff, 2015; Hoek & van Hoeken, 2003; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011; Waaddegaard, Davidsen, & Kjølner, 2009), which are recognized as persistent disorders with negative consequences on various life domains (Maxwell et al., 2011). As such, increasing scientific insight into vulnerability factors in adolescents is important for screening, prevention and intervention purposes. According to theories considering the vulnerability for psychopathology, the probability of developing a

psychological disorder is determined, at least partly, by the interaction between certain reactive temperament traits and self-regulatory capacities (e.g. Lonigan, Vasey, Phillips, & Hazen, 2004; Nigg, 2006). However, to our best knowledge, this interaction between reactive temperament and self-regulatory capacities in the context of ED symptoms has not been examined in adolescents before (Bakalar et al., 2015; Hoek & van Hoeken, 2003; Swanson et al., 2011; Waaddegaard et al., 2009).

Previous research on the role of temperament in EDs has increasingly focused on the role of reactive approach and avoidance related traits, with several studies supporting the assumption that a vulnerable temperamental profile might increase the risk to develop an ED (Cassin & Von Ranson, 2005; Harrison, O'Brien, Lopez, & Treasure, 2010; Matton, Goossens, Vervaet, & Braet, 2015). An important theoretical framework, on which many of these studies are based, is Gray's Reinforcement Sensitivity Theory

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(RST; Gray, 1970, 1982, 1987; Gray & McNaughton, 2000). According to this theory, human motivation, behaviour and emotion can be explained by the activation of three different brain systems. These are the Behavioural Inhibition System (BIS), the Behavioural Activation System (BAS) and the Fight Flight Freeze system (FFFS). Following the revised RST (Gray & McNaughton, 2000), the BAS and the FFFS are each other counterparts since these systems are activated by signals of reward versus punishment respectively. The BIS fulfils the role of a conflict detection and resolution system, which is activated whenever competing goals are involved. Based on this theory, the temperament traits of Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) are defined as the reflection of the combined sensitivity of the BIS and the FFFS in the case of SP and as the reflection of the sensitivity of the BAS in the case of SR (Gray, 1970, 1982, 1987; Gray & McNaughton, 2000; Harrison et al., 2010; Matton et al., 2015). Importantly, these traits are assumed to act as vulnerabilities for developing an ED (Harrison et al., 2010; Matton, Goossens, Braet, & Vervaet, 2013; Matton et al., 2015).

Most research on the role of temperament so far focused on clinical samples of ED patients and reports conflicting results, especially regarding the role of SR: some studies suggest that increased SR is specifically related to EDs characterized by binge eating (Harrison et al., 2010; Matton et al., 2015), being Anorexia Nervosa of the Binge/Purge type (AN-B/P), Bulimia Nervosa (BN) and Binge Eating Disorder (BED) (Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-V), American Psychiatric Association (APA), 2013) whereas other studies suggest that increased SR is also characteristic of Anorexia Nervosa of the Restricting type (AN-R) (Glashouwer, Bloot, Veenstra, Franken, & de Jong, 2014; Harrison et al., 2010). The finding of high SR being specifically associated with binge/purge EDs in some studies (Harrison et al., 2010; Matton et al., 2015) can be explained by the association between SR and impulsivity (Gray, 1970, 1982, 1987; Gray & McNaughton, 2000) as well as by the assumption that high SR is also translated into high reward sensitivity regarding food stimuli (Vandeweghe, Vervoort, Verbeke, Moens, & Braet, 2016). On the other hand, it has been suggested that not the level of SR but the nature of the stimuli that are experienced as rewarding changes in AN-R patients (Keating, Tilbrook, Rossell, Eiticott, & Fitzgerald, 2012), which might explain the findings of high SR in AN-R patients that are reported in other studies (Glashouwer et al., 2014; Harrison et al., 2010). The findings regarding SP are more consistent and generally show heightened levels of SP in ED patients regardless of the specific ED type (Harrison et al., 2010; Matton et al., 2015). From the theoretical perspective that is offered by the RST (Gray, 1970, 1982, 1987; Gray & McNaughton, 2000), it is assumed that increased levels of SP are associated with increased levels of avoidance behaviour and feelings of anxiety, which may result in an ED and in the symptom of restrained eating specifically. In line with this assumption, previous research has shown that high SP is associated with more food-specific avoidance behaviour in children (Vandeweghe et al., 2016).

As previously mentioned, an important limitation is that few studies examined interaction effects, although it is assumed that the influence of SP and SR on ED symptoms will depend on the level of other variables. More specifically, theories considering the vulnerability for psychopathology emphasize the role of self-regulatory processes (e.g. Lonigan et al., 2004; Nigg, 2006) such as Effortful Control (EC; Rothbart, 1989; Rothbart & Ahadi, 1994) that may influence the association between certain reactive temperament traits and psychopathology (Bijttebier, Beck, Claes, & Vandereycken, 2009). In other words, it is assumed that EC moderates the association between reactive traits and psychopathology in the sense that a high level of EC might help individuals to control their vulnerable temperament which might decrease their risk of

developing psychopathology. According to this perspective, it is important to discriminate between executive behavioural inhibition or top-down control versus reactive behavioural inhibition or bottom-up control (Nigg, Silk, Stavro, & Miller, 2005). Whereas the traits defined by the RST refer to bottom-up processes, EC refers to top-down control and reflects self-regulation abilities that develop later in life compared to reactive traits that appear early in life (Claes, Mitchell, & Vandereycken, 2012; Nigg et al., 2005). EC consists of the ability to voluntary focus or shift attention (i.e. attention control), the ability to inhibit behaviour (i.e. inhibitory motor control) and the ability to activate behaviour as needed (i.e. activation motor control), which can be measured through observation and self-report questionnaires (Rothbart & Ahadi, 1994; Rothbart, 1989). From the neuropsychological perspective, different tasks have been developed measuring more cognitive aspects of EC, namely the ability to maintain a specific response in the presence of other competing stimuli (i.e. interference control), the ability to exclude mental information from the working memory by actively suppressing it (i.e. cognitive inhibition) and the ability to intentionally delay a motor response (i.e. motor inhibition) (Nigg, 2000; Nigg et al., 2005).

The hypothesis that EC might moderate the association between reactive traits and psychopathology has already been supported by the results of several studies. For example, in the domain of addiction, it has been shown that the association of SP with alcohol use is indeed moderated by EC, as measured with a neuropsychological task in university students aged 18–32 years (Jonker, Ostafin, Glashouwer, van Hemel-Ruiter, & de Jong, 2014). More specifically, these authors found that SP was negatively associated with alcohol use, but only when EC was low. In other words, when EC was low the reactive trait SP had more influence on behaviour whereas in the case of high EC, this trait seemed to overrule the influence of SP (Jonker et al., 2014). Another study showed that the association between SR and alcohol use was moderated by EC in pupils from secondary schools aged 14–20 years (Willem, Bijttebier, & Claes, 2010). In this study, EC was operationalized by a self-report scale measuring attention, inhibitory and motor control (Willem et al., 2010). Again, the results were in line with the general hypothesis: SR was positively associated with alcohol use, but only in the case of low EC. In the domain of personality disorders, interactions between SP and attention control, measured with a self-report scale, have also been found in an adult sample with a mean age of 37.84 years (Claes, Vertommen, Smits, & Bijttebier, 2009). Again in line with the hypothesis that high EC might overrule the effect of reactive traits on (pathological) behaviour, these authors found that high SP was only related to severe personality disorders if EC was low.

Consistent with these findings, previous research in ED patients has found that high SP was associated with higher probabilities to engage in non suicidal self injury in the presence of low EC (Claes, Norré, Van Assche, & Bijttebier, 2014). Claes, Robinson, Muehlenkamp, Vandereycken, and Bijttebier (2010) also examined the level of EC, measured with both a self-report questionnaire discriminating between the three aspects of EC and with a neuropsychological task measuring interference control, in a clinical sample of ED patients. They found evidence for decreased EC in ED subtypes characterized by binge eating compared to AN-R patients, but the moderating effect of EC on the association of SP and SR with ED symptoms was not examined. In addition, previous research has distinguished three clusters based on SP, SR and EC that were differentially related to symptom severity in patients with an ED (Turner et al., 2014), which further supports the idea that all three variables may play an (interactive) role in ED symptoms. Burt, Boddy, and Bridgett (2015) examined the interaction effect between EC, measured with a self-report questionnaire, and the trait

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