



Attention-Deficit/Hyperactivity Disorder symptoms: Associations with Gray's and Tellegen's models of personality

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ABSTRACT

Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms of inattention (IA) and hyperactivity/impulsivity (HI) were examined in relation to three personality instruments: Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ); the Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) scales; and the Multidimensional Personality Questionnaire-Brief (MPQ-BF) ($N = 214$). Results showed that IA was associated positively with Sensitivity to Punishment (in the SPSRQ), Negative Emotionality (in the MPQ-BF), and Behavioral Inhibition System (in the BIS/BAS scales). HI was associated positively with Sensitivity to Reward (in the SPSRQ), Reward Responsiveness and Drive (both in the BIS/BAS scales), and Positive Emotionality (in the MPQ-BF). Both IA and HI were associated negatively with Constraint (in the MPQ-BF), and HI was associated positively with Fun Seeking (in the BIS/BAS scales). These findings are interpreted in terms of the original and revised reinforcement sensitivity theories.

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1. Introduction

A growing number of studies have shown that Attention-Deficit/Hyperactivity Disorder (ADHD; DSM-IV-TR, *American Psychiatric Association, APA, 2000*) is systematically related to some of the major personality and temperament dimensions (for a review, *Gomez, 2009*), thereby raising the possibility that they share common underlying systems. The aim of this study was to examine how the major traits in *Gray's (1970, 1982)* and *Tellegen's (2000)* personality theories are related to ADHD.

In *Gray's (1970, 1982)* original theory, currently referred to as Reinforcement Sensitivity Theory (RST), personality reflects individual differences in two major neurobiological systems, namely the Behavioral Inhibition System (BIS) and the Behavioral Approach System (BAS). The BIS is viewed as being sensitive to signals of punishment, frustrative nonreward and novelty. Its activation results in anxiety and avoidance behaviors. The BAS is viewed as being sensitive to signals of reward and nonpunishment. Its activation results in positive emotion and approach behaviors. Traits relating to anxiety and impulsivity are linked to the BAS and BIS, respectively.

The original RST or o-RST has been substantially updated by *Gray and McNaughton (2000)* and *McNaughton and Corr (2004)*;

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for a review see *Corr, 2008*). In the revised model or r-RST, BAS is conceptualized as in o-RST. Although the BIS is still linked to anxiety, it is not related to mediating reactions to punishment (as in the original model) but to resolving goal conflicts, especially approach-avoidance conflicts. It is also linked to cognitive processes, such as attention and memory, involved in resolving such conflicts. Too high or too low BIS activity is assumed to be dysfunctional. Reactions to all types of punishment are now postulated to be mediated by a Fight-Flight-Freeze System (FFFS), which in many respects is comparable to the original or o-BIS. The FFFS mediates the emotion of fear.

O-RST of personality has spawned a large literature (*Corr, 2008*), the majority of which is based on two psychometric measures: the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; *Torrubia, Avila, Molto, & Caseras, 2001*) and, most notably, the Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) scales (*Carver & White, 1994*). In the SPSRQ, the sensitivity to punishment (SP) and sensitivity to reward (SR) scales measure the traits of the BIS and BAS, respectively. In the BIS/BAS scales, the BIS scale and BAS scale measure their namesakes. However, *Heym, Ferguson, and Lawrence (2008)* have shown that the seven items in the BIS scale can be separated into subscales for Anxiety (BIS-Anxiety) and Fear (BIS-Fear). According to them, these measure the BIS and FFFS, respectively, as conceptualized in r-RST. The BAS scale has subscales for Reward Responsiveness (BAS-RR), Drive (BAS-DR) and Fun Seeking (BAS-FS). BAS-RR measures ap-

proach motivation in anticipation of a future reward; BAS-DR measures goal-directed behavior; and BAS-FS measures motivation to approach immediately (a form of impulsivity). Smillie, Jackson, and Dalgleish (2006) have shown that these scales are better conceptualized as comprising two factors: a super-factor (reward reactivity) for the BAS-RR and BAS-DR factors, and another factor for BAS-FS (impulsivity). They have argued that BAS-FS may not be related to BAS, as conceptualized in o-RST.

Tellegen's (2000) personality model has three primary factors, namely Positive Emotionality (PEN), Negative Emotionality (PEN), and Constraint (CON). PEN measures dispositions towards positive emotions, and appetitive approach, and NEN measures negative emotions, reactivity to stress and emotional lability, and defense withdrawal. Thus, conceptually, PEN can be linked to the BAS, especially reward reactivity (Watson, Wiese, Vaidya, & Tellegen, 1999), while NEN can be linked to o-BIS. The empirical data is supportive of links between the NEN and o-BIS, and between CON and both the o-BIS (negatively) and the BAS (Carver & White, 1994). Tellegen's (2000) model of personality is measured using the Multidimensional Personality Questionnaire (MPQ; Tellegen, 2000). There is also a brief version of the MPQ (MPQ-BF; Patrick, Curtin, & Tellegen, 2002).

For the diagnosis of ADHD, DSM-IV (and also DSM-IV TR, APA, 2000) lists 18 symptoms under two separate symptom groups, namely inattention (IA) and hyperactivity/impulsivity (HI), with nine symptoms for each group. DSM-IV indicates that there are three types of ADHD: (a) ADHD inattentive type (presence of only the IA symptom group); (b) ADHD hyperactive/impulsivity type (presence of only the HI symptom group); and (c) ADHD combined type (presence of both IA and HI symptom groups). In children, the related externalizing disorders of Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) are highly comorbid with ADHD (Pliszka, 1998). Although originating in childhood, ADHD is now regarded as a valid adult disorder (American Psychiatric Association, 1994). Follow-up studies have shown that while ADHD is fairly stable from childhood to adulthood, ADHD behaviors decline with age, and they are relatively higher among males than females (Biederman, Mick, & Faraone, 2000). Also, Harpold et al. (2007) has noted that the spectrum of behaviors in ODD is also highly comorbid with ADHD among adults.

Theoretical models suggest that ADHD is associated with a response inhibition deficit (Barkley, 1997), dysfunctions involving responses to rewards (for a review, see Luman, Oosterlann, and Sergeant (2005)), underactive BIS (as proposed in the original RST; Quay, 1988), and insensitivity to delayed rewards (Sagvolden, Aase, Zeiner, & Berger, 1998). In contrast to these single pathway models, there are dual pathways models of ADHD that implicate different processes for the IA and HI symptom groups. Sonuga-Barke (2003) has proposed that deficits in executive functioning underlie the IA symptoms, while deficits in reward response underlie the HI symptoms. Martel and Nigg (2006) have linked problems with cognitive control processes to the IA symptoms, and problems with motivational control processes to HI symptoms.

A handful of studies have examined how the traits in Gray's (1970, 1982) o-RST and Tellegen's (2000) models are related to ADHD. Hundt, Kimbrel, Mitchell, and Nelson-Gray (2008) found that IA correlated positively with SP, while HI correlated positively with SR. Mitchell and Nelson-Gray (2006) used composite measures of the BIS and BAS, derived from the SPSRQ, BIS/BAS scales, and measures of trait impulsivity and anxiety and found that both IA and HI correlated positively with the composite BAS and BIS measures. These relationships held even when CD was partialled out in the analyses. Cukrowicz, Taylor, Schatschneider, and Iacono (2006) compared the personality profiles of "pure" ADHD (i.e., without CD), ADHD + CD, CD, and normative control groups of adolescents and children for the traits in the MPQ. They found no

group difference for PEN. All three clinical groups had high scores for NEN and lower scores for CON, compared to the normative mean. The ADHD + CD group had more extreme scores compared to "pure" ADHD and "pure" CD groups, who did not differ from each other.

When the relations between the traits of o-RST and Tellegen's model, the empirical data on their relationships with IA and HI, and the theoretical models of ADHD are considered together, they raise the possibility that ADHD may be related to dysfunctional BIS and BAS (involving both poor reward reactivity and impulsivity). Since r-BIS is associated with cognitive, attention and memory processes when resolving goal-directed conflicts, it can be speculated further that ADHD may be associated with dysfunctions in these respect. In terms of IA and HI separately, existing data is mixed. While Hundt et al. (2008) found associations for IA with BIS, and HI with BAS, Mitchell and Nelson-Gray (2006) found that both IA and HI correlated positively with BAS and BIS.

In addition to the mixed findings, there are significant gaps and limitations in relation to the existing data on the relationships of ADHD with the personality traits proposed in RST and Tellegen's models. First, there has been no study on how the BIS/BAS scales by themselves (i.e., not combined in composites with other related measures) are related to ADHD. Thus we have no data on how IA and HI are related to different scales of the BIS/BAS scales, or to BAS-reward reactivity as opposed to impulsivity. Second, no study has examined the relevance of Tellegen's model for ADHD in a community sample. Such studies will allow additional evaluation of how IA and HI are related to BAS-reward reactivity (measured by PEN) and Impulsivity (measured by CON). Third, existing data have not explored the relationships of IA and HI with the traits in r-RST. Fourth, not all past studies have controlled for ODD and/or CD. Controlling for such problems is critical as they have been linked to concurrent overactive BAS and underactive BIS (Quay, 1988). Fifth, although age and sex are known to influence ADHD symptom levels, their effects were not controlled in previous studies.

Given these gaps and limitations, this study examined, in a community sample, the relationships of the traits in the RST and Tellegen's personality models with IA and HI. To allow for an examination of r-RST, the BIS scale of the BIS/BAS scales was also examined for BIS-Anxiety (measure of r-BIS) and BIS-Fear (measure of FFFS in r-RST). In all analyses, the potential confounding effects of ODD, age and sex were partialled out. The study also used a path model to examine the relationships of IA and HI with composite scores, based on factors obtained from an exploratory factor analysis of all the scales in three personality measures. The composite scores were BIS, BAS-reward reactivity, and Impulsivity. As existing data for the relationship of the various personality traits (examined here) with IA and HI is either mixed or lacking, no specific prediction was made.

2. Method

2.1. Participants

Two-hundred and fourteen adults (115 females and 99 males), with age ranging from 18 to 76 years (mean age = 31.71, $SD = 16.48$) were recruited through several sources from the State of Victoria, Australia. For the entire sample, the mean (SD) scores for the IA and HI symptom groups were 5.84 (4.03) and 5.75 (3.76), respectively. These scores compare to 6.44 (4.55) and 6.25 (4.42) for IA and HI respectively for a large Australian community group (Gomez, submitted for publication). Thus on the whole the sample in this study can be seen as having about normative levels of the IA and HI traits.

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