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Attention-Deficit/Hyperactivity Disorder symptoms in an adult sample: Associations with Cloninger's temperament and character dimensions

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ABSTRACT

Relationships between C.R. Cloninger's temperament and character dimensions and the Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms of inattention (IA) and hyperactivity/impulsivity (HI) were examined in 231 adults from the general population. Regression analyses that predicated overall ADHD, IA and HI by the seven temperament/character dimensions revealed: IA was predicted positively by Harm Avoidance and negatively by Self-Directedness; HI was predicted positively by Persistence; and overall ADHD was predicted negatively by Self-Directedness. These findings are also interpreted in terms of current theories of ADHD, and the related original and revised versions of Gray's reinforcement sensitivity theory (RST) of personality.

1. Introduction

Personality/temperament traits and various clinical disorders are often assumed to lie on a continuum, reflecting different manifes tations of the same underlying systems. Miller, Miller, Newcorn, and Halperin (2008) have argued that it is possible that Attention-Deficit/Hyperactivity Disorder (ADHD; DSM-IV-TR, American Psychiatric Association, APA, 2000) and personality/temperament are the same constructs viewed through different theoretical lenses. A growing number of studies have examined these relationships (Gomez, 2009). The aim of this study is to examine how the temperament and character dimensions of C.R. Cloninger's biopsychosocial theory of personality (Cloninger, Svrakic, & Przybeck, 1993) are related to core ADHD symptoms.

Originating in childhood, ADHD is now regarded as a valid adult disorder (DSM-IV, APA, 1994). 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. The IA symptom group includes behaviors such as distractibility and difficulty focusing on tasks for a sustained period; and the HI symptom group includes behaviors such as fidgeting, excessive talking and restlessness. 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). Follow-up studies have shown that, while ADHD is fairly stable from childhood to adulthood, its behaviours decline with age, and they are relatively higher among males than females (Biederman, Mick, & Faraone, 2000).

A common feature of ADHD in both children and adults is the high comorbidity with other externalizing disorders. Approximately 60% of ADHD children have Oppositional Defiant Disorder (ODD) and/or Conduct Disorder (CD) (Pliszka, 1998). ODD refers to recurrent pattern of negativistic, defiant, disobedient and hostile behaviors, especially to authority figures (DSM-IV, APA, 2000). In adults with ADHD, about 20–30% have ODD (Harpold et al., 2007), and about 30% have antisocial personality disorder).

There are a number of reoccurring research themes in ADHD research: response inhibition deficit (Barkley, 1997); dysfunctions involving responses to rewards (Luman, Oosterlann, & Sergeant, 2005); an underactive behavioural inhibition system (BIS; Quay, 1988). In contrast to these single pathway models, there are dual pathway models of ADHD that differentiate processes underlying IA and HI symptom groups. For example, Sonuga-Barke (2003)

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proposed that deficits in executive functioning underlie the IA symptoms, while deficits in reward response underlie the HI symptoms; and Martel and Nigg (2006) linked problems with cognitive control processes to IA symptoms, and problems with motivational control processes to HI symptoms.

One major neurobiological model of personality that may be of special interest to understanding AHDH is Cloninger's (Cloninger et al., 1993). This is because this model has 'temperament' and 'character' components. Temperament refers to innate dispositions, based on major brain-behavioural systems of emotion, motivation and reinforcement, whereas character is seen to reflect largely environmental influences. The interplay of these factors have been implicated in the phenotypic expression, continuity and changes in clinical presentation of ADHD (Laucht et al., 2007; Thapar, Langley, Asherson, & Gill, 2007). This means that Cloninger's model will enable us to acquire a comprehensive understanding of how personality factors linked to biological and environmental processes are associated with ADHD.

The original formulation (Cloninger, 1987) proposed a tridimensional structure, comprising the temperament dimensions of Novelty Seeking (NS), Harm Avoidance (HA) and Reward Dependence (RD). As the facet of Persistence (P) did not closely correlate with its designated RD factor, it was suggested as a fourth temperament dimension. NS is the tendency to approach novel situations for rewards, and to experience relief from non-punishment. High NS includes impulsivity, quick-temper and proneness to breaking rules. HA is the tendency to inhibit or avoid responses to aversive cues, such as punishment and non-reward. High HA is associated with high anticipatory anxiety and fear. RD is the tendency to maintain responses that have been previously conditioned through rewards. High RD is associated with being sociable and sensitive to social cues. P is the tendency to maintain responses, despite frustration and fatigue. High P is associated with persevering and being ambitious. Cloninger's model has three character dimensions, namely, Self-Directedness (SD), Cooperation (CO) and Self-Transcendence (ST). SD reflects the ability to control, regulate and adapt one's behavior to concur with existing situations to achieve one's goals and values. CO reflects identification with and acceptance of others. ST reflects imaginativeness and spirituality.

A number of studies involving clinical and non-clinical samples have examined the associations of the Cloninger's temperament and character dimensions with ADHD in children and adolescents (Cho et al., 2008; Rettew, Copeland, Stanger, & Hudziak, 2004; Tillman, Geller, & Craney, 2003; Yoo et al., 2006) and adults (Anckarsater et al., 2006; Downey, Stelson, Pomerleau, & Giordani, 1997; Faraone, Doyle, Mick, & Biederman, 2001; Jacob et al., 2007; Lynn et al., 2005; Purper-Ouakil et al., 2010; Salgado et al., 2009; Sizoo, van den Brink, van Eenige, & van der Gaag, 2009; Smalley, Loo, Hale, Shrestha, & McGough, 2009). In general, these studies reveal that the temperament dimensions of HA and NS are associated positively with ADHD and P and (to a lesser degree) RD are associated negatively with ADHD. Among the character dimensions, CO and SD have generally been shown to be associated negatively with ADHD.

At least two studies have reported the correlations of the temperament and character dimensions with IA and HI separately (Lynn et al., 2005; Yoo et al., 2006). Yoo et al. (2006) reported correlations for a group of children from the general community. Their findings indicated that both IA and HI were correlated positively with NS, and negatively with P, SD and CO. IA was also correlated positively with HA. Lynn et al. (2005) used a latent correlation model to examine this for a group of adults, many of whom had ADHD. The model included NS, HA, SD, CO and ST, but not P and RD. They found that NS was associated positively with both IA and HI, and CO was associated negatively with HI.

Overall, existing data show that six (HS, HA, RD, P, SD and CO) of the seven TCI dimensions are associated with ADHD. ST is the dimension that has not shown consistent association with ADHD. With some minor exceptions, both IA and HI have shown somewhat similar associations with the TCI dimensions. The difference is that (unlike the findings for ADHD) neither IA nor HI were found to be associated with RD, and HA was associated more often with IA than HI.

Taking this regression approach, Salgado et al. (2009) examined the associations of TCI dimensions with IA and HI in a group of clinically diagnosed ADHD adults. Their analyses included ODD, age and sex as covariates; and, in addition, when IA was the criterion, HI was an additional covariate and vice versa when HI was the criterion. Their results revealed that IA was predicted positively by HA and negatively by SD, while HI was predicted positively by NS and P.

Despite these existing data in children, adolescents and adults on the relationships of ADHD with Cloninger's temperament and character dimensions, there are gaps in existing data. To date, no study has examined the relationships of the TCI dimensions with IA and HI among adults in a non-clinical general community sample. Studies of the general community, where wide range in levels of ADHD, temperament and character exist (compared to clinical samples) are important for a better understanding of how temperament and character traits may be associated with ADHD behaviours, which at high levels are reflective of the behaviours of individuals with an ADHD diagnosis. Secondly, despite the fact the IA and HI are highly correlated, all, but one previous study (Salgado et al., 2009) partialled out IA when the relationships for HI were examined, or HI when the relationships for IA were examined. Thirdly, all, but one previous study (Salgado et al., 2009) have not controlled for other externalizing problems, such as conduct and oppositional problems that are also associated with ADHD (Biederman et al., 2004; Harpold et al., 2007), as well as Cloninger's temperament and character dimensions (Kim et al., 2010; Salgado et al., 2009). Lastly, although age and sex are known to influence ADHD symptom levels, their effects were not controlled in most previous studies.

The aim of this study was to fill this lacuna in the literature by examining the relations of Cloninger's temperament and character dimensions with IA and HI and total ADHD scores in a group of adults from the general community, taking into account the other limitations mentioned earlier. Thus relative to previous studies, this study will provide a clearer understanding of how Cloninger's model is related to ADHD. To allow for comparisons with the findings in previous studies, initially our analyses involved zero-order correlations between the TCI dimensions with ADHD, IA and HI. This was followed by three multiple regression analyses predicting ADHD, IA and HI from all seven TCI dimensions. For all three analyses, the effects of sex, age, and ODD were controlled. In addition HI was controlled for the prediction of IA, and IA was controlled for the prediction of HI.

In line with existing data, it was expected that for the correlation, both NS and HA would be positively associated with ADHD, and P, CO and SD would be negatively associated with ADHD. We also expected that both IA and HI would correlate positively with NS, and negatively with P and SD. In addition, IA would also correlate positively with HA, and HI would correlate negatively with CO.

2. Method

2.1. Participants

A total of 231 adults (140 females, $M = 31.29$, $SD = 10.97$; 91 males, $M = 30.25$, $SD = 9.53$; combined sample, 30.88 years, $SD = 10.42$, range = 18–50 years) were recruited in Australia through several sources from the State of Tasmania (see Section 2.3). The

mean age of females and males did not differ significantly, t (229) = 0.74, *ns*.

2.2. Measures

2.2.1. Temperament and character inventory (TCI-125)

Cloninger's temperament and character dimensions were assessed by a shorter 125-item version of the original 240-item version of the TCI (Cloninger et al., 1993). The TCI-125 was developed by selecting the better psychometric items from each of the 25 subscales of the longer version. The TCI-125 provides scores for all four temperament dimensions of NS (20 items), HA (20 items), RD (15 items) and P (5 items) and the three character dimensions of SD (15 items), C (25 items) and ST (15 items). Each item has a true–false response format (Cloninger, Przybeck, Svrakic, & Wetzel, 1994). The TCI-125 has been shown to have the same factor structure and associations with demographic characteristics as the longer version (TC1-240). In the current study, the Cronbach α values for NS, HA, RD and P were .65, .82, .66 and .69, respectively. They were .84, .61 and .76 for SD, C and ST, respectively.

2.2.2. Current Symptom Scale (CSS)

ADHD and ODD ratings were obtained using the Current Symptom Scale (CSS; Barkley & Murphy, 1998), which contains the 18 symptoms of ADHD and the 8 symptoms of ODD, all of which correspond closely with the list of ADHD and ODD symptoms specified in DSM-IV. Participants indicated how often they experienced each symptom over the past 6 months by circling a number from 0 to 3 (0 = "never or rarely", 1 = "sometimes", 2 = "often" and 3 = "very often"). In the current study, the Cronbach's α values for the IA and HI groups of symptoms were .82 and .75, respectively; and .81 for ODD.

For the entire sample, the mean (*SD*) scores for the IA and HI symptom groups were 5.45 (3.69) and 5.79 (3.58), 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, in press).

2.3. Procedure

Ethics approval was obtained from the University of Tasmania Human Ethics Research Committee. Participants were recruited from the general community, most from shopping centers (mainly as they entered or left supermarkets), sporting and recreational clubs (at set locations approved by management) and social groups for senior citizens (at set locations approved by management). Research assistants approached potential participants directly in these centers. The research assistants then explained the procedure. If interested in participating, they were given the questionnaires and a plain language statement about the study which asked participants to complete the questionnaire as quickly as possible, without spending too much time on any one question, and also to rate each item without assistance from friends, colleagues or others. Participants returned the questionnaire in prepaid envelopes or handed them to the experimenter. In all, around 350 questionnaires were distributed; resulting in a return rate of approximately 66%.

3. Results

Table 1 shows the zero-order correlations of ADHD, IA and HI with the dimensions of the TCI-125. As shown, ADHD correlated significantly and positively with NS and HI. It correlated significantly and negatively with RD, SD and CO. For IA, the results showed a significant positive correlations with HA, and a significant negative correlation with RD, SD and CO. The results for HI showed a significantly positive correlation with NS and HA, and significant negative correlation with RD, SD and CO.

Table 1
Means (*SD*) and partial correlations of the TCI-125 dimensions with ADHD, IA and HI.

	Correlations			
	ADHD	IA	HI	Mean (*SD*)
Novelty Seeking (NS)	.07 (.15*)	−.01 (.11)	.08 (.15*)	10.46(3.39)
Harm Avoidance (HA)	.24*** (.26***)	.35*** (.33***)	−.12 (.14*)	8.75 (94.47)
Reward Dependence (RD)	−.07 (−.21**)	.02 (−.17**)	−.10 (−.21***)	10.59 (3.08)
Persistence (P)	.00 (−.03)	−.19**(−.12)	.20**(0.07)	2.54 (1.65)
Self-Directedness (SD)	−.39*** (−.54***)	−.38*** (−.55***)	−.02 (−.42***)	17.37 (4.88)
Cooperation (CO)	−.00 (−.25***)	−.07 (−.25***)	.07 (−.20**)	20.19 (4.12)
Self-Transcendence (ST)	.16* (.11)	.07 (.09)	.09 (.11)	5.57 (3.64)
Mean (*SD*)	11.23 (6.54)	5.45 (3.69)	5.79 (3.58)	

Note: IA = inattention; HI = hyperactivity/impulsivity. For partial correlations, sex, age, HI and Opposition Defiant Disorder (ODD) were control for IA; and sex, age, IA and ODD were control for HI. Correlations in parenthesis are zero-order correlations.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 2
Standard β values of the regression analyses of ADH, IA and HI on the TCI-125 dimensions.

	ADHD	IA	HI
Covariates			
Sex	−.09	−.17**	.07
Age	.05	−.02	.07
Inattention (IA)	–	–	.44***
Hyperactivity/Impulsivity (HI)	–	.43***	–
Opposition Defiant Disorder (ODD)	.47***	.11	.37***
Temperament dimensions			
Novelty Seeking (NS)	.04	.00	.07
Harm Avoidance (HA)	.10	.16**	−.06
Reward Dependence (RD)	−.08	.04	−.12
Persistence (P)	.07	−.08	.15**
Character dimensions			
Self-Directedness (SD)	−.34***	−.26***	−.09
Cooperation (CO)	.08	.07	.09
Self-Transcendence (ST)	.06	.03	.03

* $p < .05$.
** $p < .001$.
*** $p < .001$.

Table 2 shows the standardized coefficients from the results of the standard multiple regression analyses. As can be seen, ADHD was predicted significantly and negatively by SD. IA was predicted significantly and positively by HA, and significantly and negatively by SD. HI was predicted significantly and positively by P.

4. Discussion

The pattern of results supports the continuum hypothesis of personality and ADHD in a community sample. For the zero-order correlations, ADHD correlated significantly and positively with NS and HA, and significantly and negatively with RD, SD and CO. These findings have generally been reported in past studies involving adults (Anckarsater et al., 2006; Downey et al., 1997; Faraone et al., 2001; Jacob et al., 2007; Lynn et al., 2005; Purper-Ouakil et al., 2010; Salgado et al., 2009; Sizoo et al., 2009; Smalley et al., 2009). The findings for the zero-order correlations for the ADHD

symptom domains showed that IA correlated significantly and positively with HA, and significantly and negatively with RD, SD and CO. The HI domain correlated significantly and positively with NS and HA, and significantly and negatively with RD, SD and CO. These findings have generally been reported in past studies involving adults (Lynn et al., 2005; Yoo et al., 2006).

To assess unique variance, after controlling for sex, age, ODD and IA and HI as appropriate, multiple regression analyses revealed: ADHD was predicted significantly and negatively by SD; IA was predicted significantly and positively by HA, and significantly and negatively by SD and HI was predicted significantly and positively by P.

These regression results have implications for understanding the role of environmental factors in the clinical presentation of ADHD, and for treatment and future research. Both SD and P are character dimensions. In Cloninger's theory of personality (Cloninger et al., 1993), social learning is assumed to influence the character dimensions, and these in turn are believed to moderate the temperament dimensions. Thus it can be speculated that ADHD is associate with past social learning related to low ability to control, regulate one's behaviour and also that interventions targeting the development of self-control skills through social learning would be useful treatment option. To date there has been little research on either the role of social learning in the development and progression of ADHD, or the impact of social self-control training in the management of ADHD. These are clearly important areas for future research.

The regression findings also have implications for understanding the behavioural, emotional and cognitive correlates of ADHD and its symptom domains. The finding that IA and overall ADHD are associated with lower ability to control, regulate and adapt one's behaviour to concur with existing situations to achieve one's goals and values (low SD) implies problems with impulsive responses arising from poor cognitive control processing skills. Since HI alone was associated with a higher tendency for impulsive types of responses (high P), it means that Hi is associated with perseverating in the presence of reward and failing to modulate attention and behaviour when reinforcement contingencies change. Although, these findings and interpretations are consistent with theories that suggest ADHD is related to impulsivity and response inhibition deficit (Barkley, 1997), they are also consistent with dual pathways models (Martel & Nigg, 2006; Sonuga-Barke, 2003) that link IA with cognitive control processing skills, and HI with poor reactive control processes (Martel & Nigg, 2006; Sonuga-Barke, 2003).

Cloninger's model has not developed at the same pace or extent as J.A. Gray's reinforcement sensitivity theory (RST) of personality (Gray & McNaughton, 2000; McNaughton & Corr, 2004; McNaughton & Corr, 2008), although the foundations of both models are highly similar. It is thus possible to interpret the results in terms of more recent formulations. This might give greater insight into the functional and neuropsychological bases of ADHD. In the original version RST (o-RST), personality is linked to two underlying neurobiological systems: the behavioural approach system (BAS) and the behavioral inhibition (BIS). The BAS, which underlies impulsivity, is sensitive to reward and non-punishment, and its activation increases approach behaviour. The BIS, which underlies anxiety, is sensitive to signals of punishment, frustrative non-reward and novelty, and its activation induces avoidance behaviour. According to Cloninger (1987), high NS and HA are comparable to high BAS and BIS, respectively. However the empirical data show that P (and not NS) is the index for the BAS (Mardaga & Hansenne, 2007; Zelenski & Larsen, 1999). Thus, the findings from the regression analyses of positive HA–IA and P–HI imply positive associations for BIS and IA and BAS and HI, respectively (Gomez & Corr, 2010).

The o-RST has been substantially updated by Gray and McNaughton (2000) and McNaughton and Corr (2004); (for a review see Corr, 2008). In the revised model (or r-RST), revised-BAS (r-BAS) is conceptualized as in o-RST. However, the revised-BIS (r-BIS) is linked to resolving goal conflicts, and to cognitive processes, such as attention and memory, involved in resolving conflicts. Reactions to all types of punishment are linked to 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. Seen through r-RST, the regression findings imply IA is related to FFFS (high HA) and HI is related to BAS (high P). SD reflects the ability to control, regulate and adapt one's behaviour to concur with existing situations to achieve one's goals and values. Since the major function of r-BIS is resolving conflicts, and as this requires the behaviours reflected in SD, it can be argued that SD indexes r-BIS activity. Therefore, the findings that both ADHD and IA are negatively associated with SD imply that ADHD and IA are linked to r-BIS.

The speculated associations of ADHD and IA with r-BIS suggest that ADHD and IA are associated with poor skills in resolving concurrent goal conflicts. Being unable to resolve goal conflicts should be expected to produce a failure to sustain attention on task-relevant stimuli by virtue of the BIS being engaged in (task-irrelevant) risk assessment which, in terms of symptoms, presents as distractibility and inattention to the task at hand. This chain of events can be expected to be increased further by high FFFS, which is also associated with IA. The positive associations speculated for IA with FFFS mean that IA is also associated with higher sensitive to signals of punishment, avoidance behaviour and fear response. The positive association speculated for HI with r-BAS means that HI is associated with higher sensitive to signals of reward, approach behaviour and impulsive response.

In concluding, although the findings are generally consistent with existing data, they also extend existing data. This is the first study to examine the relationships of the TCI dimensions with IA and HI among adults in a non-clinical community sample. As there would be a wider range in levels of ADHD, temperament and character in such samples (compared to clinical samples), the findings here provide a broader and therefore better understanding of the relation between Cloninger's model and ADHD. In addition, as the effects of sex, age, ODD, HI (for the prediction of IA), and IA (for the prediction of HI) were controlled in the analyses, the findings here can be taken as providing more reliable findings.

Despite these positive study qualities, there are also limitations. First, as all measures involved self-ratings, it may be possible that the findings were confounded by common method variance. Secondly, as this was a cross-sectional study, the findings show only associations and not causal relations. Thirdly, as ethics approval for this study did not permit collection of information about individuals prior to inviting them to participate, there is no information about those who did not respond to the invitation to participate in this study (approximately 34%), and therefore how this impacted the results. It will be useful for future studies to conduct more studies in this area, taking into consideration these limitations.

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