

Relationships between Cloninger's biosocial model of personality and the behavioral inhibition/approach systems (BIS/BAS)

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Abstract

Novelty seeking and harm avoidance are two major temperamental dimensions from the Cloninger's biosocial model of personality that are theoretically related to Gray's behavioral approach system (BAS) and behavioral inhibition system (BIS), respectively. The revised version of the temperament and character inventory (TCI-R) and the Carver and White BIS/BAS scales were developed to assess these constructs. Despite the theoretical relationships between the two models, no study investigated the associations between these scales. Therefore, the aim of this study was to explore the relationships between the TCI-R and the BIS/BAS scales. A total of 150 healthy participants (75 females) completed the BIS/BAS scales and the TCI-R. Results showed that harm avoidance and reward dependence were good predictors of BIS, whereas persistence and novelty seeking were good predictors of BAS, when age and gender were controlled. This study supports the theoretical links between BIS and harm avoidance, and between BAS and novelty seeking, and extends these links to other Cloninger's dimension.

Keywords: Cloninger ; Gray ; TCI-R ; BIS/BAS scales

1. Introduction

Gray's reinforcement sensitivity theory (RST) is based on the existence of three independent (but interacting) emotional systems in the central nervous system that underlie motivated behavior: the behavioral approach system (BAS), the behavioral inhibition system (BIS) and the fight-flight-freezing system (FFFS) (Gray & McNaughton, 2000). The BAS is activated by conditioned and unconditioned signals of reward or relief from punishment, and it mediates approach behavior. The FFFS is activated by unconditioned, innate, and conditioned aversive signals, and it mediates escape behaviors. The BIS is responsible for inhibition or interruption of the ongoing behavior, and is activated when conflicting goals are concurrently presented (competition between two approach, or approach and avoidance behaviors), giving rise to an anxiety response (Corr, 2002; Gray & McNaughton, 2000). BAS would be involved in the experience of positive affects, and FFFS in the experience of negative ones (fear), in response to related cues, while BIS is involved in anxiety states. Furthermore, BIS and BAS sensitivity differences within individuals were proposed to account for personality differences: BAS give rise to what is called Impulsivity dimension, and BIS is linked to Anxiety dimension (i.e., predisposition to feel anxiety) (Corr, 2004; Gray, 1970). Although the predictions regarding personality-emotions relationships from Gray's recently revised model (Gray & McNaughton, 2000) have still to be clarified, the previously advanced relations between positive affects sensitivity and BAS and between negative affects sensitivity and BIS (jointly with FFFS) seem to remain generally relevant (Corr, 2002, 2004). Thus, high-BAS (impulsive) subjects would typically experience positive affects, while high-BIS (anxious) subjects would preferentially experience negative affects.

The BIS/BAS scales were developed by Carver and White (1994) to assess personality dimensions derived from Gray's RST (i.e., individual differences in BIS and BAS sensitivities), and consists of a BIS scale and three BAS subscales: reward responsiveness (RR), drive (Dr) and fun seeking (FS); RR focus on the positive affects following a reward or when anticipating a reward, Dr represents the persistent pursuit of desired goals, and FS refers to impulsive approach of potential rewards and sensation seeking. Several studies confirmed the factorial structure and the validity of the BIS/BAS scales (Carver & White, 1994; Heubeck, Wilkinson, & Cologon, 1998; Jorm et al., 1999). Although other scales were created to assess BIS and BAS sensitivities (e.g., Torrubia, Ávila, Moltó, & Caseras, 2001), Carver and White's BIS/BAS scales are the most widely used in studies investigating the relationships between personality and emotions (and more particularly when predictions are directly derived from BIS and BAS theoretical foundations) (Carver, 2004; Gable, Reis, & Elliot, 2000; Gomez & Gomez, 2002; Heponiemi, Keltikangas-Järvinen, Puttonen, & Ravaja, 2003; Ravaja, 2004; Reuter et al., 2004).

Cloninger and his colleagues proposed a psychobiological personality model, which is widely used in clinical research (e.g., Ball, Smolin, & Shekhar, 2002; Basiaux et al., 2001; Cloninger, 2000; Cloninger, Svrakic, & Przybeck, 1993; Eklund, Hansson, & Bengtsson-Tops, 2004; Hansenne et al., 1999; Le Bon et al., 2001). This model comprised four innate temperamental dimensions (novelty seeking, harm avoidance, reward dependency

and persistence), and three acquired character dimensions (self-directedness, cooperation and self-transcendence) (Cloninger, 1987; Cloninger et al., 1993). Briefly, novelty seeking (NS) is the tendency to respond actively to novel stimuli leading to pursuit of rewards and escape from punishment. Harm avoidance (HA) is the tendency to inhibit responses to signals of aversive stimuli that lead to avoidance of punishment and non-reward. Reward dependence (RD) is the tendency for a positive response to conditioned signals of reward that maintain behavior. Persistence (Ps) is perseverance despite frustration and fatigue. Self-directedness (SD) is the ability of an individual to control, regulate and adapt his or her behavior to fit the situation in accord with individually chosen goals and values. Cooperativeness (C) accounts for individual differences in identification with and acceptance of other people. Self-transcendence (ST) is associated with spirituality. More particularly, NS and HA are two major temperamental dimensions defined as responsible for activation and inhibition of behaviors, respectively (Cloninger, 1987). Thus, they explicitly refer to BAS and BIS in their theoretical foundations. The neurobiological bases of NS and HA also reflect the proximity with BAS and BIS respectively, and were largely validated (e.g., Ebstein, Benjamin, & Belmaker, 2003; Gerra et al., 2000; Hansenne & Ansseau, 1999; Hansenne et al., 2002). Cloninger's dimensions are assessed by the 240-item self-questionnaire Temperament and Character Inventory, revised (TCI-R, Cloninger, 1999).

Zelenski and Larsen (1999) reported the results of a factor analysis run with multiple personality scales (including the BIS/BAS scales and the TCI). The analysis yielded three factors: an impulsivity factor (that included NS and FS dimensions), a punishment sensitivity factor (that included HA and BIS dimensions), and a reward sensitivity factor (that included RR, Dr and Ps dimensions). Moreover, two studies (Carver & White, 1994; Caseras, Ávila, & Torrubia, 2003) investigated the relationships between Gray's model (as measured by the Carver and White BIS/BAS scales) and Cloninger's dimensions. They both found positive correlations between BIS and both HA and RD, between NS and FS, between RR and RD, and negative correlations between HA and both Dr and FS subscales. However, both of them used the Tridimensional Personality Questionnaire (TPQ) as a measure of Cloninger's model that measures the dimensions of the Cloninger's model previous version, the major difference with the TCI-R being the absence of Ps and character dimensions. Taken together, these results confirm the relationship between Cloninger's and Gray's models.

Thus, in spite of the theoretical proximity of Gray's and Cloninger's models, no study investigated the associations between the TCI-R and the BIS/BAS scales. Therefore, the aim of this study was to confirm the theoretical relationships between NS and BAS and between HA and BIS dimensions, thus replicating the results from previous studies, and to extend these results to other Cloninger's dimensions.

2. Methods

The study was conducted on a sample of 150 participants (75 females), with ages ranging from 18 to 28 years (mean = 22.4, SD = 2.4). Most of them were undergraduate students. Participants completed a French version of the Carver and White (1994) BIS/BAS scales (translation and validation of the French version were performed by Van der Linden, M., unpublished) and the 240-item self-questionnaire TCI-R (Cloninger, 1999; Hansenne, Delhez, & Cloninger, 2005) the same day, alone in a quiet room. The BIS/BAS scales contains 24 items (including 4 distracter-items), measuring BIS (7 items regarding reactions to the anticipation of punishment) and three BAS subscales: RR (5 items relative to positive affects following a reward or when anticipating a reward), Dr (4 items relative to persistent pursuit of desired goals), and FS (4 items relative to impulsive approach of potential rewards and sensation seeking).

All statistical analyses were performed with Statistica (6.0) for Windows. Gender differences were investigated with Student's *t*-tests regarding BIS/BAS scales scores. Pearson's correlations were conducted between the BIS/BAS scales, with Bonferroni correction applied to interpretation of α values. Stepwise forward regressions were conducted on BIS and BAS as the dependent variable, with age and gender forced in the regressions, and the TCI-R dimensions entered as independent variables.

3. Results

Student's *t*-tests showed significantly higher BIS and RR scores in women than men, and no gender difference regarding other scores (Table 1).

Results of Pearson's correlations between BIS/BAS scales are presented in Table 2. Significant positive correlations appeared between BAS and the three BAS subscales (RR, Dr and FS), as well as between these three subscales, and a negative correlation appeared between BIS and FS. The positive correlation between BAS and RR, Dr and FS was significant in both genders, whereas the positive correlation between FS and Dr and RR and Dr, as well as the negative correlation between BIS and Dr only reached statistical significance among men, and the positive correlations between RR and both BIS and Dr reached statistical significance in women only.

Table 1 Mean, SD, and Student's t-test between genders for BIS/BAS scales

	Female (N = 75)	Male (N = 75)	$t_{(df=148)}$	p
BIS	22.6 ± 3.1	19.1 ± 4.0	6.13	<0.0001
Reward responsiveness	16.8 ± 1.8	15.6 ± 2.9	2.85	0.005
Drive	11.5 ± 1.7	11.3 ± 2.0	0.53	0.60
Fun seeking	11.5 ± 1.9	11.8 ± 2.5	-0.92	0.36
BAS	39.7 ± 3.7	39.0 ± 5.7	0.92	0.36

Table 2 Pearson's correlations between BIS/BAS scales. Significant associations in bold ($p < 0.05$)

	BIS	RR	Dr	FS
Male (N = 75)				
Female (N = 75)				
All (N = 150)				
Reward responsiveness	0.02			
	0.32	-		
	0.20			
Drive	-0.35	0.23		
	0.12	0.33	-	
	-0.13	0.26		
Fun seeking	-0.27	0.34	0.65	
	-0.20	0.15	0.17	-
	-0.26	0.25	0.46	
BAS	-0.22	0.52	0.83	0.88
	0.11	0.71	0.70	0.66
	-0.07	0.57	0.78	0.79

The results of the hierarchical/stepwise regressions are presented in Table 3. BIS score was best predicted by HA and RD dimensions, and BAS score by P and NS, when age and gender were controlled.

Table 3 Stepwise regression analysis showing predictions of BIS and BAS scores by age and gender (forced), and TCI-R dimensions

Predictors	β	Overall model F	Adj. r^2
<i>BIS</i>			
Age	-0.07	46.73	0.55
Gender	-0.11		
HA	0.61		
RD	0.29		
<i>BAS</i>			
Age	-0.16	16.40	0.29
Gender	-0.03		
P	0.40		
NS	0.39		

Significant F and β in bold ($p < 0.05$).

4. Discussion

The purpose of the present study was to examine relationships between Carver and White (1994) BIS/BAS scales and Cloninger's TCI-R (1999). As expected, BIS score was predicted by HA score (jointly with RD score). This is congruent with HA definition as responsible for inhibition of behaviors (Cloninger, 1987), as well as with former correlation studies between the BIS/BAS scales and the TPQ (Carver & White, 1994; Caseras et al., 2003). Moreover, Corr, Pickering, and Gray (1995) and Caseras et al. (2003), conducting correlations between the TPQ and the Eysenck personality questionnaire (EPQ), found that HA correlated positively with neuroticism and negatively with extraversion (HA = N + E—), which situates HA in the same place as BIS within the Eysenckian personality space (Gray, 1970).

As expected, BAS score was predicted by NS, consistently with NS definition as responsible for activation of behaviors (Cloninger, 1987), as well as with Carver and White (1994) and Caseras et al. (2003) studies. BAS was also predicted by Ps score. The implication of Ps in the BAS scale may be due to the proximity of this dimension to Dr BAS subscale, as both Ps and Dr dimensions are defined as the tendency to persistent pursuit of desired goals (Carver & White, 1994; Cloninger et al., 1993).

On the other hand, the prediction of BIS and not BAS scale by RD observed here is not congruent with Corr et al. (1995) and Caseras et al. (2003) findings showing that RD correlated positively with both extraversion and neuroticism ($RD = E + N+$), which situates this dimension close to BAS. However, it must be noted that these studies used the TPQ, in which Ps was included in the RD dimension, whereas RD measured by the TCI-R does not include Ps anymore, but mostly refers to the social aspect of reward (i.e., sentimentality, sensitivity to social approval) (Cloninger et al., 1993). Thus it might be argued that the Ps subscale accounted for the involvement of the RD dimension in the BAS scale, and conversely that social aspects of reward are not involved in behavioral approach but in behavioral inhibition. The emergence of RD as a good predictor for BIS may be due to the fact that high-RD subjects may be sensitive to reward as well as to punishment indices in social contexts, as they were originally defined as dependent upon approval, and sensitive to rejections and criticisms (Cloninger et al., 1993). Moreover, some BIS items (e.g., "Criticism or scolding hurts me quite a bit") precisely refer to social aspects of punishment.

Thus, regarding behaviors, the present results suggest that HA and RD consist in inhibitory influence, while Ps and NS dimensions consist in different aspects of activating influence. Unfortunately, the present results do not address Gray's third emotional system, the FFFS, as it was not included in Carver and White BIS/BAS scales.

No Cloninger's model character dimension predicted for either BIS or BAS. The three character dimensions refer to acquired aspects of personality, related to learning and environment, with SD, C and ST referring to individual, social and spiritual achievement, respectively (Cloninger et al., 1993). Although their influence on behaviors are a function of temperamental basis, so that they modulate the expression of temperaments, they are theoretically independent from the innate part of personality. The lack of relationship between Cloninger's character dimensions and the BIS/BAS scales reported here give some support to Cloninger's distinction between innate (i.e., temperaments) and acquired (i.e., characters) aspects of personality, with only temperamental dimensions being related to the innate and neurobiologically-based BIS and BAS.

Regarding BIS-BAS inter-correlations, it should be noticed that the negative correlation between BIS and Dr was observed in men but not in women. As well, RR-BIS positive correlation was significant in women, but not in men. Conversely, FS-BIS correlations were very similar in both genders. These results suggest that BIS and some BAS dimensions may interact differently within men and women, so that in men BIS and BAS would tend to be somehow antagonistic systems, while they seem quite orthogonal in women, more consistently with Gray's theory (Corr, 2004). This might be due to the fact that as men generally have lower BIS scores (so that men are probably socially expected to be less anxious), the higher BIS males may feel and describe themselves as lower BAS (namely, lower Dr and RR) than they actually are, while women who are expected to be higher BIS would not feel anxiety as such an impediment in BAS-related behaviors. The present result of a positive RR-BIS correlation was recently reported by Franken and Muris (2006), within a mostly feminine sample (8.5% males), which is congruent with the fact that this correlation reached significance in women only in the present study.

Finally, women showed higher BIS scores than men. This result is consistent with Caseras et al. (2003) and Jorm et al. (1999) results, as well as with results regarding neuroticism (Costa, Terracciano, & McCrae, 2001) and Cloninger's HA (Hansenne et al., 2005). As well, RR scores were higher in women than men, consistently with Jorm et al. (1999) results; these authors argue that this gender difference "*may be due to the fact that [RR] has some neuroticismlnegative affectivity component (on which females tend to score higher)*". Recent finding from Franken and Muris (2006) of a positive correlation between RR and BIS scales (that was replicated within women in the present study) gives support to this interpretation.

In conclusion, the present results support the theoretical links between Cloninger's and Gray's personality models as well as previous findings based on the TPQ, and extend these links to persistence and character dimensions.

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