# A closer look at Carver and White's BIS/BAS scales: Factor analysis and age group differences

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# A Closer Look At Carver and White's BIS/BAS Scales: Factor Analysis and Age Differences


**Abstract**

The Behavioural Inhibition and Behavioural Activation System (BIS/BAS) scales were developed by Carver and White (1994) and comprise four scales which measure individual differences in personality (Gray 1982, 1991). More recent modifications, namely the five-factor model derived from Gray and McNaughton's (2000) revised Reward Sensitivity Theory (RST) suggests that Anxiety and Fear are separable components of inhibition. This study employed exploratory and confirmatory factor analyses on the scales in order to test whether the four or five-factor model was the better fit in a sample of 994 participants aged 11-30 years. Consistent with RST, superior model fit was shown for the five-factor model with all variables correlated. Significant age effects were observed for BIS Fear and BIS Anxiety, with scores peaking in middle and late adolescence respectively. The BAS subscales showed differential effects of age group. Significantly increasing scores from early to mid and from mid to late adolescence were found for Drive, but the effect of age on Fun Seeking and Reward Responsiveness was not significant.



**Key Words:** Reinforcement Sensitivity Theory; BIS/BAS scales; Factor Analysis; Adolescence;

## 1. Introduction

Gray (1982, 1991) proposed the Behavioural Inhibition System (BIS) and the Behavioural Activation System (BAS) as key components of what later was termed the Reinforcement Sensitivity Theory (RST) of individual differences in personality (Pickering, Diaz, & Gray, 1995). Generally speaking, the BIS is understood to be characterised by inhibitory responses in circumstances where cues signalling aversive consequences are present whereas the BAS system is characterised by responding to cues of reward, escape, and avoidance. Greater BIS sensitivity has been suggested as reflecting greater propensity toward anxiety disorders (Carver & White, 1994), whereas heightened reward sensitivity has been invoked to explain adolescent risk taking behaviours such as alcohol and drug use, and the development of psychopathology (Bijttebier, Beck, Claes, & Vandereycken, 2009). Individual differences in this respect are thus an area of continued importance to disentangle the mechanisms associated with elevated risk of problem behaviour during adolescence.

Carver and White (1994) developed measures of BIS/BAS systems and performed exploratory factor analysis of their scale items, using a sample of 732 college students (51.1% female). Through examination of the factor structures of their measures and as derived from the latent variables detected, they were ultimately able to break BAS down into three subscales: Fun Seeking, Drive, and Reward Responsiveness. Reward Responsiveness refers to a positive reaction to or anticipation of a reward, Drive to the relentless pursuit of desired goals, and Fun Seeking to the desire and tendency to impetuously approach a potential reward. Although the BIS/BAS scales tend to significantly correlate with one another in adult studies, patterns, and particularly strengths, of relationships differ across studies.

Research on reinforcement sensitivity theory (RST) has only recently expanded from adulthood into childhood and adolescence (Colder & O‘Connor, 2004; Cooper, Gomez, & Aucote, 2007; Urošević, Collins, Muetzel, Lim, & Luciana, 2012). In a cross sectional sample aged 9-23 years, Urošević et al. (2012) found overall increases in all BIS/BAS measures from early (9-12 years) to late adolescence (13-17 years) and early adulthood (18-23 years). By contrast, longitudinally, there was evidence for decline in the young adult group in Reward Responsiveness across the two year follow-up period, which the authors acknowledged may represent age-cohort effects. BIS/BAS developmental changes were associated with developmental changes in reward sensitivity related brain structures, including the orbitofrontal cortex and nucleus accumbens (Urošević et al., 2012). Consistent with previous research (Carver & White, 1994; Jorm et al., 1998), Urošević et al. also reported greater BIS scores for females, as well as greater rates of BIS sensitivity with increasing age. Sex differences in BAS sensitivities are much more varied and the question remains as to whether sex differences in BIS/BAS sensitivity are developmentally consistent or whether differences appear and disappear throughout different developmental stages.

The Carver and White scales are a popular measure of reinforcement sensitivity, though the superiority of any single factor model of BIS/BAS has yet to be agreed upon (Demianczyk, Jenkins, Henson, & Conner, 2014; Corr, 2016). Some researchers propose that BIS/BAS scales, which were originally developed for adults, are appropriate for use in children and adults alike (Colder & O' Connor, 2004; Cooper, Gomez, & Aucote, 2007) and there is greater accord that they are appropriate for use with adolescents (Cooper et al., 2007; Urošević et al., 2012). Essentially, the question does remain whether the Carver and White (1994) BIS/BAS scales are accurately measuring the constructs they were designed to and whether they are measuring the same precise construct in participants of varying demographic characteristics. Problems with the factor structure of the BIS/BAS scales have been noted (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Demianczyk et al., 2014; Jorm et al., 1998), particularly in the BIS scale (see Poythress et al., 2008). Gray and McNaughton's (2000) proposal that Anxiety and Fear are separable dimensions of threat sensitivity is consistent with the finding that self-report measures of Trait Anxiety and Fear accounted for more variance than total BIS scores in a behavioural measure of threat sensitivity (Perkins, Kemp & Corr, 2007). Finally, it has been suggested that the BIS, Drive, and Fun Seeking subscales of the Carver and White (1994) BIS/BAS scales are inadequate for measurement of moderately high to high levels of BIS/BAS sensitivity (Gomez, Cooper, & Gomez, 2005), as might be expected in adolescent populations.

Research examining the factor structure of these scales, drawing age comparisons between early adolescents and adults is sparse at best, though Cooper et al. (2007), who supported the comparability of the BIS/BAS scales for adolescents and adults, came notably close with a sample of adolescents aged 12-16 and adults aged 21-40. In this study, we will assess the goodness of fit of the Carver and White (1994) model, and then explore the age and sex effects on each of the subscales.

## 2. Method

### *2.1 Participants*

The sample was composed of 994 males and females (58.4% female), aged 11-30 years. Data was then split into four developmental categories: early adolescence (age 11-13, *n* = 431, 53.1% female), mid-adolescence (age 14-16, *n* = 363, 54.8% female), late adolescence (age 17-22, *n* = 120, 76.7% female) and adulthood (age 23-30, *n* = 80, 76.3% female).

### *2.2 Measures*

*2.2.1 The BIS/BAS Scales (Carver & White, 1994).* These scales include 20 items: seven items measure Behavioural Inhibition, four items measure Drive, four measure Fun Seeking and five measure Reward Responsiveness.

### *2.3 Procedures*

Participants were recruited from an opportunity sample of school and university students in Northern Ireland. An electronic survey was administered via Survey Gizmo which contained items from the BIS/BAS scales utilised here, as well as participant information, consent, and additional measures collected as part of an ongoing developmental study. Parental consent (for adolescents) and participant consent was gained prior to participation in the survey and all responses were anonymous. Ethical approval was granted by the Local University Research Ethics Committee.

### *2.4 Statistical Approach*

*2.4.1 Preliminary analyses.* Data was analysed using IBM SPSS Statistics for Windows Version 21. Internal consistency, skewness, and kurtosis were first inspected to verify the overall normality and suitability of the data. Exploratory factor analyses (EFA) were performed using IBM SPSS and, for confirmatory factor analyses (CFAs), IBM SPSS Amos Version 20 (Arbuckle, 2012) was used to further assess model fit. EFAs were performed with principal axis factoring extraction and oblique rotation; chosen to be consistent with the procedure employed by Carver and White (1994). Two-way MANOVA was then conducted with sex and age as between-subject factors and BIS/BAS measures (mean scale item scores) as dependent variables.

*2.4.2 Model Comparisons.* Several measures of goodness of fit were utilised in the CFAs of the BIS/BAS models, the first of which being the chi-squared value. Here, a non-significant chi-squared value would be indicative that the proposed model appropriately fits – i.e. is supported by – the data. However, as large sample sizes often cause chi-squared tests to be significant, the chi-squared value is divided by the degrees of freedom in order to determine how suitable the model is; a quotient of 3 or less is considered generally indicative of good model fit (Carmines & McIver, 1981). The Root Mean Square Error of Approximation (RMSEA; Steiger, 1990) was calculated to concur with these results and to further assess whether each item for each scale belongs where it is and the scales interrelate as proposed. RMSEA values of ≤ .06 are indicative of desirable model fit, with of ≤ .08 being indicative of reasonable fit between the model structure as per the BIS/BAS design, and the model proposed by the observed data (Byrne, 2013; Hu & Bentler, 1999). The Comparative Fit Index (CFI; Bentler, 1990) and the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973) values were also calculated to further assess and verify model fit. CFI and TLI values of ≥ .90 signify acceptable model fit, with values of ≥ .95 being indicative of good fit (Hu & Bentler, 1999). Finally, the Expected Cross Validation Index (ECVI) values were calculated along with 90% confidence intervals. These values offer a comparative evaluation of multiple models, with lower values being indicative of relatively superior fit (Browne & Cudeck, 1993).

In following similar factor analytic research on the BIS/BAS scales, efforts were made to make alterations to the BIS/BAS scales, such that indices of model fit could be compared in order to identify the superior model design for the scales for different demographics. The two modification comparisons, drawn from previous research on these scales and further suggested by the results of exploratory principal axis factor analysis, included assigning the reverse-coded items to their own second BIS variable, labelled BIS-F as the items represent Fear. The remaining five items, representing Anxiety, are labelled BIS-A. This five-factor model is tested whilst then constraining the two BIS variables to be uncorrelated to the three BAS variables for one model and having the five variables correlated in the other model.

## 3. Results

Cronbach's alpha values for BIS (α = .72), Drive (α = .80), Fun-Seeking (α = .71), and Reward Responsiveness (α = .80) were within an acceptable range and were even slightly higher than Carver and White's original range of .66 to .74 (Carver & White, 1994). The two reverse-coded items in the BIS scale were shown as problematic in terms of their effect on the Cronbach's alpha value of this scale and this held for all groups when the data was split by sex and age.

### *3.1 Factor Analysis*

EFAs revealed that each item loaded most strongly to its intended scale, for both sexes and throughout the age span discussed here, with the exception of the two reverse-coded BIS items. These items were calculated to belong to a separate fifth factor in which these two items were the only content. The Kaiser-criterion, parallel analysis and scree plot all suggested retaining a five-factor model which provided a parsimonious fit with all items loading on one factor and no cross-loading. CFAs were then performed on the original four--factor Carver and White (1994) model and the two five-factor modification comparisons. The fit indices for model comparisons are shown on Table 1. CFAs showed that the factor structure of the BIS/BAS scales did not acceptably fit the data with the model design proposed by the scales' authors. For the total sample, the five-factor model with all variables correlated was shown to be a superior fit, as highlighted with significant nested likelihood ratio difference tests ($\chi^2$ (4) = 45.1, p < .001; $\chi^2$ (6) = 156.96, p < .001), ECVI values 8 to 20 points lower than competing models and (albeit slightly) lower values of RMSEA, CFI & TLI. Factor loadings for this superior model are shown on Table 2.

Table 1 Fit Indices for Model Comparisons

| Group | Model | $\chi^2$ (df) | $\chi^2$/df Quotient | RMSEA [90% CI] | TLI | CFI | ECVI [90% CI] |
|---|---|---|---|---|---|---|---|
| Total Sample | | | | | | | |
| | Original Model | 735.27 (164) | 4.48 | .059 [.055, .064] | .88 | .90 | .83 [.75, .92] |
| | Five-Factor BIS and BAS Uncorrelated | 690.17 (166) | 4.16 | .056 [.052, .061] | .90 | .91 | .78 [.71, .87] |
| | Five-Factor All Correlated | 578.31 (160) | 3.61 | .051 [.047, .056] | .91 | .93 | .68 [.61, .76] |
| Females | | | | | | | |
| | Original Model | 617.51 (164) | 3.77 | .069 [.063, .075] | .85 | .87 | 1.22 [1.10, 1.36] |
| | Five-Factor BIS and BAS Uncorrelated | 551.62 (166) | 3.32 | .063 [.057, .069] | .87 | .89 | 1.10 [0.99, 1.23] |
| | Five-Factor All Correlated | 490.24 (160) | 3.06 | .060 [.054, .066] | .89 | .90 | 1.02 [0.91, 1.14] |
| Males | | | | | | | |
| | Original Model | 321.12 (164) | 1.96 | .048 [.040, .056] | .92 | .93 | 1.00 [0.89, 1.14] |
| | Five-Factor BIS and BAS Uncorrelated | 332.46 (166) | 2.00 | .049 [.042, .057] | .91 | .92 | 1.02 [0.90, 1.16] |
| | Five-Factor All Correlated | 282.27 (160) | 1.76 | .043 [.035, .051] | .93 | .94 | 0.93 [0.82, 1.05] |

*Note.* RMSEA: Root Mean Square Error of Approximation, TLI: Tucker-Lewis Index, CFI: Comparative Fit Index, ECVI: Expected Cross Validation Index.

Table 2

*BIS/BAS Scale Factor Loadings*

| | BIS-A | BIS-F | Drive | Fun Seeking | Reward Responsiveness |
|---|---|---|---|---|---|
| Q1 | .61 | | | | |
| Q2 | .76 | | | | |
| Q3 | .66 | | | | |
| Q4 | .73 | | | | |
| Q5 | | .42 | | | |
| Q6 | .76 | | | | |
| Q7 | | .60 | | | |
| Q8 | | | .72 | | |
| Q9 | | | .71 | | |
| Q10 | | | .66 | | |
| Q11 | | | .53 | | |
| Q12 | | | | .53 | |
| Q13 | | | | .69 | |
| Q14 | | | | .64 | |
| Q15 | | | | .54 | |
| Q16 | | | | | .73 |
| Q17 | | | | | .69 |
| Q18 | | | | | .61 |
| Q19 | | | | | .73 |
| Q20 | | | | | .66 |
| | | | | | |
| BIS-A | | | | | |
| BIS-F | .18* | | | | |
| Drive | .11 | -.21* | | | |
| Fun Seeking | .19** | -.46*** | .43*** | | |
| Reward Responsiveness | .29*** | -.17* | .38*** | .51*** | |

*Note.* Five-factor model with all variables correlated. Inter-variable correlations given at the bottom of the table. All factor loadings significant ($p < .001$). *$p < .05$. **$p < .01$. ***$p < .001$.

When split by sex, poor fit was achieved overall for females in each model, though the five-factor model with all variables correlated was still better than the other models. Males, conversely, had adequate fit for each of the models tested and the five-factor model with all variables correlated was again the optimal model. Additional CFAs were also performed for each of the individual age groups and the results repeated the hierarchy of fit across models.

*3.2 MANOVA*

A two-way MANOVA was conducted with sex and age as between-subject factors and BIS-F, BIS-A, Drive, Fun Seeking, and Reward Responsiveness as dependent variables. It was revealed that both sex (Pillai’s Trace = .07, $F$ (5, 982) = 14.46, $p$ < .001, $\eta_p^2$=.069) and age (Pillai’s Trace = .11, $F$ (15, 2952) = 7.46, $p$ < .00, $\eta_p^2$=.037) showed significant group differences throughout the sample. There was a statistically significant multivariate interaction between sex and age group on the subscales (Pillai’s Trace = .05, $F$ (15, 2952) = 3.29, $p$ < .001 $\eta_p^2$= .016), suggesting the effect of age group differed for males and females, on at least some of the subscales.

The data for males and females at each of the age groups is presented in Table 3. A note of caution is warranted regarding the interpretation of the provided data for the female sample given the problems with model fit. Here, it is provided for juxtaposition purposes, as the influence of the uneven group size and sexual characteristics is unknown. For BIS-A, males had lower scores than females at each age group (main effect for sex ($F$ (1, 986) = 62.57, $p$ < .001, $\eta_p^2$= .06). The main effect for age was also significant ($F$ (3, 986) = 8.63, $p$ < .001, $\eta_p^2$= .03), as was the sex by age interaction ($F$ (3, 986) = 3.32, $p$ < .05, $\eta_p^2$=.01). Separate MANOVAs for males and females showed a much larger effect size for females ($\eta_p^2$=.06) than males ($\eta_p^2$=.02). Post-hoc LSD tests showed that for females, the early adolescent group scored significantly lower than all the other groups ($p$<0.0001 for all comparisons), whereas for males, there was a significant increase in scores between the early adolescent and the late adolescent groups ($p$=.04), and a significant decrease in scores between the late adolescent and young adult group ($p$=.02).

Table 3

*Descriptive Statistics for Sex and Age for each of the BIS/BAS factors*

| | | BIS-A[ab] | | BIS-F[b] | | Drive[b] | | Fun Seeking[a] | | Reward Responsiveness | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Group | Scale | M | SD | M | SD | M | SD | M | SD | M | SD |
| Males | | | | | | | | | | | |
| | Age 11-13 | 2.56 | 0.65 | 2.52 | 0.66 | 2.40 | 0.61 | 2.82 | 0.54 | 3.30 | 0.57 |
| | Age 14-16 | 2.66 | 0.56 | 2.65 | 0.64 | 2.55 | 0.65 | 2.80 | 0.47 | 3.28 | 0.45 |
| | Age 17-22 | 2.81 | 0.54 | 2.60 | 0.55 | 2.67 | 0.56 | 2.93 | 0.41 | 3.30 | 0.50 |
| | Age 23-30 | 2.38 | 0.63 | 2.50 | 0.55 | 2.75 | 0.54 | 2.93 | 0.43 | 3.29 | 0.52 |
| Females | | | | | | | | | | | |
| | Age 11-13 | 2.81 | 0.63 | 2.90 | 0.60 | 2.24 | 0.54 | 2.66 | 0.51 | 3.34 | 0.50 |
| | Age 14-16 | 3.04 | 0.51 | 2.97 | 0.63 | 2.42 | 0.57 | 2.77 | 0.57 | 3.31 | 0.42 |
| | Age 17-22 | 3.13 | 0.50 | 2.67 | 0.82 | 2.63 | 0.57 | 2.80 | 0.54 | 3.39 | 0.43 |
| | Age 23-30 | 3.13 | 0.56 | 1.92 | 0.59 | 2.67 | 0.57 | 2.79 | 0.58 | 3.41 | 0.43 |
| Total | | | | | | | | | | | |
| | Age 11-13 | 2.69 | 0.65 | 2.72 | 0.66 | 2.32 | 0.58 | 2.74 | 0.53 | 3.32 | 0.53 |
| | Age 14-16 | 2.87 | 0.56 | 2.82 | 0.65 | 2.48 | 0.61 | 2.78 | 0.53 | 3.30 | 0.44 |
| | Age 17-22 | 3.06 | 0.52 | 2.66 | 0.77 | 2.64 | 0.57 | 2.83 | 0.51 | 3.37 | 0.45 |
| | Age 23-30 | 2.96 | 0.65 | 2.06 | 0.63 | 2.69 | 0.56 | 2.83 | 0.55 | 3.39 | 0.45 |

*Note.* [a] Significant sex differences were found. [b] Significant age differences were found (see text for explanation of differences).

For BIS-F, the main effect of sex was not significant. The main effect for age was significant ($F$ (3, 986) = 14.52, $p$ < .001 $\eta_p^2$=04), as was the sex by age interaction ($F$ (3, 986) = 10.01, $p$ < .001, $\eta_p^2$=.03). This interaction is explained by the lack of a significant age effect for males, whereas the age effect for females was significant ($F$ (3, 577) = 43.66, $p$ < .001 $\eta_p^2$=06). Post hoc LSD tests showed that for females, the decline in scores between mid-adolescence and late adolescence and further from late adolescence to young adulthood was significant ($p$ < .001 for all).

A significant effect of age group was detected for Drive ($F$ (3, 986) = 13.79, $p$ < .001, $\eta_p^2$= .04), but neither the sex effect, nor the sex by age interaction was significant. Post hoc

LSD tests confirmed that for both males and females there was a significant increase in scores from early to mid-, and from mid- to late adolescence ($p < 0.01$ for all).

Males had higher Fun Seeking scores than females ($F$ (1, 986) = 5.56, $p < .05$, $\eta_p^2$=.006), but the age effect, nor the age by sex interaction was not significant. Reward Responsiveness showed no significant age, sex or interaction effects.

## 4. Discussion

The EFAs conducted here largely supported the five-factor model of the BIS/BAS scales and is consistent with Gray and McNaughton's (2000) proposition that Anxiety and Fear are separate aspects of negative emotionality. Reliability analysis revealed the two reverse coded items adversely affected both the factor structure and the internal consistency of the scale, which is commonly found (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Cooper, Gomez, & Aucote, 2007), though it is unclear whether this is due to their content or their coding. The CFAs further supported the five-factor. The need to distinguish theoretically between Anxiety and Fear is further demonstrated by the inter-variable correlations, in which BIS-F – and only BIS-F – correlated negatively with each other variable, with all other correlations being positive. Even with modifications, however, the design fell short of optimal fit for the total sample and for the female-only group. This contrasts somewhat with the findings of Cooper, Perkins, and Corr (2007), who reported that males and females had similar relationships between the constructs of Fear, Anxiety, and total BIS scores. Their study differed from the present study in that their sample was older and they employed separate measurements of Fear and Anxiety.

The current findings align with those who argue the factor structure and external validity of these scales are mixed at best (see Demianczyk et al., 2014). Whilst model modifications are commonly performed when performing CFAs on these scales, Demianczyk et al. (2014) argue caution as the need for modifications in order to achieve adequate model fit may signify the need for modifications to the underlying theory. This is of particular importance when considering RST measurement tools often differ on how many components of RST exist, as well as how they are conceptualised (Corr, 2016). Though Gray and McNaughton's (2000) revision of RST proposed the separation of Fear and Anxiety – which has been statistically verified here and elsewhere (Perkins et al., 2007) – the sex differences have not been fully accounted for. As such, further research on these scales need to employ a two-factor BIS and take sex into account as males and females were found to differ quite considerably.

In terms of the effect of age, BIS-A and BIS-F were shown to peak in late adolescence in both females and males. BIS-F levels dropped off in females in young adulthood, but remained stable in males, whereas BIS-A levels dropped in adulthood for males, but remained at adolescent levels for females. Comparison with other studies is limited given that the trend has been to utilise combined BIS scores, which fail to differentiate between Fear and Anxiety. As such, the present results mark new territory in examining age related changes in BIS/BAS characteristics.

In previous research, females were shown to have higher scores on BIS related measures than males (Cooper et al., 2007; Perkins et al., 2007; Urosevic et al., 2012). In the present study this pattern was only evident in BIS-A scores, which suggests that Anxiety, rather than Fear, may have important implications for understanding the differential rates of mood related disorders in adolescent girls and boys. Given the limitations of our model fit for females, however, the appropriateness of gender comparisons is questionable and warrants further study.

Findings of a mid-late adolescent peak in BAS scores are consistent with current models of adolescent behaviour that posit that affective decision making in adolescence is associated with increased reward sensitivity during this time (Steinberg, 2010). However, the effect of age was not uniform across all BAS subscales, as no change in Reward Responsiveness across the age groups was observed. These findings contrast with Urosevic et al. (2012) who reported the expected peak in in mid-adolescence followed by a decline in adulthood for Reward Responsiveness scores. It is interesting to note that the cross-sectional and longitudinal changes reported by Urosevic et al. (2012) were inconsistent, which may suggest the presence of cohort effects. Closer inspection of their results for Reward Responsiveness highlight that the significant age effect in their study was only evident at Time 1. That is, Reward Responsiveness scores of adolescents aged 9-12 were significantly lower than the late adolescent group (aged 13-17). At Time 2, however, when the youngest age group was between 11-14 years – and hence more comparable to our early adolescent group – scores did not differ from the late adolescent group, who were then aged 15-19 years. Although the present study report mean item rather than total subscale scores, direct inspection of the mean total scores across studies (data available upon request) suggests that despite the age differences, the present study's early adolescent scores are more similar to Urosevic et al.'s (2012) early adolescents at Time 1 than to Time 2. Thus cohort effects rather than age differences likely account for the discrepancy across the two studies.

Expected elevated BAS scores in males were evident for Fun Seeking and, to a lesser extent, Drive ($p$ = .06), but the lack of age by sex interaction for all BAS measures suggests that the impact of sex on reward sensitivity is consistent across adolescence.

The data obtained yielded an uneven distribution of sex and age throughout. The greater sex disparity across the age groups is explained by the sampling of mainly females in the older age groups. This is a common product of sampling from University students, and future studies should recruit from a more representative demographic population. Inspection of standard deviations in Table 3 corresponds with acceptable statistical indices of skewness and kurtosis. Furthermore, our examination of age by sex interactions permitted examination of potential confounding age and sex effects where present.

Future research should also aim to follow BIS/BAS measures employing a longitudinal design beginning in childhood and continuing into at least early to mid-adulthood. Though demanding, such would provide the opportunity to track changes in the development of these constructs *within* individuals, rather than inferring developmental trajectories cross-sectionally, and avoid the present study's issues with confounding age and cohort effects. Furthermore, incorporating a two-factor BIS – will give a better representation of the scale's ability to predict performance. As explained by Perkins et al. (2007): though BIS as a measure of punishment sensitivity is a strong predictor of performance, this variance is better accounted for by the individual contributions of Fear and Anxiety separately. Finally, employing age as a continuous – rather than categorical – variable will allow for a more thorough examination of non-linear developmental trends.

Though the Carver and White BIS/BAS scales have been employed for countless studies, there are many facets of these traits which remain incipient. As such, it is hoped that this study sparks renewed interest in tracking the development of these traits and evaluating the tools used to measure them.

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