Appetitive motivation predicts the majority of personality and an ability measure: a comparison of BAS measures and a re-evaluation of the importance of RST

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Abstract

Our first study develops a measure of appetitive motivation and our second study compares several measures of Gray's (1987) behaviour activation system (BAS) in the prediction of the surface scales of personality. In particular, we were interested in determining the utility of the new appetitive motivation scale and Dickman's functional impulsivity scale. In comparison to other well-known measures, both scales were generally good predictors. We conclude that the appetitive motivation scale is a promising measure of BAS based upon construct validation. Contrary to previous studies which have suggested that BAS is a generally poor predictor of the surface scales of personality, we discovered appetitive motivation to be an important predictor of personality in general. Interestingly, the scale was also predictive of scores on the Baddeley reasoning test.
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Keywords: EPP; BAS; RST; Appetitive motivation; Approach; Impulsivity; Functional impuslivity

1. Introduction

Gray's (1982, 1987) reinforcement sensitivity theory (RST) is a motivational theory of personality with a biological basis. Implicit in RST is that it is at least a partial *cause of personality* (e.g., Corr, 2001; Gray, 1970; Matthews & Gilliland, 1999). The model consists of three systems but the focus of this study is constrained to the behaviour activation system (BAS). According to most recent clarification, the BAS mediates responses to appetitive stimuli and involves

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approaching reward and actively avoiding punishment (Corr, 2002; Gray & McNaughton, 2000). Gray's theory specifies the BAS as the causal basis of trait impulsivity, the implication being that impulsive people are most highly motivated by reward (Corr, 2001; Matthews & Gilliland, 1999).

Descriptively, the BAS is aligned at 30° to Eysenck's (1967) scale of extraversion (Corr, 2001; Pickering, Corr, & Gray, 1999). In terms of Eysenck's (1967) model, it seems clear that the BAS should correlate with extraversion and neuroticism, and by virtue of its relationship with trait impulsivity, also share some variance with psychoticism. A good measure of BAS should have these features and therefore could be expected to account for much variance in personality overall. It seems unlikely however that a good BAS scale would predict anxiety (assuming that BAS, and BIS, Gray's basis for anxiety, are separate systems).

Various scales are available for measuring BAS. Some studies use extraversion and neuroticism from the EPQ (Eysenck & Eysenck, 1975, 1991), while others have developed specific measures (e.g., Avila, 2001; Carver & White, 1994). Jackson (2001, 2002, 2003) reports that the impulsivity and anxiety scales of the Eysenck personality profiler (EPP; Eysenck, Barrett, Wilson, & Jackson, 1992; Jackson, Furnham, Forde, & Cotter, 2000) are effective measures of BAS and BIS within the framework of Gray's RST. Jackson shows that these EPP primary scales correlate in expected ways with a goal oriented criterion from the work-place (reflecting the motivational nature of RST) and with components of RST scales derived from the Gray–Wilson personality question-naire (Wilson, Gray, & Barrett, 1990).

A further, and presently unexplored, candidate for a measure of BAS is Dickman's functional impulsivity scale (Dickman, 1990). The functional impulsivity scale measures individual differ-ences in appropriate spontaneity (e.g., to 'seize the moment'), as opposed to typical impulsivity questionnaires which focus more on potentially problematic disinhibition (e.g., failing to 'look before you leap') which Dickman terms dysfunctional impulsivity.

What all these measures have in common is the use of impulsivity as a proxy for measuring BAS. Whilst according to RST, impulsivity is a potential manifestation of BAS, the motivational role of appetitive stimuli seems to have been minimized in the design of presently used scales. As a result, we developed an appetitive motivation questionnaire which assesses BAS from the per-spective of impulsively approaching appetitive stimuli with the goal of obtaining a rewarding experience.

The aims of our two studies are to develop and then examine the psychometric properties of our new questionnaire. In doing so, we determine how well appetitive motivation, and other BAS measures, predict the surface scales of personality as measured by the EPP. The EPP is a 420 item questionnaire measuring 21 primary scales which provide a reasonable fit to Eysenck's three factor model comprised of extraversion (E); neuroticism (N) and psychoticism (P). Recently Jackson et al. (2000) have suggested that the EPP provides good all-round measurement of the surface of personality. By this it is meant that they provide a good *description* of personality (i.e., quanti-fication of that which is observable, as opposed to necessarily identifying a causal basis of per-sonality).

Jackson (2002) reported that Gray's RST was unlikely to be an important predictor of the surface scales of personality, since its ability to predict scales of the EPP was relatively low. Jackson (2003) re-analyses the data and presents evidence that RST may be more of a cause of personality than the first study suggested. However, both of these studies rely on the Gray–Wilson personality questionnaire (Wilson et al., 1990) to be an adequate measure of Gray's RST. In this

study, it was predicted that the appetitive motivation questionnaire (with its greater emphasis on rewarding stimuli, rather than impulsive behaviour per se), and possibly also Dickman's functional impulsivity questionnaire (with its focus on the potential advantages of impulsive behaviour), will offer improved measures of BAS. This will thereby provide a better test of a general hypothesis that BAS is a good predictor of many of the surface scales of personality.

2. Study 1: Development of the appetitive motivation scale

We have been interested in the psychometric measurement of BAS for some time and have developed a bank of items which reflect a motivation to approach ideas and physical stimuli, as well as reflecting the appraisal of obtaining rewards. After multi-stage item evaluation over a three year period, we identified 20 items to form our appetitive motivation scale. Study 1 examines the psychometric properties of the appetitive motivation scale.

2.1. Method

2.1.1. Participants and method
A total of 152 participants completed the appetitive motivation scale. They comprised psychology students participating for course credit (62% females; mean age is 19.31, SD is 2.45). Copies of the questionnaire were distributed by hand. Participants were fully debriefed regarding the purpose of the study, and the theory underlying Gray's model. Additional aspects of the procedure are beyond the scope of this study.

2.2. Results

Items from the appetitive motivation scale are shown in Table 1. When scored as True $= 1$ and False $= 0$, the mean is 14.47 (SD is 3.14) and an alpha of 0.74 is obtained. Note that a high scorer is more responsive to appetitive stimuli (i.e., a high BAS scorer). Corrected item total correlations were generally satisfactory (mostly >0.3). Age was not related to a person's score ($r = -0.06$, ns), although males (mean $= 15.25$, SD $= 2.42$) scored slightly higher on BAS than females (mean $= 14.09$, SD $= 3.42$; $t(140) = 2.08$, $p < 0.05$). This trend is consistent with Gray's (1987) account of BAS sex differences.

A principal components analysis was conducted to check the anticipated 1-factor structure. The first component accounted for 21% of the variance (eigenvalue $= 4.01$). The next six components had eigenvalues in the range of 1–1.7, and inspection of a scree-plot suggested that a 1-factor solution was most efficient. Item loadings on this single factor were satisfactory (greater than 0.3 for the majority of items).

2.3. Discussion

These results demonstrate adequate structure and internal consistency of the appetitive motivation scale. In study 2, we examine the construct validity of the scale, in comparison with other

Table 1
Items of the appetitive motivation scale

1. I believe that rules are stifling
2. I put plans into action
3. I like to be busy
4. I like to see how things work
5. Generally, I choose which rules to follow
6. I like to do things which are new and different
7. I like to do things spontaneously
8. I like to do things my way
9. I tend to do several things all at the same time
10. It is important to enjoy the present moment
11. I actively look for new experiences
12. I have a feel for how things work
13. I look for new sensations
14. I am excited by what is new in my field
15. I often have lots of spontaneous ideas
16. I prefer not to plan things too much
17. I like to be rewarded for what I do
18. The here and now is what is important
19. I have new ideas all the time
20. I enjoy starting projects

BAS measures, by assessing the extent to which appetitive motivation can explain low and high bandwidth personality.

3. Study 2: Appetitive motivation, personality, and intelligence

3.1. Method

3.1.1. Participants

A total of 59 participants were involved in the second study. They comprised students attending a 13 week course on psychometrics. Each week, participants completed one or more questionnaires and received test feedback and information about the assessment that they had completed. Average age of the sample was 25.8 years (SD = 9.4) and comprised 72% females. Since questionnaires were completed over a relatively large period of time, it should be noted that sample size varies according to class attendance.

3.1.2. Questionnaires

Participants completed the following personality questionnaires: the appetitive motivation scale (shown in Table 1), EPQ-R (Eysenck & Eysenck, 1991), NEO-FFS (Costa & McCrae, 1992), the Eysenck personality profiler (Eysenck et al., 1992), BIS/BAS scales (Carver & White, 1994) which include three BAS scales (drive, fun and reward responsiveness), and both functional and dysfunctional impulsivity (Dickman, 1990).

Participants also completed two intelligence tests: the Wonderlic ability test (Wonderlic, 1999) which is a general measure of *g*, and the Baddeley ability reasoning test (Baddeley, 1968). This test takes 3 min to complete and involves the understanding of sentences at various levels of syntactic complexity. Both intelligence tests show good convergent validity with respected measures of intelligence.

3.1.3. Statistical analyses

We present correlations among BAS scales as indications of construct validity, and correlations between BAS scales and the surface scales of personality as evidence of BAS utility for prediction of personality. The study does *not* test causality in as much as no evidence is presented suggesting that BAS causes surface scales of personality. Our results show significance according to the actual numbers of participants available in each of the reported bivariate relationships, and typically sample size was between 38 and 59.

3.2. Results

Consistent with study 1, a mean of 13.13 (SD = 3.42) was obtained with an alpha of 0.72. All the other scales are from existing questionnaires with known and respectable psychometric properties.

3.2.1. Construct validity

Table 2 shows that the appetitive motivation scale correlates most highly with functional impulsivity, and shows a reasonably strong relationship with BAS drive, BAS fun and the EPP scale of impulsiveness. Interestingly, the EPP impulsiveness scale correlates mainly with dysfunctional impulsivity and the Carver and White's scales correlate with both functional and dysfunctional impulsivity.

3.2.2. Relationship of BAS measures with high bandwidth personality scales

Correlations with the BAS measures and the high bandwidth scales are shown in Table 3. With the exception of dysfunctional impulsivity, all BAS measures correlate with extraversion as measured by the EPQ, EPP and the NEO. Functional impulsivity negatively correlates with

Table 2
Construct validation

	AM	F-IMP	D-IMP	DRIVE	FUN	RR	IMP (EPP)
AM	–						
F-IMP	0.50**	–					
D-IMP	−0.11	0.20	–				
DRIVE	0.31*	0.54**	0.33*	–			
FUN	0.37**	0.34*	0.33*	0.47*	–		
RR	0.04	0.40*	0.21	0.49*	0.52**	–	
Impulsiveness (EPP)	0.30*	0.05	0.54**	0.24	0.41**	0.23	–

AM = appetitive motivation scale, F-IMP = functional impulsivity, D-IMP = dysfunctional impulsivity, DRIVE = BAS drive, FUN = BAS fun, RR = BAS reward responsiveness, IMP = EPP impulsiveness (subscale of psychoticism).
$^{*} p < 0.05$; $^{**} p < 0.01$.

Table 3
Correlations between BAS measures and high bandwidth personality measures

	AM	F-IMP	D-IMP	DRIVE	FUN	RR	IMP (EPP)
EPQ E	0.38**	0.54**	0.19	0.31*	0.46**	0.41*	0.14
EPQ N	−0.18	−0.55**	0.11	−0.01	−0.17	−0.04	0.11
EPQ P	0.34*	0.02	0.02	−0.22	0.1	−0.17	0.33*
EPP E	0.55**	0.50**	0.19	0.49*	0.37**	0.28*	0.35**
EPP N	−0.36**	−0.61**	−0.11	−0.31*	−0.34*	−0.09	−0.16
EPP P	0.27*	0.05	0.29	0.1	0.39**	−0.19	0.69**
NEO E	0.48**	0.41**	−0.05	0.34*	0.46**	0.35*	0.12
NEO N	−0.23	−0.24	0.03	−0.11	−0.12	0.14	−0.15
NEO O	0.26	−0.02	−0.37*	−0.02	−0.01	0.09	0.03
NEO A	−0.11	−0.12	−0.08	−0.05	0.08	0.01	−0.13
NEO C	−0.01	0.36*	−0.39*	0.49*	0.26	0.40*	−0.34*

For EPQ and EPP: E = extraversion, N = neuroticism, P = psychoticism; for NEO: E = extraversion, N = neuroticism, O = openness to experience, A = agreeableness, C = conscientiousness.
* $p < 0.05$; ** $p < 0.01$.

neuroticism from the EPQ and EPP, whilst appetitive motivation (along with BAS drive and BAS fun) only negatively correlates with neuroticism from the EPP. Only appetitive motivation correlates with psychoticism from both the EPP and EPQ. Dysfunctional impulsivity correlates with NEO openness and NEO conscientiousness; and interestingly functional impulsivity, BAS drive and BAS reward responsiveness positively correlate with NEO conscientiousness. However, the EPP impulsivity scale negatively correlates with the NEO conscientiousness scale. None of the BAS measures predict NEO neuroticism or NEO agreeableness.

3.2.3. Relationship of BAS measures with low bandwidth EPP scales

The appetitive motivation scale has positive correlations with most of the extraversion EPP primary scales with only functional impulsivity being nearly as predictive (see Table 4). In the prediction of EPP neuroticism primary scales, functional impulsivity and appetitive motivation were both good negative predictors, whereas the other BAS measures were generally weak. In the prediction of the primary scales of psychoticism, appetitive motivation predicted more scales than any of the other BAS measures, and functional impulsivity this time predicted none.

3.2.4. Relationship of BAS measures with ability tests

The appetitive motivation scale has a significant negative correlation with the Baddeley reasoning test and a negative trend with the Wonderlic ability test (as shown in Table 4). No other BAS measures approach significance. The implication here is that low applied intelligence is associated with appetitive responsiveness or BAS.

3.3. Discussion

Good construct validity of the appetitive motivation and functional impulsivity scales was indicated by reasonable correlations with existing BAS measures as well as with each other. In

Table 4
Correlations between BAS measures, low bandwidth personality measures of the EPP, and measures of intelligence

	AM	F-IMP	D-IMP	DRIVE	FUN	RR	IMP (EPP)
Activity	0.54**	0.33*	0.21	0.43*	0.25	0.06	0.37**
Sociability	0.44**	0.41*	−0.12	0.16	0.30*	0.24	0.16
Expressive	0.29*	0.19	0.27	0.14	0.26	0.40*	0.28*
Assertiveness	0.39**	0.48**	0.18	0.46*	0.30*	0.25	0.19
Ambition	0.47**	0.34*	−0.09	0.58*	0.36*	0.25	0.22
Dogmatism	0.05	0.14	0.26	0.21	−0.07	−0.08	0.04
Aggression	−0.15	−0.15	0.18	0.04	−0.02	−0.07	0.15
Lowself-esteem	−0.45**	−0.53**	−0.04	−0.33*	−0.30*	−0.06	−0.1
Unhappiness	−0.37**	−0.59**	−0.13	−0.30*	−0.24	−0.17	−0.05
Anxiety	−0.27**	−0.55**	0.08	−0.12	−0.21	−0.03	−0.06
Dependence	−0.36**	−0.47**	0.00	−0.48*	−0.28*	−0.06	0.03
Hypochondriasis	−0.03	−0.16	−0.04	0.11	−0.11	−0.12	−0.19
Guilt	−0.14	−0.45**	−0.08	−0.41*	−0.20	−0.03	0.03
Obsessiveness	0.03	−0.07	−0.31	0.11	−0.32*	−0.13	−0.40**
Risk-taking	0.34**	0.09	0.27	0.13	0.42**	−0.04	0.53**
Impulsiveness	0.30*	0.05	0.54**	0.24	0.41**	0.23	
Irresponsibility	0.01	0.12	0.38*	−0.19	0.20	0.00	0.32*
Manipulative	0.04	−0.01	−0.06	0.19	0.10	−0.01	−0.04
Sensation-seeking	0.46**	0.01	−0.13	−0.06	0.20	−0.31*	0.36**
Tough-minded	0.07	0.13	−0.13	0.12	0.07	−0.23	0.07
Practical	−0.29*	−0.16	0.05	−0.07	−0.05	−0.23	0.02
BRT	−0.34**	−0.07	−0.06	−0.19	−0.03	0.02	−0.09
Wonderlic	−0.22	0.11	0.04	−0.2	−0.16	−0.13	−0.08

BRT = Baddeley reasoning test, Wonderlic = Wonderlic personnel test. All low bandwidth personality scales are from the EPP.
* $p < 0.05$; ** $p < 0.01$.

general, results indicate that both scales are superior to the EPP impulsivity scale and Carver and White (1994) BAS scales in the prediction of the surface scales of personality. This is due to the fact that they better predict high bandwidth measures of extraversion and consistently predict lower bandwidth primary scales of extraversion, as RST theory predicts.

The new appetitive motivation scale demonstrates further efficacy as it predicts both psychoticism and a reasonable number of the primary scales of psychoticism (consistent with a causal link between BAS and trait impulsivity). Additionally, the scale significantly correlates with scores from the Baddeley reasoning test and there is a notable (but not significant) correlation with the Wonderlic ability test. These results suggest that individuals with higher mental functioning are less motivated by appetitive stimuli, which is not unexpected given that the BAS is thought to be a phylogenetically old system responsible for lower order functioning. Also novel stimuli are likely to be unpredictable such that even those which seem rewarding may turn out to be 'punishers'. More intelligent people may therefore exhibit caution rather than an approach tendency. We note however that our correlational finding of a link between intelligence and BAS is not strong and limited to just our appetitive motivation measure. We therefore recommend treating this interesting finding and our interpretation with caution pending further data collection.

In contrast to RST which states that a positive correlation between BAS and neuroticism is expected, a substantial number of our BAS scales are significantly negatively correlated with neuroticism. The appetitive motivation scale shows one of the largest negative correlations with neuroticism (but not NEO neuroticism) and consistently predicts lower bandwidth primary scales of neuroticism.

We suspect that when impulsivity is measured as an approach motivation then it psychometrically overlaps with anxiety (consistent with the joint-subsystems view of RST, e.g., Corr, 2002). This evidence suggests (a) anxiety may act as an antagonistic mechanism in restricting approach activity such that it has an opposite effect to impulsivity. This may therefore maintain an adaptive approach-avoid balance, (b) the psychometric approach may not be able to fully distinguish the BIS from the BAS. Given that our new measure of appetitive motivation and functional impulsivity seem to be excellent general predictors of personality overall, it may be that there is little psychometric need for a BIS measure.

In contrast to the generally powerful overall predictiveness of appetitive motivation and functional impulsivity, it needs to be noted that it takes all three of Carver and White's (1994) BAS measures to predict about the same number of EPP primary scales. Reward responsiveness, which seems most related to learning from reward, has only a weak predictiveness of personality. On a more positive note, we do find that Carver and White's scales do not predict anxiety which is in line with predictions from RST. Overall, we therefore find that Carver and White's scales confirm the usefulness of understanding the causes of personality from the perspective of RST if all of their three BAS scales are used.

Together with the general usefulness of appetitive motivation and functional impulsivity scales, we believe that RST does predict a substantial amount of personality and therefore this study contrasts with the evidence presented by Jackson (2002, 2003). Jackson (2002, 2003) was interested in determining the utility of the Gray–Wilson personality questionnaire in the prediction of the 'surface scales' of personality, and it seems that there may be better representations of RST than this questionnaire.

There are several other noteworthy findings:

(a) Functional impulsivity seems a reasonable measure of BAS, except that it does not correlate with any of Eysenck's primary scales of psychoticism. This would be expected of a good BAS measure since impulsivity (a primary scale of psychoticism in the structure of the EPP) is thought to have its basis in the BAS. One interpretation is that functional impulsivity may differ from dysfunctional impulsivity in that only dysfunctional impulsivity is related to psychoticism.

(b) Apart from the extraversion scale, the NEO generally is not well predicted by any of the measures of impulsivity used in this study. If it is accepted that RST is a causal basis of personality, then the results of this study suggest that the NEO description of personality (based on lexical analysis) is not strongly associated with underlying biological processes.

(c) The most noticeable failure of BAS scales to predict personality scales are those analogous to Gray's fight/flight/freezing system (FFFS, formerly the fight/flight system, FFS). Notice in Table 4 the lack of significant correlations between BAS measures and aggression, dogmatism and tough-mindedness. It may be that the appetitive motivation scale needs supplementing with a FFFS scale.

(d) Dysfunctional impulsivity is an all round poor predictor of the surface scales of personality, except for impulsivity. This suggests that the traditional trait view of impulsivity (''leap before you look'') can not represent a causal basis of personality which is not surprising since it is not conceptually very similar to learning from reward.

In summary, functional impulsivity and appetitive motivation are good predictors of BAS activity. The appetitive motivation scale in particular predicts Eysenck's three dimensional model remarkably well. Moreover, the possible correlation with ability, further suggests that this scale has possible utility for elucidating links between personality and intelligence. This study supports RST as a major predictor of personality, suggesting that further research to determine predictive validity across different settings would be worthwhile (following on from the work of Jackson, 2001).

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