Elsevier Editorial System(tm) for Personality and Individual Differences
Manuscript Draft

Manuscript Number: PAID-D-10-00315R3

Title: The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity

Article Type: Research Paper (<5000 words)

Section/Category: Regular Issue

Keywords: Behavioral Inhibition System; Behavioral Activation System; Reinforcement Sensitivity Theory; Psychoticism; Psychopathy

Corresponding Author: Dr Nadja Heym, BSc, MSc, Ph.D.

Corresponding Author's Institution: University of Nottingham

First Author: Nadja Heym, BSc, MSc, Ph.D.

Order of Authors: Nadja Heym, BSc, MSc, Ph.D.; Claire Lawrence, PhD

Abstract: Gray's revised Reinforcement Sensitivity Theory (rRST; Gray & McNaughton, 2000) may play a role in explaining deficits in Psychoticism (P) and psychopathy (Corr, 2010). In this paper, we examine the relationships of P with anxiety, fear, impulsivity and reward reactivity in normal populations to assess whether these associations mirror the hypothesized role of RST motivations in psychopathy. Two hundred and twelve participants completed measures of Psychoticism, impulsivity and rRST motivations (BIS-anxiety, FFFS-fear and BAS). BIS-anxiety mediated the association of P with FFFS-fear and BAS-fun seeking. An exploratory factor analysis distinguished between trait impulsivity (P, impulsivity and BIS) and reward reactivity (BAS-reward responsiveness and BAS-drive). Subsequent moderation analyses showed that whilst neither BIS nor BAS moderated the P-impulsivity link, the association between P and impulsivity was more pronounced in individuals with raised levels of FFFS-fear. Findings are discussed in terms of the roles of fear versus anxiety and impulsivity versus reward reactivity in the P-psychopathy continuum.

Nadja Heym
RASPH - Risk Analysis Social Processes and Health
School of Psychology,
University of Nottingham,
University Park,
Nottingham, NG7 2RD, UK.
Tel.: +44(0) 115 8468272
Fax: +44(0) 115 9515324
E-mail: Nadja.Heym@ nottingham.ac.uk

Personality and Individual Differences
Elsevier Ltd.
The Boulevard
Langford Lane
Kidlington Oxford
OX5 1GB
United Kingdom

02nd July 2010.

Dear Prof. Vernon and Prof. Eysenck,

We would like the attached manuscript (Word count: 5018) entitled '*The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity'* to be considered for publication in *Personality and Individual Differences*.

The manuscript addresses the role of Gray's revised Reinforcement Sensitivity Theory as underlying mechanism in the Psychoticism-psychopathy continuum. The manuscript reports the examination of the relationships of Psychoticism (P) with (i) anxiety and fear; and (ii) impulsivity and reward reactivity in normal populations to assess whether these associations mirror the hypothesized role of the RST motivations in primary and secondary psychopathy. Our data show that P is associated with reduced fear (FFFS) and anxiety (BIS) akin to primary psychopathy and support the key role of BIS as a potential mechanism for P and primary psychopathy associated punishment insensitivity. Secondly, the manuscript distinguishes between trait impulsivity and reward reactivity (BAS) and shows that P and impulsivity are linked to a deficit in behavioural inhibition (BIS) as opposed to reward reactivity (BAS). Thirdly, the data show that P-related impulsivity is more pronounced in individuals with raised levels of punishment sensitivity akin to secondary psychopathy. These associations of Psychoticism with the revised RST have to our knowledge not been shown before.

We argue that the associations support Eysenck's continuity hypothesis for Psychoticism and Psychopathy as well as the role of the revised RST as underlying mechanisms in P and potentially psychopathy. Moreover, we emphasize the importance of distinguishing between anxiety and fear as well as impulsivity and reward reactivity in personality, specifically psychopathy research. We believe this manuscript makes some interesting contribution to the existing RST literature, the Eysenckian model of personality, specifically P, as well as the conceptualization of psychopathy.

Please send any correspondence to the above address.
We are looking forward to hearing from you.

Yours sincerely,

Nadja Heym and Claire Lawrence

Dear Professor Corr,

Thank you for organizing the review process and for your email of June 16th 2010 allowing us the opportunity to revise and resubmit the MS. We would like to thank the two reviewers for the time and effort they put into their reviews – which we found very useful in helping us to clarify the conceptual focus of the paper and strengthen the rationale. Detailed answers to both reviewers' concerns and comments are presented below. We have addressed all of the reviewers' comments and have highlighted the major changes in the text below. However, we hope that you will see that the introduction has changed substantially to incorporate all of the reviewers' concerns. Following your suggestion, we have more fully discussed the conceptual basis of the paper in line with the arguments of Corr (2010), and we feel that this substantially helps the paper in terms of its conceptual focus and basis in the literature. We thank you very much for this suggestion.

Reviewers' comments:

Reviewer 1:

> *In this paper the authors examined associations among impulsivity, fear, anxiety, and Psychoticism, using mediation and moderator analyses, in a sample of 212 undergraduates. The authors frame their research design in terms of Gray's revised (2000) RST and theoretical relations of fear, BIS, and impulsivity to the psychopathy construct. It is refreshing to see a manuscript that focuses on revised RST; now a decade after the revision was published, one still sees numerous investigations that are framed in terms of the earlier theoretical framework.*

We thank the review for their positive comments. It is very much our intention to develop work framed in terms of the revised RST rather than original RST.

> *Psychoticism/Psychopathy*
> *The introduction discusses Eysenck's Psychoticism (P) in relation to the psychopathy construct. They cite Haworth (1986) as providing evidence that P is associated with the affective and cognitive features of psychopaths, in contrast to Hare (1982) who found that*

P was not related to these features (at least as measured by the PCL), but that P was related to the socially deviant lifestyle features of psychopathy. They conclude (p.4) that "the association of P with the factor of psychopathy is debated and needs further investigation." However, there was no measure of psychopathy used in the present study, which left me wondering somewhat about the purpose of developing this point in the first place.

We thank the reviewers for this point and we have made substantial changes throughout the MS (in particular the introduction) based on this comment. Specifically, we have dramatically reduced the discussion of 'psychopathy' per se in general terms, and instead have discussed the paper in terms of Corr's (2010) argument regarding the possible link between the cognitive and emotional processing deficits found in psychopathy and the cognitive and emotional patterns found in P and the potential role of revised RST therein. In this way, the paper also addresses the extent to which psychoticism is likely to be conceptualised on a continuum. Specifically, there is strong indirect evidence to support the psychoticism-psychopathy continuum, as the pattern of effects for observed in the literature for psychopathy is also seen in non-clinical population for P. This suggests that the theoretical models relating to RST appear to apply across the psychoticism-psychopathy continuum (Ferguson, 2009). As a result, the revised manuscript now discusses deficits in psychopathy *purely* in order to identify the anticipated deficits in P – rather than examining P and psychopathy together. We have now clarified this main aim throughout the introduction.

Indeed the introduction now starts with a discussion of Psychoticism and links into Corr's (2010) proposition of the revised RST as a key explanatory model in understanding the neurological mechanisms for P. The basis of the paper in Corr's (2010) argument is reiterated at the bottom of page 2, again – and the use of this argument as a conceptual focus of the study is now highlighted.

The authors' presentation of the primary versus secondary psychopathy notions is also somewhat awkward. On p. 3 they cite Hare et al. (1990) in identifying items that comprise the two commonly found PCL/PCL-R factors, which the present authors call "clusters" and

characterize as representing primary and secondary psychopathy. Although some subsequent investigators have expressed the view that these factors link (mainly) to primary and secondary psychopathic features, that is not the case for Hare et al. (or for Hare in most of his other writings). Hare's view generally has been that psychopathy as measured by the PCL/PCL-R is a unitary construct and one that represents (mainly) Clecklian or primary psychopathy. Thus, the authors' presentation seems somewhat misleading insofar as the reader might infer that Hare (or Hare et al., 1990) are advocating that the PCL-R factors map onto variants of psychopathy.

Again – we thank the reviewer for their point. We have changed the material discussing primary and secondary psychopathy in line with these comments. Specifically, on page 3 para 2, continued onto page 4, we now state that although psychopathy has been generally seen as a unitary construct (Hare & Newman, 2008), some researchers argue that two factors define specific variants of psychopathy – namely primary and secondary psychopathy, respectively (Skeem, Poythress, Edens, Lilienfeld & Cale, 2003). Although Hare (1982) showed that P was related to psychopathy in male prison inmates, P correlated only with the impulsive and antisocial aspects of secondary psychopathy. However, P is defined by affective deficits (e.g. Eysenck, 1992) also ascribed to primary psychopathy. In this way, we hope that we have clarified any misleading presentation in the previous MS and demonstrate, as the reviewer points out, that Hare's view has been that psychopathy as measured by the PCL/PCL-R is a unitary construct representing (mainly) primary psychopathy.

All of this becomes somewhat more difficult to fathom later in the paper when the on page 3 para authors use the term "P/psychopathy," which seems to suggest that they are treating the constructs somewhat synonymously. In light of their earlier discussion about uncertainties regarding whether or to what extent P measures various aspects of PCL psychopathy, I was unsure what to make of this term.

The reviewer is right to point out the incorrect use of the term P/psychopathy. This was used in the previous MS purely as a space-saving device – and the problematic interpretation of the two as synonymous constructs was overlooked. This has now been removed.

Measurement Issues

To represent BIS and FFFS components of revised RST, the authors used combinations of items from Carver and White's (1994) BIS scale, identified by Heym et al. (2008) to represent BIS-anxiety (4-items) and FFFS-fear (3 items). These groups of items did appear to identify separate factors in the CFAs used by Heym et al., but the present authors present no evidence that this disaggregation of BIS items has been replicated elsewhere (and two other investigations - Johnson et al. (2003) and Poythress et al. (2008) reported a different disaggregation of the BIS scale items). Further there is no evidence of the construct validity for these brief scales.

We agree that beyond Heym, et al (2008), there is no published evidence for the construct validity of the disaggregation of the BIS scale into BIS-anxiety and FFFS-fear as used here. However, Heym et al (2008) did show some construct validity in their study – demonstrating that while P was related to both FFFS-fear and BIS-anxiety, the relationship between BIS-anxiety and P was much greater. As a result, the fact that in the current paper, it has been shown that the list between FFFS-fear and P is fully mediated by BIS-anxiety is an important addition to the literature, and one which speaks to Corr's (2010) argument.

Moreover, there is some extant, to-be-published evidence supporting the distinction between BIS-anxiety and FFFS-fear using Heym et al (2008) disaggregation (Heym, 2009). Specifically Heym (2009) has shown experimentally that low FFFS-fear is associated with reduced variability of response to startle during presentation of differently valenced stimuli, and effect not shown for BIS-anxiety. This work will be published, and will draw upon the current MS. Indeed, the data presented in the current MS, in themselves, offer some support for the validity of the Heym et al (2008) dis-aggregation.

Finally, we have included the following point in the MS – that Heym et al (2008) compared alternative disaggregations of the Carver & White BIS scale, but found the Heym et al (2008) version to be a better fit to the data.

The C&W BIS scale has been criticized extensively as poorly capturing the complexity of the Behavioral Inhibition System as envisioned by Gray (for a review, see Poythress et al., 2008, and a rebuttal by Newman & Malterer, 2008); whether the reduced 4-item BIS-anxiety scale identified by Heim et al. is in some way a better measure of the BIS construct than is the original 7-item measure is unknown.

We agree – the C&W scales are certainly not without their critics, and while we would certainly not hold the C&W scales up as a gold standard for the measurement of the revised RST, we hope that there is merit in using the Heym et al (2008) version of the existing C&W scales in order for comparability with other studies using the old conceptualisation of the scales. As a result, we now say (on page 5, para 2 of the revised MS), 'The Carver and White (1994) scales are the most commonly used instruments to measure RST constructs and as a result, the findings of the current study will be comparable across findings in the wider literature'.

Similarly, the 3 original BIS items that parcel out as a putative index of FFFS-fear - apparently mainly because the word "fear" appears in two of them - has not been demonstrated to adequately represent the FFFS construct as Gray envisioned it. How representative these 3 items may be of the broader array behaviors and emotions associated with FFFS is unclear, and the authors offer no psychometric evidence that this 3-item scale shares significant variance with other more established measures of fear sensitivity. Thus, there are significant concerns with the measures of several key constructs in this study, and without better assurance regarding the validity of the measures it is difficult to generate much enthusiasm for, or confidence in, the findings. [Also, there was no citation in the reference list for the IPIP Impulsivity Scale mentioned in the text]

As we mentioned above, we agree that beyond Heym, et al (2008), there is no *published* evidence for the construct validity of the disaggregation of the BIS scale into BIS-anxiety and FFFS-fear as used here, and that FFFS is broader than the items reflecting it here. However, Heym et al (2008) have shown some construct validity in their study – demonstrating that while P was related to both FFFS-fear and BIS-anxiety, the relationship between BIS-anxiety and P was much greater. As a result, the fact that in the current paper, it has been shown that the list

between FFFS-fear and P is fully mediated by BIS-anxiety is an important addition to the literature, and one which speaks to Corr's (2010) argument.

Moreover, Heym (2009) has shown experimentally that low FFFS-fear is associated with reduced variability of response to startle during presentation of differently valenced stimuli, and effect not shown for BIS-anxiety. This work will be published, and will draw upon the current MS. Indeed, the data presented in the current MS, in themselves, offer some support for the validity of the Heym et al (2008) disaggregation.

The citation for the IPIP impulsivity scale is now included in the reference section.

> *The analysis plan for this study seems appropriate to the study design and hypotheses. However, on page 11 the authors interpret the moderating effect of FFFS-fear as "marginally significant" (p = .054). It seems to me that the finding is more accurately described as "marginally non-significant" or as a trend toward statistical significance, and that such an interpretation might temper the enthusiasm for the result as currently expressed.*

We have taken this point on board – and have now changed description of the finding as 'a trend towards statistical significance' as suggested by the reviewer.

Reviewer 2

> *The manuscript is inspired by Corr's (2010) ideas regarding the explanation of both Psychoticism and psychopathy in terms of RST constructs. The literature review describes the historical ideas regarding the relation between Psychoticism and psychopathy especially in regards to Eysenck continuity hypothesis and the distinction between primary and secondary psychopathy. The study is an interesting attempt to explore the relation between Psychoticism and RST measures. Overall the paper is well written and can add substantial to the literature.*

We thank the reviewer very much for their positive comments.

Impulsivity

The construct of impulsivity is complex (attentional, motor and planning) and requires comprehensive measurement. The IPIP Recklessness measure was constructed to be similar to the TCI measure. A more well established and comprehensive measure such as Barratt's BIS would have added significantly. The conclusions should be tempered due to this shortcoming.

We thank the reviewer for this point – and as a result, we have added the following point in the MS as a footnote (footnote 2, page 8): In a separate sample of undergraduates (N = 278), this Recklessness scale was highly correlated with the Barratt Impulsivity scale (BIS-11; Patton, Stanford & Barratt, 1995; r = .70) and the Impulsive sensation seeking scale (ImpSS; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993; r = .60). Therefore – we agree that by using the BIS-11 would mean that we have used a more established and multi-faceted measure. For this reason, we have included a further point in the Discussion section (page 14, para 1) which agrees that it should also be noted, that impulsivity is a complex multi-dimensional construct and the measure used here may not tap into all aspects of impulsivity. As such, future research should also examine the role of other impulsivity constructs in these associations. We thank the reviewer for suggesting this opportunity to temper our conclusions and suggest further work.

Primary and secondary psychopathy.

There appears to be an extensive literature on the distinctions of primary and secondary psychopathy. While this paper is extensively written with this in mind, it does not appear to adequately address this in the measures presented. There were no measures of psychopathy and this leaves no direct way to delineate primary from secondary psychopathy. The correlation of P to both BIS and FFFS is as far as the data allow on this point and this has already been demonstrated in Heym et al. 2008 but not referenced. It would have been exciting to see a test of Eysenck's distinction of high and low anxiety in relation to primary and secondary psychopathy.

We thank the reviewer for this comment, and indeed we are developing follow-up studies which examine just these points, based on Heym (2009). However, we feel that is important at this initial stage to publish the deficits found in psychopathy in normal populations within Psychoticism – especially in the light of the recent work by Corr (2010) who explicitly calls for investigations of this type. Indeed Corr (2010) suggests that '..the core neuropsychological deficits bifurcate into primary and secondary types [of psychopathy]. This differentiation is commonplace in psychopathy research but not so in psychoticism research'. The study presented here begins to provide some indirect evidence for distinct 'primary' and secondary' type differentiation in P, using RST constructs. As such, we do not measure psychopathy – and the revised MS is now rewritten (the introduction, in particular) to more rigorously develop the conceptual argument. Specifically, we have dramatically reduced the discussion of 'psychopathy' per se in general terms, and instead have discussed the paper in terms of Corr's (2010) argument regarding the possible link between the cognitive and emotional processing deficits found in psychopathy and the cognitive and emotional patterns found in P and the potential role of revised RST therein. As a result, the revised manuscript now discusses deficits in psychopathy *purely* in order to identify the anticipated deficits in P – rather than examining P and psychopathy together. We have now clarified this main aim throughout the introduction.

Indeed the introduction now starts with a discussion of Psychoticism and links into Corr's (2010) proposition of the revised RST as a key explanatory model in understanding the neurological mechanisms for P. The basis of the paper in Corr's (2010) argument is reiterated at the bottom of page 2, again – and the use of this argument as a conceptual focus of the study is now highlighted.

Ferguson, E. (2009). A taxometric analysis of health anxiety. *Psychological Medicine, **39***, 277-285.

Heym, N. (2009). *The role of psychoticism and its primary traits impulsivity and empathy in emotions, cognitions and behaviour in normal populations*. Unpublished doctoral thesis. University of Nottingham.

***Title page with author details**

The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity

Nadja Heym, Claire Lawrence

Personality, Social Psychology and Health group, School of Psychology, University of Nottingham, Nottingham NG7 2RD, UK

Correspondence to:

Nadja Heym, PSPH, School of Psychology, University of Nottingham, Nottingham, NG7 2RD, UK; Nadja.Heym@nottingham.ac.uk; Fax: 0044115-951-5324

The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity

Abstract

Gray's revised Reinforcement Sensitivity Theory (rRST; Gray & McNaughton, 2000) may play a role in explaining deficits in Psychoticism (P) and psychopathy (Corr, 2010). In this paper, we examine the relationships of P with anxiety, fear, impulsivity and reward reactivity in normal populations to assess whether these associations mirror the hypothesized role of RST motivations in psychopathy. Two hundred and twelve participants completed measures of Psychoticism, impulsivity and rRST motivations (BIS-anxiety, FFFS-fear and BAS). BIS-anxiety mediated the association of P with FFFS-fear and BAS-fun seeking. An exploratory factor analysis distinguished between trait impulsivity (P, impulsivity and BIS) and reward reactivity (BAS-reward responsiveness and BAS-drive). Subsequent moderation analyses showed that whilst neither BIS nor BAS moderated the P-impulsivity link, the association between P and impulsivity was more pronounced in individuals with raised levels of FFFS-fear. Findings are discussed in terms of the roles of fear versus anxiety and impulsivity versus reward reactivity in the P-psychopathy continuum.

Keywords: Behavioral Inhibition System, Behavioral Activation System, Reinforcement Sensitivity Theory, Psychoticism, Psychopathy

The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity

Introduction

Individuals scoring high on P are impersonal, emotionally indifferent with a shallow affect, lacking empathy, guilt and remorse. They show deficits in cognitive and attentional domains that are reflected in their reckless, antisocial and aggressive tendencies (Eysenck, 1992). It is not surprising, then, that P is associated with offending behavior, and a large corpus of work examining P has been conducted within forensic populations (e.g. Eysenck & Eysenck, 1976), associating P with some of the affective, cognitive and behavioural features seen in psychopathic populations (Howarth, 1986; see also Corr, 2010 for review), and supporting Eysenck's view that psychopathy is at the extreme end of the P dimension (Eysenck & Eysenck, 1976). Recently, Corr (2010) suggested that Gray's revised Reinforcement Sensitivity Theory (rRST; Gray & McNaughton, 2000), namely the roles of fear, anxiety and reward reactivity, may be key in explaining the underlying neurological mechanisms for P and psychopathy.

While the roles of fear, anxiety and reward reactivity have been established as possible underlying core deficits in the development of psychopathic tendencies, little work has demonstrated empirically the association between these rRST components with Psychoticism. Subsequently, this paper examines the link between Psychoticism and the rRST assessing the associations of P with (i) reduced anxiety and fear, and (ii) increased impulsivity and reward reactivity. Following Corr's (2010) discussion on the P-psychopathy continuum, the extent to which these associations mirror the established and theoretical relationships of primary and secondary psychopathy with a lack of anxiety and fear, and raised levels of impulsivity and reward reactivity, respectively, will be discussed.

Eysenck's continuity hypothesis: The Psychoticism-Psychopathy continuum

Investigating the extent to which a lack of fear and anxiety and higher levels of impulsivity found amongst psychopaths (e.g. Hare, 1970), are seen in those high in P in normal populations is important for three main reasons. First, while most research has investigated the role of Psychoticism in criminal populations, less is known of the role of P in cognitions, emotions and behaviour in non-forensic populations. Second, whilst the Psychoticism construct has been extensively validated in criminal and clinical populations applying the continuity approach (Eysenck & Eysenck, 1976), the association of Psychoticism with core deficits associated with psychopathy (Corr, 2010) has not been investigated to the same extent. Finally, if the core deficits typically demonstrated in psychopathy are seen in high P individuals within normal populations, this lends support to the continuity hypothesis (Ferguson, 2009). This investigation is important as one of the main debates in the literature refers to a categorical versus dimensional model for psychopathy. The dimensional view sees psychopathy at the extreme end of one or several continuous normal personality traits (Edens, Marcus, Lilienfeld & Poythress, 2006; Walters, Brinkley, Magaletta & Diamond, 2008). Subsequently, this paper examines the associations of Psychoticism with underlying deficits highlighted in the psychopathy literature in normal populations.

Linking Primary and Secondary Psychopathic Deficits to Psychoticism

Hare, Harpur, Hakstian, Forth, Hart and Newman (1990) described two correlated factors of psychopathic tendencies. The first is concerned with deficits in affective (e.g. lack remorse, guilt and empathy, shallow affect) and interpersonal style (e.g. superficial charm, callousness and deceitfulness), whilst the second is associated with antisocial behaviour (e.g.

impulsivity, aggression, recklessness). Although psychopathy has been generally seen as a unitary construct (Hare & Newman, 2008), some researchers argue that these two factors define specific variants of psychopathy – namely primary and secondary psychopathy, respectively (Skeem, Poythress, Edens, Lilienfeld & Cale, 2003). Although Hare (1982) showed that P was related to psychopathy in male prison inmates, P correlated only with the impulsive and antisocial aspects of secondary psychopathy. However, P is defined by affective deficits (e.g. Eysenck, 1992) also ascribed to primary psychopathy.

Lower levels of anxiety have been regarded as a key feature of psychopathy (Lykken, 1957; Newman & Brinkley, 1997) and the prominent 'lack of fear' hypothesis assumes that psychopaths' lack of fear results in their inability to learn following punishment (Fowles, 1980). Moreover, more recent studies show that the punishment processing deficit is associated with primary psychopathy (Sutton, Vitale & Newman, 2002), whilst secondary psychopathy is linked to higher levels of anxiety and punishment sensitivity (see Skeem et al., 2003 for review). Using rRST constructs (following Corr, 2010), the current study examines whether those high in P demonstrate deficits associated more with primary (lower anxiety and fear) or secondary psychopathy (higher anxiety and fear).

The distinction between fear and anxiety in P and primary psychopathy

Despite conceptual differences between the constructs of anxiety and fear, research has conflated these two when examining psychopathy (Lilienfeld, 1994). Recent revisions of Gray's RST (Gray & McNaughton, 2000) however, highlighted the need to distinguish fear and anxiety in personality research (Corr & McNaughton, 2008). According to the rRST, fear and anxiety are mediated by two separate but interacting brain systems: the fight-flight-freeze system (FFFS) linked to simple avoidance behaviour for aversive/punishment contingencies and the behavioural inhibition system (BIS) linked to conflict detection and risk assessment

via inhibition of ongoing behaviour during approach and/or avoidance conflicts. Subsequently, the BIS mediates approach and avoidance behaviour. Corr (2010) argued that the core deficits seen in both P and psychopathy may result from a dysfunction in BIS. However, despite strong evidence for a link between reduced BIS/anxiety and primary psychopathy in the literature (Newman & Brinkley, 1997; Corr, 2010), Hare and Neumann (2008) argue that psychopathy is only weakly related to reduced anxiety and more associated with a lack of fear. Nevertheless, they emphasised that investigating the interactive roles of both fear and anxiety may help to explain specific deficits associated with psychopathy.

Concerning Psychoticism, it was recently shown that P is negatively associated with BIS and FFFS in normal populations as measured by a revision of Carver and White's (1994) BIS/BAS scales (Heym, Ferguson & Lawrence, 2008). However, in line with the rRST, the lack of fear and punishment sensitivity in P may be mediated by the BIS. Subsequently, the association of P with deficits in anxiety and fear warrants further investigation. The current study uses Heym et al.'s (2008) revision, where following confirmatory factor analysis BIS was split into two factors: BIS-anxiety (four items) and FFFS-fear (three items). This structure was a better fit to the data than the unitary BIS scale or an alternative structure (e.g. Johnson, Turner & Iwata, 2003; Poythress, Skeem, Weir, Lilienfeld, Douglas, Edens & Kennealy, 2008) and demonstrated good internal reliability and discriminant validity with regards to Eysenck's PEN. The Carver and White (1994) scales are the most commonly used instruments to measure RST constructs and as a result, the findings of the current study will be comparable across findings in the wider literature.

Distinguishing between BAS-reward reactivity and trait impulsivity

The third system specified within the rRST - the behavioural approach system (BAS), regulates appetitive motivation and responds to signals of reward or non-punishment, and is

thought to facilitate impulsivity (Gray, 1982). Both, impulsivity and BAS are linked to Psychoticism (Pickering & Gray, 1999) and secondary psychopathy (Newman, MacCoon, Vaughn & Sadeh, 2005), and an increased BAS may therefore underlie the relationship between P and impulsivity. However, Smillie, Jackson and Dalgleish (2006a) argue that BAS is more associated with reward reactivity than P-related trait impulsivity. Indeed, evidence suggests that P is strongly and consistently related to Fun Seeking (BAS-FS), only weakly to Drive (BAS-DR) and negatively to Reward Responsiveness (BAS-RR; Smillie et al., 2006a; Heym et al., 2008). Subsequently, Smillie et al. (2006a) proposed a distinction between reward reactivity incorporating BAS-DR and BAS-RR versus trait impulsivity incorporating BAS-FS, P and impulsiveness. Indeed, as BAS-RR encompasses future-oriented planning and management of uncertainty (Heym et al., 2008), it is contrary to the notion of P-related recklessness and rash impulsiveness. Conversely, BAS-FS items are associated with instant gratification and lack of future contemplation, therefore conceptually more strongly linked to P (Eysenck & Eysenck, 1976). Consequently, prior associations of P and secondary psychopathy with BAS may be due to the conflation of impulsivity and reward reactivity items within BAS scales.

Further, it has also been suggested that impulsivity may be caused by a deficiency in behavioural inhibition (Fowles, 1987). Indeed, according to the rRST, a deficient BIS should lead to reduced avoidance/increased approach in response to novel or conflicting stimuli without consideration of consequences, which may explain the reckless impulsive behaviour associated with P and secondary psychopathy. Consequently, a deficient BIS in high P individuals would lead to impaired risk assessment and account for the (i) negative association of P with FFFS and (ii) positive association of P with BAS. However, a deficient BIS leading to reduced punishment sensitivity (FFFS) was argued to underlie deficits in P akin to primary psychopathy, whereas the impulsive antisocial style associated with

secondary psychopathy is thought to be related to *increased* levels of anxiety or fear (e.g. Skeem et al., 2003). Indeed, contrary to primary psychopathy, secondary psychopathy has been associated with greater psychophysiological responsivity towards threat (Vanman, Mejia, Dawson, Shell & Raine, 2003). This suggests that high levels in FFFS may underlie impulsivity in secondary psychopathy, and thus, potentially P. In the extant literature, therefore, the roles of BIS and FFFS in the P-impulsivity link are unknown.

The current study will further examine the association of P with the rRST variables and in doing so, tease apart the roles of (i) anxiety and fear, and (ii) impulsivity and reward reactivity in P, and their moderating impact as underlying mechanism in the P-impulsivity link. Although the definition of P maps conceptually onto deficits found in psychopathy (Corr, 2010), this study tests specifically how a lack of fear and anxiety, and increased impulsivity and reward reactivity are associated with P in non-forensic populations.

Hypotheses

The following predictions are made:

1. BIS mediates the relationships of Psychoticism with both FFFS and BAS.
2. P and trait impulsivity are more associated with BAS-FS and reduced behavioral inhibition (BIS) as opposed to reward reactivity (BAS-DR and BAS-RR).
3. BAS underlies P-related impulsivity - individuals high in BAS display a greater P-impulsivity link than individuals low in BAS;
4. The extent to which BIS or FFFS underlie the P–impulsivity link will be examined.

Method

Participants and procedure

Two-hundred and twelve undergraduates (age range = 18-42; mean age = 21.63, SD = 4.02) were recruited from a UK University via undergraduate e-mail distribution lists and a participant pool database. Of these, 134 were females[1]. The local ethical review board approved the study.

Measures

Psychoticism was measured using the 32-item P scale from the EPQ-R (Eysenck, Eysenck & Barrett, 1985). The EPQ-R has a yes/no answer format (yes = 1 and no = 0).

Reinforcement sensitivity motivations were measured using Heym et al.'s (2008) conceptualization of the Carver and White (1994) BIS/BAS scales measuring: BIS-anxiety (4 items); FFFS-fear (3-items); BAS – Reward Responsiveness (BAS-RR; 5 items); BAS – Drive (BAS-DR; 4 items); and BAS – Fun Seeking (BAS-FS; 4 items).The three BAS scales were also combined for an overall BAS score (BAS-OV). Items are scored on a scale of 1 (very true for me) to 4 (very false for me).

Impulsivity (IMP) was assessed using the 10-item IPIP Recklessness scale (Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger & Gough, 2006). Items are scored on a scale of 1 (very true for me) to 4 (very false for me). This measure was used as it is a short and reliable assessment of impulsivity[2].

[1] The data were examined for sex differences. Females scored significantly lower in P and higher in BIS-anxiety, FFFS-fear and BAS-RR. Partial correlations controlling for participant sex showed no changes compared to the zero-order correlations. Therefore, the data were analysed as one group.

[2] In a separate sample of undergraduates (N = 278), this Recklessness scale was highly correlated with the Barratt Impulsivity scale (BIS-11; Patton, Stanford & Barratt, 1995; r = .70) and the Impulsive sensation seeking scale (ImpSS; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993; r = .60).

For all scales, higher scores indicated greater levels of the respective measure.

Statistical Analyses

Mediation and moderation analyses were used to examine the relationships between the variables following Baron and Kenny's (1986) procedure. For mediation analyses, indirect effects via mediators were further examined for statistical significance using the Sobel (1982) test. For moderation analyses, simple slope analyses were conducted to further assess the moderation effects at one standard deviation above and below the mean of the moderator across the sample population, which indicates whether the gradients of the slopes are significantly different from zero (Preacher, Curan & Bauer, 2006).

Results

Descriptive Statistics

Descriptive statistics and scale reliabilities for all measures are shown in Table 1. The distributions for P, IMP, BIS-anxiety, FFFS-fear and BAS-RR were significantly skewed and were normalized: negatively skewed variables (BIS-anxiety, FFFS-fear and BAS-RR) were reflected, then Lg10 transformed (together with the positively skewed P and IMP), and then again reflected. Transformed variables were used in the subsequent analyses.

**********INSERT TABLE 1 ABOUT HERE**********

Zero-order Correlations

The zero-order correlations between P, impulsivity and rRST factors are presented in Table 2.

**********INSERT TABLE 2ABOUT HERE**********

The role of BIS in mediating the relationships of P with FFFS and BAS

Two mediation analyses were conducted to examine whether BIS-anxiety mediates the relationship of P with FFFS-fear and BAS-FS (Hypothesis 1). Figure 1 shows that BIS-anxiety fully mediated the association between P and FFFS-fear, confirmed using the Sobel test ($z=-3.62$, $p<.001$). Figure 2 shows that BIS-anxiety only partially mediated the association between P and BAS-FS, and the indirect effect of P on BAS via BIS was not significant (Sobel test: $z=1.72$, $p=.08$).

**********INSERT FIGURE 1 ABOUT HERE**********

**********INSERT FIGURE 2 ABOUT HERE**********

The distinction between P related impulsivity and reward reactivity

A principal component analysis with varimax rotation was conducted on the P, impulsivity, BIS-anxiety, BAS-DR, BAS-RR and BAS-FS scales to explore the distinction between trait impulsivity and reward reactivity (Hypothesis 2). The K1 extraction method, scree-plot and parallel analysis indicated a 2-factor structure, explaining 63.81% of the variance (KMO=.651; Bartlett's Test: $\chi 2=233.486$; $p<.001$). Table 3 shows the factor loadings, with impulsivity, BIS-anxiety and P forming factor 1 (Trait Impulsivity), and BAS-RR and BAS-DR forming factor 2 (Reward Reactivity). BAS-FS loaded onto both factors.

**********INSERT TABLE 3 ABOUT HERE**********

A BAS-Reward Reactivity (BAS-RWR) composite score was computed summing BAS-DR and BAS-RR. Zero-order correlations showed that neither P (r=.09, p=.21), impulsivity (r=.07, p=.29) or BIS-anxiety (r=.06, p=.34) were associated with BAS-RWR.

The moderating impact of rRST components on the P-impulsivity relationship

To examine the moderating role of the RST systems on the P-impulsivity link (Hypothesis 3), five two-step hierarchical regression analyses were conducted, entering P and one of the respective moderator variables in step one and the interaction term[3] in step two, regressing on impulsivity. Three alternative BAS variables were used as potential moderators: BAS-FS (most strongly linked to P and impulsivity), BAS-OV (identified in the literature as being linked to P and secondary psychopathy) and the BAS-RWR factor (as a reward reactivity system independent of trait impulsivity) alongside BIS-anxiety and FFFS-fear. Table 4 shows that the P-impulsivity link was not moderated by any BAS measure or BIS, however, the PxFFFS-fear interaction term showed a trend towards statistical significance (p = .054). Both P (β = .34, p<.001) and FFFS-fear (β = -.20, p<.01) independently predicted impulsivity. The interaction of P with FFFS-fear explained an additional 2% of the variance. The coefficients show that only FFFS-fear (β = -.60, p<.01) and the interaction term between P and FFFS-fear (β=.72, p=.05) were significant in model 2 whilst P became non-significant (β=-.33, p=.35).

**********INSERT TABLE 4 ABOUT HERE**********

[3] Results are reported for non-standardised moderator cross-product terms; however, the standardised moderator variables produced the same results in terms of their significance. All simple slope analyses were conducted with standardised variables.

A simple slope analysis was conducted 1 SD above and below the mean level of FFFS-fear (see Figure 3). The simple slopes were significant for both, lower levels of FFFS-fear ($\beta = .03$, $t = 2.74$, $p<.01$) and higher levels of FFFS-fear ($\beta = .05$, $t = 4.82$, $p<.001$). Although at lower levels of P, low FFFS-fear was linked to greater impulsivity compared to high FFFS, the P-impulsivity slope was steeper in high FFFS-fear.

**********INSERT FIGURE 3 ABOUT HERE**********

Discussion

This paper makes two key contributions to the literature. First, it demonstrates that P is associated with reduced fear and anxiety akin to primary psychopathy, and increased impulsivity akin to secondary psychopathy. Second, it distinguishes between (i) fear and anxiety, highlighting the key role of BIS as a mechanism for punishment insensitivity in P, and potentially primary psychopathy; and (ii) impulsivity and reward reactivity, questioning the role of BAS underlying impulsive behaviour in P, and potentially secondary psychopathy. As such the findings provide a basis for future work within forensic settings.

Psychoticism-psychopathy continuum: The association of P with the rRST components

The results showed that Psychoticism is linked to reduced fear (FFFS) and anxiety (BIS) as well as increased behavioural activation (BAS), showing the same pattern as found in psychopathy (e.g. Newman et al., 2005), thus, supporting Eysenck's continuity hypothesis. However, one of the problems in the literature has been the lack of distinction between the constructs of anxiety and fear. The present findings show that although Psychoticism is associated with a lack of FFFS-fear, this appears to be due to a deficit in BIS indicating that punishment insensitivity in high P is due to a reduced appraisal and risk assessment

mechanism (Heym et al., 2008). These associations of P with lack of fear and anxiety have not been demonstrated elsewhere, but closely mirror the processing deficits associated with primary psychopathy. Although Hare and Neumann (2008) argued that the role of anxiety was less important than the lack of fear in psychopathy, the current findings support Corr's (2010) argument that BIS may be fundamental in explaining core psychopathic deficits. Future research should incorporate this theoretical framework for the distinction between anxiety and fear as potential underlying mechanisms in the affective-interpersonal deficits associated with primary psychopathy, and use additional indexes of BIS and FFFS to assess the robustness of their influence.

Impulsivity versus reward reactivity in Psychoticism

Although Psychoticism was linked to increased behavioural activation (BAS-FS), this association was only partially due to a deficient BIS. Thus, a deficient BIS leading to reduced punishment sensitivity ***and*** an overactive BAS-FS play a role in Psychoticism. However, while BAS has been linked to secondary psychopathy (Newman et al., 2005), and is assumed to underlie the P-impulsivity link (Pickering & Gray, 1999), the current findings show that P and impulsivity (i) formed a factor with BIS rather than BAS; (ii) were only related to BAS-Fun Seeking; and (iii) were unrelated to the BAS reward reactivity factor. Thus, the findings suggest that reward sensitivity is not primarily associated with P-related impulsivity, and thus, potentially secondary psychopathy.

Moreover, the current findings highlight the problem of using total BAS scores due to the different qualities of the subscales. Reward reactivity could be conceptualised as a functional trait underlying pure BAS-mediated approach motivation (Smillie & Jackson, 2006b). Fun-seeking motivations, however, may have functional *and* dysfunctional outcomes, which are more dependent on behavioural inhibition and the ability to consider

consequences. The findings support a possible two-factor structure of the BAS scales separating reward reactivity from trait impulsivity, and provide support for revision of these scales in future research (Smillie et al., 2006a).

The role of the rRST as underlying mechanism in the P-impulsivity link

P coupled with high levels of FFFS-fear, but not BIS or BAS, led to more pronounced impulsivity. Thus, although P was generally associated with a lack of punishment sensitivity due to reduced levels of BIS, high P individuals with increased fear sensitivity may show greater impulsive behaviour akin to secondary psychopathy. Conversely, the weaker P-impulsivity link in low FFFS mirrors the pattern for primary psychopathy which is associated with more goal-directed and instrumental behaviour (Lilienfeld & Andrews, 1996). Moreover, FFFS appears important in explaining reduced impulsive behaviour at low levels of P where individuals scoring high in FFFS showed lower levels of impulsivity compared to those scoring low on FFFS. Thus, increased punishment sensitivity and avoidance motivation in low P individuals may be protective, preventing these individuals from reacting impulsively. Future work should address the role of the FFFS as an underlying mechanism in the impulsive behavioural style in secondary psychopathy to assess whether the pattern found for Psychoticism replicates in those individuals, thus supporting the P-psychopathy continuum. However, it should also be noted, that impulsivity is a complex multi-dimensional construct and the measure used here may not tap into all aspects of impulsivity. As such, future research should also examine the role of other impulsivity constructs in these associations.

Conclusion

Taken together with the speculations of Corr (2010), the current findings suggest that P along with rRST constructs could be used to measure deficits associated with primary *and* secondary psychopathy in normal populations. Finally, this paper raised some methodological questions in relation to the measurement of reward reactivity and impulsivity and starts to answer some questions regarding the conceptualisation and measurement of psychopathic deficits in normal populations.

References

Baron, R.M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Carver, C.S., & White, T.L. (1994). Behavioral inhibition, behavioral activation and affective responses to impending reward and punishment: the BIS-BAS scales. *Journal of Personality and Social Psychology, 67*, 319-333.

Corr, P.J. (2010). The psychoticism-psychopathy continuum : A neuropsychological model of core deficits. *Personality and Individual Differences, 48,* 6, 695-703.

Corr, P. J. & McNaughton, N. (2008). Reinforcement Sensitivity Theory and personality. In P. J. Corr (Ed), *The Reinforcement Sensitivity Theory of Personality* (pp. 155-187). Cambridge: Cambridge University Press.

Edens, J.F., Marcus, D.K., Lilienfeld, S.O., & Poythress, N.G. (2006). Psychopathic, not psychopath: Taxometric evidence for the dimensional structure of psychopathy. *Journal of Abnormal Psychology, 115*, 131–144.

Eysenck, H.J. (1992). The definition and measurement of psychoticism. *Personality and Individual Differences, 13*, 757-785.

Eysenck, H.J., & Eysenck, S.B.G. (1976). *Psychoticism as a dimension of Personality*. London: Hodder & Stoughton.

Eysenck, S.B.G., Eysenck, H.J., & Barratt, P. (1985). A revised version of the psychoticism scale. *Personality and Individual Differences,6,* 21-29.

Ferguson, E. (2009). A taxometric analysis of health anxiety. *Psychological Medicine, **39**,* 277-285.

Fowles, D.C. (1980). The three arousal model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology, 17,* 87-104.

Fowles, D.C. (1987). Application of a behavioural theory of motivation to the concepts of anxiety and impulsivity. *Journal of Research in Personality, 21,* 417-435.

Goldberg, L.R., Johnson, J.A., Eber, H.W., Hogan, R., Ashton, M.C., Cloninger, C.R., & Gough, H.C. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality, 40,* 84-96.

Gray, J.A. (1982). *Neuropsychological Theory of Anxiety: An investigation of the septal-hippocampal system.* Cambridge: Cambridge University Press.

Gray, J.A., & McNaughton, N. (2000). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system* (2nd ed), Oxford University Press, Oxford.

Hare R.D. (1970). *Psychopathy: Theory and Research.* Wiley, New York.

Hare, R.D. (1982). Psychopathy and the personality dimensions of psychoticism, extraversion and neuroticism. *Personality and Individual Differences, 3,* 35-42.

Hare, R.D., Harpur, T.J., Hakstian, A.R., Forth, A.E., Hart, S.D., & Newman, J.P. (1990). The revised psychopathy checklist: Reliability and factor structure. *Psychological Assessment, 2,* 338.

Hare, R.D., & Neumann, C.S. (2008). Psychopathy as a clinical and empirical construct. *Annual Review of Clinical Psychology, 4*, 217-246.

Heym, N., Ferguson, E., & Lawrence, C. (2008). An evaluation of the relationship between Gray's revised RST and Eysenck's PEN: Distinguishing BIS and FFFS in Carver and White's BIS/BAS scales. *Personality and Individual Differences*, 45, 709-715.

Howarth, E. (1986). What does Eysenck's psychoticism scale really measure? *British Journal of Psychology, 77*, 223-227.

Johnson, S.L., Turner, R.J., & Iwata, N. (2003). BIS/BAS levels and psychiatric disorder: an epidemiological study. *Journal of Psychopathology and Behavioral Assessment, 25*, 25–36.

Lilienfeld, S.O. (1994). Conceptual problems in the assessment of psychopathy. *Clinical Psychology Review, 14*, 17-38.

Lilienfeld, S.O., & Andrews, B.P. (1996). Development and preliminary validation of a self-report measure of psychopathic personality traits in noncriminal populations. *Journal of Personality Assessment, 66*, 488-524.

Lykken, D.T. (1957). A study of anxiety in the sociopathic personality. *Journal of Abnormal and Social Psychology, 55*, 6–10.

Newman, J.P., & Brinkley, C.A. (1997). Reconsidering the low-fear explanation for primary psychopathy. *Psychological Inquiry, 8*, 236–260.

Newman, .P, MacCoon, D.G., Vaughn, L.J., & Sadeh, N. (2005). Validating a distinction between primary and secondary psychopathy with measures of Gray's BIS and BAS constructs, *Journal of Abnormal Psychology, 114*, 319–323.

Patton, J.H., Stanford, M.S. & Barratt, E.S. (1995). Factor structure of the Barratt impulsivity scale: Journal of Clinical Psychology, 51, 768-774.

Pickering, A.D., & Gray, J.A. (1999). The neuroscience of personality. In L. Pervin & O. John (Eds.), *Handbook of Personality* (2nd ed.). New York: Guilford Press.

Poythress, N. G., Skeem, J. L., Weir, J., Lilienfeld, S. O., Douglas, K. S., Edens, J. F., & Kennealy, P.J. (2008). Psychometric properties of Carver and White's (1994) BIS/BAS scales in a large sample of offenders. *Personality and Individual Differences, 45,* 732–737.

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics, 31,* 437-448.

Skeem, J.L., Poythress, N., Edens, J.F., Lilienfeld, S.O., & Cale, E.M. (2003). Psychopathic personality or personalities? Exploring potential variants of psychopathy and their implications for risk assessment. *Aggression and Violent Behavior, 8,* 513-546.

Smillie, L.D., & Jackson, C.J. (2006a). Functional impulsivity and reward-reactivity. *Journal of Personality, 74,* 47-83.

Smillie, L. D., Jackson, C. J., & Dalgleish, L. I. (2006b). Conceptual distinctions among Carver and White's (1994) BAS scales: A reward-reactivity versus trait impulsivity perspective. *Personality and Individual Differences, 40,* 5, 1039.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology*, (pp. 290-312). San Francisco: Jossey-Bass.

Sutton, S.K., Vitale, J.E., & Newman, J.P. (2002). Emotion among women with psychopathy during picture perception. *Journal of Abnormal Psychology*; *111*, 610-619.

Vanman, E.J., Mejia, V.M., Dawson, M.E., Raine, A., & Schell, A.M. (2003). Modification of the startle reflex in a community sample: Do one or two dimensions of psychopathy underlie emotional processing? *Personality and Individual Differences, 35,* 2007-2021.

Walters, G.D., Brinkley, C.A., Magaletta, P.R., & Diamond, P.M. (2008). Taxometric analysis of the Levenson Self-Report Psychopathy scale. *Journal of Personality Assessment, 90*, 491-8.

Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P. & Kraft, M. (1993). A comparison of three structural models for personality: The big three, the big five, and the alternative five. *Journal of Personality and Social Psychology, 65*, 757-768.

Table1

Table 1

Descriptive Statistics for all variables

Scale	α	Mean	SD	Z_{skew}	Z_{Kurt}
P	.71	5.81	3.67	5.08	1.76
P^t		0.74	0.24	-0.74	-1.90
IMP	.86	20.56	5.07	4.46	3.39
IMP^t		1.30	0.11	-0.63	0.99
BIS-anx	.75	12.80	2.51	-4.05	-0.15
$BIS\text{-}anx^t$		1.01	0.13	-0.70	-2.55
FFFS-fear	.73	8.68	2.09	-2.30	-1.01
$FFFS\text{-}fear^t$		0.78	0.15	1.88	-1.72
BAS-RR	.57	16.89	2.05	-4.15	2.24
$BAS\text{-}RR^t$		1.17	0.07	-1.26	-0.47
BAS-DR	.76	10.27	2.52	0.75	-2.36
BAS-FS	.73	11.63	2.43	-1.13	-1.81
BAS-OV	.78	38.71	5.35	-0.95	-1.10

Note: SE Skew = 0.168, Z test for significance of skew (>1.96) = coefficient of skew/SE of skew; Z test for significance of kurtosis (>1.96) = coefficient of kurtosis/SE of kurtosis; superscript t denotes transformed variables

Table 2

Correlations for all variables

	P	IMP	BIS-anx	FFFS-fear	BAS-RR	BAS-DR	BAS-FS
IMP	.39**						
BIS-anx	-.29**	-.46**					
FFFS-fear	-.21**	-.27**	.48**				
BAS-RR	-.09	-.12	.38**	.09			
BAS-DR	.09	.08	.06	-.17*	.42**		
BAS-FS	.28**	.41**	-.16*	-.29**	.30**	.38**	
BAS-OV	.14	.17*	.10	-.17*	.72**	.80**	.76**

Note: *p<.05; **p<.01; N=212; P = Psychoticism; IMP = impulsive recklessness; BIS-anx = BIS-anxiety, BAS-RR = reward responsiveness; BAS-DR = drive; BAS-FS = fun seeking; BAS-OV = overall BAS

Table 3

Factor loadings (>0.4) of impulsivity vs. reward reactivity scales

Scales	Trait Impulsivity	Reward Reactivity
Impulsivity/recklessness	.82	
BIS-anxiety	-.76	
Psychoticism	.67	
BAS-Reward Responsiveness		.81
BAS-Drive		.78
BAS-Fun Seeking	.51	.66
Eigenvalue	2.07	1.77

Table 4

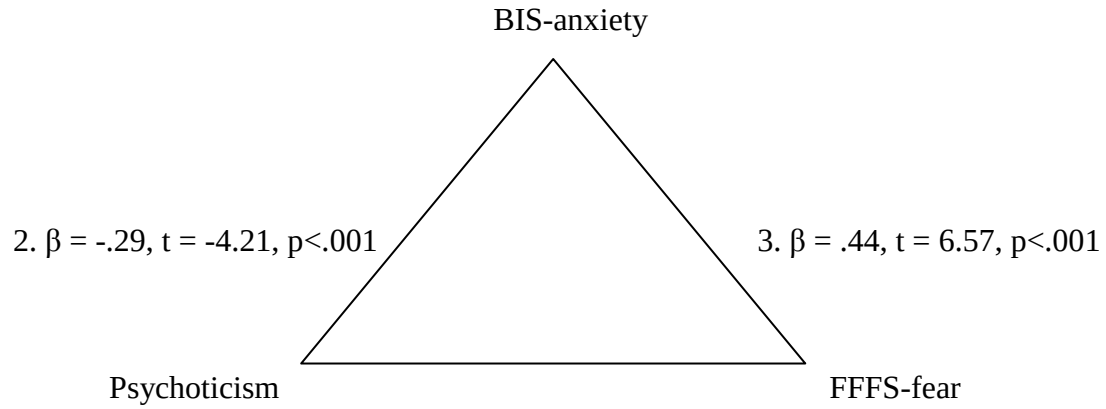
Moderation models for P with RST components on impulsivity

Interaction Term	Step 1: P and moderator	Step 2: interaction term
PxBIS-anxiety	R=.52, $F_{2,190}$=35.97, p<.001	ΔR^2=.01, $F_{1,189}$=2.27, p=.133
PxFFFS-fear	R=.43, $F_{2,190}$=21.93, p<.001	ΔR^2=.02, $F_{1,189}$=3.77, p=.054
PxBAS-FS	R=.49, $F_{2,190}$=30.86, p<.001	ΔR^2=.24, $F_{1,189}$=0.92, p=.338
PxBAS-RWR	R=.39, $F_{2,190}$=16.95, p<.001	ΔR^2=.01, $F_{1,189}$=0.00, p=.998
PxBAS-OV	R=.41, $F_{2,190}$=19.05, p<.001	ΔR^2=.01, $F_{1,189}$=1.46, p=.229

Figure1

Figure 1

Mediation of BIS-anxiety on the relationship between P and FFFS-fear



1. β = -.20, t = -2.89, p = .004

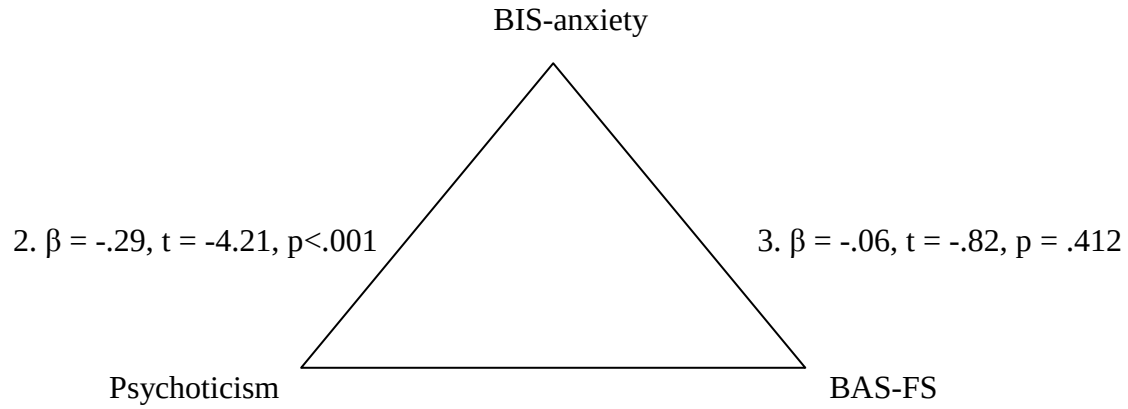
4. β = -.08, t = -1.14, p = .255 n.s.

			95% Confidence for B	
	ΔR^2	B	Lower	Upper
Path 1	.04	-.12	-.21	-.04
Path 2	.08	-.29	-.23	-.08
Path 3	.21	.51	.35	.66
Path 4	.01	-.05	-.13	.03

Figure2

Figure 2

Mediation of BIS-anxiety on the relationship between P and BAS-FS



1. β = .28, t = 3.99, p<.001

4. β = .26, t = 3.58, p<.001

			95% Confidence for B	
	ΔR^2	B	Lower	Upper
Path 1	.08	2.90	1.47	4.34
Path 2	.08	-0.29	-0.23	-0.08
Path 3	.02	-1.18	-3.99	1.64
Path 4	.06	2.72	1.22	4.22

Figure 3

Simple slopes for the relationship between P and impulsivity at 1 SD above and below the mean of FFFS-fear