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Risk as Reward:

Reinforcement Sensitivity Theory and Psychopathic Personality Perspectives on Everyday Risk-Taking

[ACCEPTED: Personality and Individual Differences]

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Highlights

- We studied risk-taking using impulsive, fearless and antisocial traits
- We find that Fearlessness (across models) related to 'pro-social' risks
- We find that Impulsivity (across models) related to health and ethical risks
- RST and callous-unemotional traits can be combined to represent psychopathic personality

Abstract

This study updates and synthesises research on the extent to which impulsive and antisocial disposition predicts everyday pro- and antisocial risk-taking behaviour. We use the Reinforcement Sensitivity Theory (RST) of personality to measure approach, avoidance, and inhibition dispositions, as well as measures of Callous-Unemotional and psychopathic personalities. In an international sample of 454 respondents, results showed that RST, psychopathic personality, and callous-unemotional measures accounted for different aspects of risk-taking behaviour. Specifically, traits associated with 'fearlessness' related more to 'prosocial' (recreational and social) risk-taking, while traits associated with 'impulsivity' related more to 'antisocial' (ethical and health) risk-taking. Further, we demonstrate that psychopathic personality may be demonstrated by combining the RST and callous-unemotional traits (high impulsivity, callousness, and low fear). Overall this study showed how impulsive, fearless and antisocial traits can be used in combination to identify pro- and anti-social risk-taking behaviours; suggestions for future research are indicated.

Keywords: Personality; Reinforcement Sensitivity Theory; Psychopathy; Callous-Unemotional traits; Risk-taking.

1. Introduction

Individuals prone to high risk-taking behaviour create problems for themselves and society (Wilson & Daly, 1985). Research into early indicators of antisocial behaviours has highlighted the importance of impulsivity (Bacon, Corr & Satchell, 2018; Carroll et al., 2006; Loeber et al., 2012; Lynam, et al., 2000), sensation seeking (Mann et al., 2017; Pérez & Torrubia, 1985; Simó, & Pérez, 1991), and poor social understanding (Hepper, Hart, Meek, Cisek & Sedikides, 2013). All three of these traits are relevant for explaining youth (e.g., Sitney, Caldwell & Caldwell, 2016) and adult (e.g. Krstic et al., 2017; Shepherd, Campbell & Ogloff, 2016) offending behaviour. However, not all societal problems are criminal in nature and risk-taking in financial, health and recreational domains may also lead to negative social consequences. There has been caution regarding the application of the *trait* models of personality to *state* and domain dependent risk-taking (Blais & Webber, 2006); however, contemporary personality theorising has highlighted the importance of impulsivity and fearlessness (see Corr, 2016). Both of which are, theoretically, antecedents to risk-taking behaviour. This study investigated the extent to which personality theories can account for, and possibly help to explain, risk-taking across multiple domains of pro- and antisocial behaviour.

The traits of impulsivity, risk-taking and antisociality are similar to those used to characterise psychopathic personality (Lilienfeld, Latzman, Watts, Smith & Dutton, 2014; Patrick, Fowles & Krueger, 2009). The terminology used by different groups of psychopathy researchers may diverge, but there is general consistency in a three trait model. For example, the Psychopathic Personality Inventory may be considered in terms of three higher -order factors: Fearless Dominance (social influence and low stress), Self-Centred Impulsivity (non-planful behaviour and rebelliousness) and Coldhearted disconnection from other people (Lilienfeld et al., 2014; Lilienfeld & Widows, 2005). In a similar manner, Patrick et al. (2009) consider a triarchic model of psychopathic personality containing Boldness ("a tolerance for unfamiliarity and danger"), Disinhibition ("propensity toward impulsive control problems"), and Meanness ("deficient empathy" and "callousness"). It is important to note that there are differences in the detail of these three-part solutions (e.g., the social dominance of Patrick et al.'s Meanness is explicitly separated out in Lilienfeld & Windows's 2005 measure). The popular Psychopathy Checklist (PCL-R, Hare, 2003) points to the existence of four factors:

Interpersonal ('grandiose self-worth'), Lifestyle (impulsivity and irresponsibility), Antisocial (poor behavioural controls and adolescent antisocial behaviour) and Affective (shallow affect and lack of empathy) deficits. There are conceptual (Patrick et al., 2009) and statistical (notable intercorrelations between factors; Neumann, Hare & Pardini, 2014) reasons to be circumspect of the four-part solution to the PCL-R; in fact, "the PCL-R interpersonal facet overlaps with the PCL-R's Affective, Lifestyle and Antisocial facets" (Patrick et al., 2009, p. 927). For example, the PCL-R facet on Lifestyle includes impulsivity as a criteria and the Antisocial facet includes the highly similar 'poor behavioral control'. As others have argued (Patrick et al., 2009), it is possible to consider the widely-used PCL-R in terms of the three facets described by others. As a generalisation these explanations of psychopathic personality describe: (1) low fear or stress; (2) impulsive or nonplanful behaviour; and (3) antisocial or socially manipulative disposition (Drislane, Patrick & Arsal, 2014; Patrick et al., 2009, for a review). These three traits can be observed in the population at large and are distinct from clinical diagnoses of psychopathy (Hall & Benning, 2006; Levenson et al., 1995; Skeem, Poythress, Edens, Lilienfeld & Cale, 2003).

General models of personality have been related to psychopathic disposition. One such model, which addresses impulsivity and risk sensitivity, is the Reinforcement Sensitivity Theory (RST) of personality (Corr, 2004; 2016). RST may be seen as complementary to theories of psychopathic personality as both focus on reward and punishment (RST: Corr, 2016; Psychopathy: Patrick & Bernat, 2009) and have a neuropsychological explanation (RST: Corr, 2004; Psychopathy: Wahlund, & Kristiansson, 2009). To contribute to the growing body of work on normative (as opposed to clinical) explanations of high risk behaviour, the current study brings together contemporary measures of RST with measures of callous-unemotionality to predict psychopathic personality and everyday risk-taking.

RST considers three main traits that attempt to account for personality factors that are sensitive to contingencies in the environment. The tendency to avoid potential harm and react to aversive stimuli is mediated by the Fight/Flight/Freeze System (FFFS) - an individual who has a strong FFFS disposition is more likely to be phobic and overly avoid potential risks (Corr, 2008). The Behavioural Approach System (BAS) manages the seeking and control of appetitive rewards in the

world - an individual whose personality is strongly influenced by the BAS is likely to be impulsive, sensitive to novelty and more diligent in pursuing rewards (Corr & Cooper, 2016). These two personality factors are moderated by a Behavioural Inhibition System (BIS), which is activated upon detection of significant goal conflict (e.g., FFFS and BAS co-activation). A BIS individual is oriented towards hesitancy and rumination, during which time the eliciting conflicting goal stimuli are subjected to cognitive appraisal. The outcome is that stimuli are either classified as appetitive or aversive – or, in more general terms, an attractor or repulsor (Corr & McNaughton, 2012) - or neither, in which case control reverts to a 'just checking' neutral mode. A dominant BIS personality trait is likely to lead to more everyday hesitancy, anxiety and worry (Corr, 2008). Although there is a well-developed and growing RST literature, there is still limited evidence on its explanatory utility to predict everyday behaviours. There has been some work along these lines, including educational outcomes (Satchell, Hoskins, Corr & Moore, 2017), antisocial behaviour (Bacon et al., 2018) and organisational behaviour (Corr et al., 2016), but little else. Indeed, RST has not been widely used to explore everyday risk in any great detail, whilst other models (psychopathic personality research) often explicitly focus on the broad behavioural outcome of risk-taking. Theoretically, RST is well suited to describing risk-taking behaviour. The BAS tendencies to be impulsive and novelty seeking should be expected to lead to more risk-taking, whereas the defensive nature of high trait FFFS individuals and the cautiousness of high BIS individuals should lead to less risky behaviour.

There is evidence to suggest an overlap between RST and psychopathic personality traits. There are key papers that define psychopathy in RST terms, such as Corr's (2010) work on identifying 'primary' psychopathy in terms of low functioning FFFS and BIS and 'secondary' psychopathy with high functioning BAS. The widely used Carver and White (1994) RST tool has previously been related to measures of the triarchic model of psychopathy (Sellbom & Phillips, 2013) and Levenson's (Levenson, Kiehl & Fitzpatrick, 1995) primary and secondary psychopathy (Hughes, Moore, Morris & Corr, 2012). However, the Carver and White (1994) measure was designed for the original version of RST which did not differentiate FFFS and BIS processes and, even with revisions to the analysis of the Carver and White tool (Heym, Ferguson & Lawrence, 2008), it still does not capture fully the contemporary understanding of RST (Corr, 2016; Corr & Cooper, 2016). Our current

study updates the literature relating RST to psychopathic personality traits, but by using a more comprehensive measure of RST (Corr & Cooper, 2016) and a measure of psychopathic personality (Lilienfeld, 2004).

Unlike many personality models, such as the Big Five (see Soto & John, 2009), HEXACO (Lee & Ashton, 2004) and the MMPI (Greene, 2000), the RST of personality does not have an explicit focus on social and interpersonal interests. It has been shown that social behaviours are 'rewarding', in both neuroendocrine (Dunbar & Shultz, 2007) and cognitive (Clark, 1993) terms, and sociality could be expected to be associated with high reward seeking (BAS) and low fear (FFFS) and anxiety (BIS) behavioural patterns. So, whilst RST has the potential to explore some facets of psychopathy in more detail, it lacks the essential antisocial components to take the place of psychopathy.

A subset of psychopathic personality research has focused on, and refined, measures of antisocial disposition. Measures of callous and unemotional traits were developed to explore lack of empathy and coldheartedness in more detail (Frick, 2004; Essau, Sasagawa & Frick, 2006). Given the shared lineage, it is unsurprising that the callous-unemotional trait measures correlate highly with psychopathic personality (Kimonis, Branch, Hagman, Graham & Miller, 2013) and lowly with anxiety (uncaring; Byrd et al., 2013). Recently, it has also been demonstrated that the original three callous-unemotional traits are best represented by a core antisocial trait (Ray, Frick, Thornton, Steinberg & Cauffman, 2016). This well-developed measure of antisocial tendencies provides a strong framework to examine the extent to which callous-unemotional disposition relates to different domains of risk-taking.

Callous-unemotional traits lack the impulsivity and fearlessness aspects of a complete psychopathic personality profile. There has been some previous research relating callous-unemotional traits to RST in adolescents (Roose, Bijttebier, Claes & Lilienfield, 2011); but this study, once again, used the less-than-comprehensive Carver and White (1994) psychometric measures of RST. Roose et al. (2011) reported that the callous-unemotional factor of the youth Psychopathic Traits Inventory (Adershed, Kerr, Stattin & Levander, 2002) was negatively correlated with FFFS, BIS, and BAS reward responsiveness. With callous-unemotional traits addressing the social tendencies that are lacking in assessments of RST personality, it could be the case that combining these two models

produces an effective proxy of psychopathic personality, and one based in normally distributed personality traits and processes. Furthermore, this research strategy allows us to explore the relationship between antisocial traits and RST, using updated tools that have more psychometrically robust trait measures (Corr & Cooper, 2016; Ray et al., 2016), than those used in Roose et al.'s (2011) previous work.

This study has two principal aims. First, to demonstrate the expected overlap between measures of psychopathic, RST and callous-unemotional personality traits. Secondly, to explore the extent to which these three popular tools can predict everyday risk-taking in non-criminal domains.

We hypothesised the following. (1) Variance in psychopathic personality traits can be explained by antisocial (callous-unemotional), fear and impulsivity (RST) traits - this effect would largely be a replication of known effects and a synthesis of previous literature using contemporary tools. (2) Risk-taking should be predicted by high RST impulsivity (BAS) and low FFFS. (3) High fearless and impulsive psychopathic personality should also predict risk-taking, as should (4) a callous-unemotional disposition. In addition, it is of further interest to explore the differences between the correlates of pro- and antisocial domains of risk-taking which, themselves, may show differential associations with the personality and psychopathic measures.

Method

2.1 Participants. Respondents were recruited using websites that advertise academic research. To motivate engagement with the study, they were told that they would receive a personalised summary of their BIS, BAS and FFFS trait scores. They were informed during briefing that incomplete data would be considered as withdrawal from the study and incomplete datasets would not be retained for analysis. In total, there were 732 individuals who clicked on the study; however, only 454 respondents provided complete data for analysis and to respect participant withdrawal from the study all incomplete data were deleted.

This sample had more females (n = 277) than males (n = 161, with prefer not to say, other or missing = 16). The average age was 26.80 years old (SD_{Age} = 8.21, Min_{Age} = 18, Max_{Age} = 65, 27 did not report). Other sample characteristics included: heterosexual (n = 297; bisexual = 89, homosexual = 26, other/prefer not to say = 42); speaking English as a first language (n = 357, as a foreign

language = 97); and engaging in optional education (mandatory pre-16 only = 28, post 16 years old = 121, undergraduate = 193, postgraduate = 112). Respondents reported if they lived in the UK (*n* = 199), outside the UK but inside the EU (*n* = 85) or outside the EU (*n* = 250).

2.2 Procedure and materials. After giving informed consent, respondents completed four questionnaires presented in chronological order, as shown below. Descriptive, reliability and normality statistics for the traits can be found in Table 1. It should be noted that, as would be expected with these risk-taking and antisocial traits, many of the distributions were skewed and non-normal.

2.2.1 The Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ). The 65-item RST- PQ (Corr & Cooper, 2016) contains a series of statements that may describe the respondents (e.g., *"I am very open to new experiences in life"* & "*I find myself doing things on the spur of the moment*"). Participants are asked "how accurately does this statement describe you?", and respond on a scale of *Not at all* (0) to *Slightly* (1), *Moderately* (2) to *Highly* (3) in each case. The RST-PQ has the following scales: Fight/Flight/Freeze System (FFFS), Behavioural Inhibition System (BIS), and Behavioural Approach System (BAS) - the BAS is divided into four subdomains of novelty attractiveness (BAS-Reward Interest), spontaneity of behaviour (BAS-Impulsivity), long-term planning (BAS-Goal-Drive Persistence) and sensitivity to gains (BAS-Reward Reactivity).

2.2.2 Psychopathic Personality Inventory – Revised: Short Form (PPI-R:SF). The 56-item PPI-R:SF (Lilienfeld & Widows, 2005) assesses eight subdomains of a psychopathic personality which can be analysed in three higher-order factors and also yields an overall psychopathic personality score (Lilienfeld et al., 2014). The Fearless Dominance domain contains such behaviours as low resting stress, low fearlessness and social control. Self-Centred Impulsivity reflects blaming others, carelessness, non-conformity and ego driven behaviour. Cold-heartedness is a smaller domain that is focused on lack of interest in social and interpersonal issues. Respondents answer these questions using by stating how true the statements are for them on a scale of *True* (3), *Mostly True* (2), *Mostly False* (1) and *False* (0). See Table 1 for descriptive statistics and reliabilities of the traits.

2.2.3 Inventory of Callous-Unemotional (ICU) traits. Respondents completed the ICU (Essau et al., 2006) which is a tool that assesses antisocial tendencies. This involves tendencies to be Callous (not caring attitude towards others, e.g., "*I do not care who I hurt to get what I want*"),

Uncaring (not caring attitude towards performance, e.g., the revised "*I work hard on everything I do*"), and Unemotional (not emoting openly, e.g., "*I do not show my emotions to others*"). Respondents are asked if the statement is true for them: *Definitely True (3), Mostly True (2), Slightly True (1) or Not at all True (0).* In line with the latest recommendations for analysis, we computed one overall factor to reflect ICU responding (Ray, et al, 2016). The reliability and distribution of scores can be found in Table 1.

2.2.4 Domain-Specific Risk-Taking scale (DOSPERT). The Blais and Weber (2006) DOSPERT measures the propensity to risk take in differing domains: Ethical Risk (e.g., *"Having an affair with a married man/woman"* and *"passing of somebody else's work as your own"*); Financial Risk (e.g., "*Betting a day's income at the horse races*" and "*Investing 10% of your annual income on a new business venture*"); Health Risk (e.g., "*Engaging in unprotected sex*" and "*Riding a motorcycle without a helmet*"); Recreational Risk (e.g., "*Taking a skydiving class*" and "*Piloting a small plane*"); and Social Risk (e.g., "*Disagreeing with an authority figure on a major issue*" and "*Admitting that your tastes are different from those of a friend*"). We assessed the responses to this measure by asking respondents how likely they were, on a scale of *Extremely Unlikely* (1) through *Not Sure* (4) to *Extremely Likely* (7), to engage with the risk behaviours. We find the internal reliability for the Ethical and risk-taking to only be moderate (see Table 1). Financial, Recreational and Social risk-taking showed greater internal reliability.

As expected in a general sample, the DOSPERT responses presents a profile of, on average, 'Unlikely' to engage in risk-taking behaviour. The notable exception is Social risk-taking where mean responses are comfortably within the "likely" range.

[Insert Table 1 here]

2.3 Analyses.

There are two aims in this paper. First to explore covariance in the trait models and secondly to investigate extent to which the trait models predict risk-taking behaviour. To analyse shared variance in the trait domains, we conducted pairwise correlations between the trait measures. We further conducted an oblimin (oblique) exploratory factor analysis using the R package 'psych'

(Revelle, 2017). The factor number fit solutions were investigated using parallel analysis and model fit indices.

The effectiveness of the trait measures at predicting risk-taking behaviour was analysed using regression models. To investigate how the RST-PQ trait measures predicted risk-taking, hierarchical regressions were built with a null model containing sex and age (for their known relationship with antisociality) then, a second model containing the RST-PQ personality traits of interest and then a third model was built containing the additional psychopathic and callous-unemotional personality traits. This would provide information as to the importance of antisocial oriented personality traits are needed to explain risk-taking behaviour and if the RST-PQ traits are sufficient to explain risk-taking. We also conducted pairwise correlations between the risk-taking domains and the trait measures.

3. Results

3.1 Shared variance in psychometric measures. We initially analysed the relationship between the psychometric measures of RST personality (from the RST-PQ), dispositional callous-uncaringness (from the overall score of the ICU) and psychopathic personality (from the PPI-R:SF). The correlation between these variables can be found in Table 2. The ICU general trait positively correlated psychopathic Coldheartedness, and negatively with RST BAS factors (predominantly Reward Reactivity). As would be expected, BAS Impulsivity positively correlated with PPI-R:SF impulsivity and fearlessness negatively correlated with RST fear (FFFS) and anxiety (BIS). Interestingly, there were negative correlations across RST domains of BIS, FFFS and BAS-Reward Reactivity and PPI-R:SF Coldheartedness. As RST lacks an explicit social facet, these correlations (distinct to those with the ICU traits) are informative about the roles of anxiety, fear and reward sensitivity to social disconnection.

These results were supplemented with a factor analysis to explore the smallest number of factors that explain these similar trait domains. All RST-PQ traits, the ICU summary trait and three domains of the PPI-R:SF were entered into the exploratory factor analysis.

[Table 2 about here]

A parallel analysis ('fa.parallel', Revelle, 2017) suggested a four factor solution, however the model fit indices were not optimal (RMSEA= .11, 95% CI [.08, .13], Tucker Lewis index= .86). A

five factor model was built, achieving a good model fit (RMSEA= .06, 95% CI [.02, .10], Tucker Lewis index= .96). The factor loadings of this five factor model are found in Table 3. The analysis grouped the 'impulsive factors' of RST-PQ's BAS Impulsivity and the PPI-R:SF's Self-Centred Impulsivity (BAS-Reward reactivity also reasonably loading onto this factor). The 'antisocial factors' of the PPI-R:SF's Coldheartedness and the ICU overall trait. The non-impulsive RST-PQ BAS traits of Goal-Drive Persistence, Reward Interest and Reward Reactivity loaded on the same factor. The RST-PQ's BIS strongly positively loaded onto a factor with the negatively loaded PPI-R:SF's Fearless Dominance. The RST-PQ's FFFS trait strongly loaded onto a fifth factor, and there was some evidence that the PPI-R:SF's Fearless Dominance also negatively loaded onto this factor.

The difference between the five factor solution and the four factor solution (suggested by parallel analysis), was that the RST-PQ factors of BIS and FFFS and the PPI-R:SF's Fearless Dominance loaded onto a single factor in the four factor model.

These results support our first hypothesis and the work of the extant literature. Due to the RST lacking a social facet and the ICU not including impulsivity or risk taking, neither scale fully accounted for psychopathic personality. However, the RST-PQ fear and impulsivity traits and the ICU trait accounted for psychopathic personality. It was the case that most BAS factors were largely separate to psychopathic and callous-unemotional personality.

[Table 3 about here]

3.2 Predicting risk-taking behaviour. We computed correlations between the risk-taking domains and the traits in this study (see Table 4). For the RST-PQ, BIS and FFFS negatively correlated with risk-taking and the BAS domains positively correlated with risk-taking (BAS-Impulsivity showed the strongest relationships for the RST-PQ overall).

Coldheartedness in the PPI-R:SF did not relate to risk-taking in general, with the exception of a positive relationship with ethical risk. The overall callous-unemotional trait from the ICU was similar, correlating positively with ethical risk and negatively with social risk. The PPI-R:SF Fearless Dominance and Self-Centred Impulsivity positively correlated with all risk-taking domains (both pro- and anti-social).

[Table 4 about here]

In regression analyses, demographic, RST-PQ and psychopathic traits were used to predict each risk-taking domain at a time (see Table 5). The Model 2s, containing RST-PQ traits explained more variance than the Model 1s (containing sex and age) and the Model 3s (additionally containing psychopathic and callous-unemotional traits) were further improvements in explaining variance (see table 5).

Only in the cases of DOSPERT ethical and social risk-taking did Model 1 explain sufficient variance. In these models, male sex was a predictor of ethical risk-taking and older age was predictive of social risk-taking. In both cases these were weak predictors of the risk-taking (table 5).

For the second Models, noteworthy predictors varied across risk-taking domain. BAS-Impulsivity was a predictor of ethical, health, recreational and social risk-taking behaviours. Heightened sensitivity to trait FFFS led to a decrease in health, recreational and social risk-taking behaviour. There was also evidence that BAS Reward Interest was a notable predictor of pro-social (recreational and social) risks. This finding supports our second hypothesis that high BAS-Impulsivity and low FFFS would relate to risk-taking. However the findings also indicate the importance of RST BAS-Reward Interest as indicative of risk-taking behaviour.

The third Models investigated the benefit of further including psychopathic and callous-unemotional traits in predicting risk-taking behaviour. In most cases the inclusion of these new traits decreased the prediction power of the RST-PQ. In ethical, health and social risk-taking, the PPI-R:SF Self-Centred Impulsivity trait became a dominant predictor, more than the RST-PQ traits. In a similar way, the Fearless Dominance psychopathic personality trait was a strong predictor for recreational risk-taking. Coldheartedness positively predicted (antisocial) ethical risk-taking and negatively predicted (pro-social) recreational risk-taking. This provides support for our third hypothesis. The Callous-Unemotional trait was the strongest predictor of financial risk taking but was only a small predictor of other domains of risk-taking, partially supporting our fourth hypothesis. Even with incorporating psychopathic and callous traits into the model, the RST traits of BIS, FFFS and BAS-Impulsivity BAS-Reward Interest predicted risk-taking behaviour.

Overall, RST and psychopathic personality traits explain different domains of risk-taking behaviour. Ethical risk-taking was defined by impulsivity and sensitivity to gains. Financial risk-taking was also related to reward reactivity but also callous-unemotional disposition. Health risk-taking was defined by low fearlessness and high impulsivity. Pro-social recreational risk-taking positively related to fearlessness, reward seeking and, somewhat unexpectedly, dispositional rumination. Social risk-taking was predicted by low fear, low anxiety, self-centred impulsivity and high reward seeking. Age and sex were negligible predictors with the personality factors considered.

[Table 5 about here]

4. Discussion

The results of the current study showed how RST, psychopathic personality and callous-unemotional traits all related to risk-taking behaviours. The strongest predictors, across measures, were the impulsive, fearless and callous traits, which were all indicative of risk-taking behaviour. In the simplest terms, impulsivity and sensitivity to appetitive stimuli generally predicted antisocial risks and pro-social risks were more defined by fearlessness and sensation seeking.

We demonstrated the expected convergence between the RST-PQ, ICU and PPI-R:SF. Notably, psychopathic personality can be expressed as low inhibition, low fearlessness, high impulsivity, sensation seeking and callousness. The factor analysis in this study grouped the trait models in the study into five domains. In line with the three factor model of psychopathy (see Drislane et al., 2014), there was a socially detached or antisocial factor, an impulsivity factor and factors containing low anxiety and fear traits. Interestingly, the RST-PQ's distinction between anxiety (BIS) and fear (FFFS) traits created two unique factors, with which the Fearless Dominance psychopathic personality showed relatively similar loadings. Anxiety (generated by unresolved evaluation of a stimulus) and fear (the response to an aversive stimulus) are distinct processes in the RST model (see Corr, 2016), but not so in the PPI-R:SF. The correlations between BIS, FFFS and the PPI-R:SF's 'Fearless' Dominance here suggest that future psychopathic personality research would benefit from exploring the distinction in low fear and low anxiety behaviour, perhaps by also using the RST-PQ.

The factor analysis suggested a further group of traits, separate to the psychopathic personality domains, of non-impulsive BAS. In part, the allocation of BAS-Impulsivity to a separate factor could be due to large amounts of shared variance with the other trait explicitly testing for impulsivity (PPI-R:SF Self-centred Impulsivity). However, other work has noted that there are differences between BAS traits focused on immediate rewards ('Now' BAS traits of Impulsivity and Reward Reactivity) and planning-oriented long term reward seeking behaviour ('Future' BAS traits of Goal-Drive Persistence and Reward Interest; see Satchell, Moore & Corr, 2017). The factor loadings for BAS-Reward Reactivity were similar for the impulsive and non-impulsive summary factors and it could be considered that signs of Now and Future BAS are found in the current data. Future BAS traits are known to principally relate to the Big Five's Conscientiousness whereas the Now BAS relate more prominently to the Big Five's Extraversion (Corr & Cooper, 2016; Satchell, Hoskins et al., 2017). Separation of BAS in this way also explains sex differences in antisocial behaviour tendencies, with male antisociality being better predicted by Future BAS and female antisociality being predicted by Now BAS (Bacon et al., 2018). In the current study of risk-taking behaviour, this distinction is particularly relevant. Future BAS traits (particularly Reward Interest) were correlated with more pro-social risk-taking (recreational and social), whereas Now BAS traits correlated more with the antisocial risk-taking (ethical and financial). Future research could consider the importance of dispositional goal-orientation associated with risk-taking behaviour, investigating how pursuit of future versus immediate rewards may encourage risk-taking.

Our results add to the growing research using the contemporary RST trait measure, the RST-PQ. Whilst other studies have demonstrated a relationship between older RST tools and varying measures of psychopathic personality (Hughes et al., 2012; Sellbom & Phillips, 2013; Roose et al., 2011), the current work uses a tool developed on the basis of the latest thinking on RST personality traits (Corr & Cooper, 2016). Here, the contemporary RST personality measure tool, again, finds evidence that psychopathic personality can be expressed as low fearlessness, low anxiety and high impulsivity. This replication is important in the context of the wider personality literature: a better synergy between work on normative brain variability in RST (Corr, 2004) and distinct neurological deficits in psychopaths (Wahlund & Kristiansson, 2009).

We also considered how psychopathy may predict risk-taking behaviour. Dispositional fearless dominance most strongly predicted pro-social risk-taking behaviour (recreational and social), self-centred impulsivity predicted ethical and health risk-taking (which both carry antisocial implications), and cold-heartedness was generally a minimal predictor of risk-taking. This result highlights that not all aspects of psychopathic personality are inherently antisocial. Fearlessness dominance appears to act in the interest of others and wider social bonding. In part, this could be part of psychopathic manipulation, but we note the analysis of the ICU at predicting DOSPERT behaviours suggests that social risk-taking is associated with *caring* and *emotional* traits. As assessments of typical populations' psychopathic personality become more common, research should focus on the extent to which sub-domains of psychopathic traits express antisociality, and how some psychopathic tendencies may have pro-social implications.

It is important to consider that our results are affected by the similar nature of the tools we used. For example, responses to measures in this study, as would be expected from general population assessments of high risk behaviour, were skewed towards more pro-social attitudes and non-normal distributions. Some of the inventories share similar language especially in terms of shared factors such as impulsivity, long term planning, fear and worry (especially in the RST-PQ and PPI-R:SF). This explains how much of the psychopathy measures were explained in combining the environmental reactivity (RST-PQ) and antisociality (ICU) traits. The convergence of measurement may not be the same as convergence of the theoretical interests and more research using different behavioural measures of impulsivity, risk-taking and antisociality, would be of interest in future research (see Furr, 2009).

The current study serves as an update and expansion of the personality and psychopathy literature, especially as it relates to risk taking. We are not unique in bringing together RST, callous-unemotional and psychopathic personality theories, but our use of contemporary measures brings this research up to date.

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Table 1. *Descriptive statistics, number of items and internal reliability of the measures*

Trait	No. of items	Mean	SD	α	Skew	K-S Test
Reinforcement Sensitivity Theory - Personality Questionnaire						
BIS	23	1.73	0.60	.92	-.16	.06**
FFFS	10	1.17	0.60	.78	.36	.09***
BAS-Imp	8	1.18	0.60	.76	.19	.06***
BAS-RR	10	1.62	0.56	.83	-.11	.07***
BAS-RI	7	1.41	0.63	.82	.15	.08***
BAS-GDP	7	1.72	0.73	.89	-.18	.07***
Psychopathic Personality Inventory – Revised: Short Form						
Fearless Dominance	21	1.42	0.51	.86	-.00	.04
Self-Centred Impulsivity	29	0.91	0.39	.83	.54	.07***
Cold-heartedness	7	1.15	0.61	.76	.39	.07***
Overall Psychopathy	56	1.06	0.33	.86	.32	.04
Inventory of Callous-Unemotional Traits						
Overall Score	22	0.86	0.38	.82	.56	.06***
Domain-Specific Risk-Taking Scale						
Ethical risks	6	2.41	0.94	.58	.86	.11***
Health risks	6	3.07	1.19	.67	.51	.08***
Financial risks	6	2.42	1.00	.74	.95	.10***
Recreational risks	6	3.40	1.55	.84	.31	.09***
Social risks	6	5.28	1.03	.69	-.65	.09***

Note.

BIS= Behavioural Inhibition System; FFFS = Fight/Flight/Freeze System; BAS = Behavioural Approach System, Imp = Impulsivity, RR = Reward Reactivity, RI = Reward Interest, GDP = Goal-Drive Persistence.

K-S Test = Kolmogorov-Smirnov Test for normality with Lilliefors' significance correction

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. *Correlations between the trait measures used in this study*

	ICU Overall	Coldheartedness	PPI-R:SF Traits Fearless Dominance	Self-Centred Impulsivity
ICU Overall	1.00	.55***	-.04	.22***
Reinforcement Sensitivity Theory – Personality Questionnaire				
BIS	.06	-.22***	-.61***	.16**
FFFS	-.06	-.20**	-.48***	-.02
BAS-Imp	-.08	-.08	.34***	.60***
BAS-RR	-.43***	-.28***	.30***	.18***
BAS-RI	-.27***	-.10*	.52***	.24***
BAS-GDP	-.34***	-.08	.29***	-.08

Note.
N= 454. * p < .05, ** p < .01, *** p < .001
ICU = Overall score from the Inventory of Callous-Unemotional traits
BIS= Behavioural Inhibition System; FFFS = Fight/Flight/Freeze System; BAS = Behavioural Approach System, Imp = Impulsivity, RR = Reward Reactivity, RI = Reward Interest, GDP = Goal-Drive Persistence.

Table 3. *The factor loadings of the exploratory factor analysis for the trait measure arranged by strongest loading trait*

		Factor				
Measure	Trait	1	2	3	4	5
RST-PQ	BAS-Imp	**.80**	-.06	.09	-.02	.12
PPI-R:SF	Self-Centred Impulsivity	**.80**	.12	-.09	.12	-.07
ICU	Callous-Unemotional Trait	.04	**1.00**	.00	.02	.03
PPI-R:SF	Coldheartedness	-.09	**.58**	.05	-.20	-.06
RST-PQ	BAS-GDP	-.18	.01	**.81**	.01	.01
RST-PQ	BAS-RI	.25	-.03	**.68**	-.01	-.11
RST-PQ	BAS-RR	.32	-.26	**.38**	-.12	.22
RST-PQ	BIS	.07	-.01	.02	**.97**	-.01
PPI-R:SF	Fearless Dominance	.37	.00	.15	**-.47**	-.34
RST-PQ	FFFS	.06	.02	-.02	.01	**.84**

Note.
Bold= Absolute strongest loading factor
RST-PQ= Reinforcement Sensitivity Theory – Personality Questionnaire
PPI-R:SF= Psychopathic Personality Inventory-Revised: Short Form
ICU = Inventory of Callous-Unemotional traits
BIS= Behavioural Inhibition System; FFFS = Fight/Flight/Freeze System; BAS = Behavioural Approach System, Imp = Impulsivity, RR = Reward Reactivity, RI = Reward Interest, GDP = Goal-Drive Persistence.

Table 4. *Pearson r correlations between the trait variables and the risk taking behaviour domains in the study*

	Domain-Specific Risk-Taking scale				
	Ethical	Financial	Health	Recreational	Social
Reinforcement Sensitivity Theory – Personality Questionnaire					
BIS	.01	-.19***	-.01	-.17***	-.29***
FFFS	-.04	-.15***	-.21***	-.47***	-.33***
BAS-Imp	.32***	.17***	.45***	.27***	.28***
BAS-RR	.12*	.20***	.18***	.13**	.21***
BAS-RI	.10*	.25***	.20***	.41***	.44***
BAS-GDP	-.04	.09	-.05	.11*	.25***
Psychopathic Personality Inventory – Revised: Short Form					
Coldheartedness	.23***	.06	.01	.03	-.06
Fearless Dominance	.20***	.31***	.35***	.60***	.49***
Self-Centred Impulsivity	.51***	.20***	.50***	.29***	.28***
Inventory of Callous-Unemotional Traits					
ICU Overall	.27***	.09	.09	.04	-.13**

Note.
N= 454. * p < .05, ** p < .01, *** p < .001

Table 5. *Regression models built using the RST-PQ traits and participants' demographics, predicting DOSPERT scores*

Predictor	Ethical			Financial			Health			Recreational			Social		
	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se
Model 1		**R^2= .02***			**R^2= .01**			**R^2= .01**			**R^2= .01**			**R^2= .04*** **	
Sex	.13	.11** [.03, .19]	.04	.08	.07 [-.02, .15]	.04	.10	.10 [.00, .20]	.05	.07	.10 [-.03, .23]	.07	.07	.07 [-.02, .16]	.04
Age	-.04	-.00 [-.02, .01]	.01	-.01	-.00 [-.01, .01]	.01	.01	.00 [-.01, .02]	.01	.00	.00 [-.02, .02]	.01	.18	.02*** [.01, .03]	.01
Model 2		**R^2= .14*** ** **ΔR^2= .12*** **			**R^2= .13*** ** **ΔR^2= .12*** **			**R^2= .30*** ** **ΔR^2= .29*** **			**R^2= .38*** ** **ΔR^2= .37*** **			**R^2= .32*** ** **ΔR^2= .28*** **	
Sex	.13	.11** [.03, .18]	.04	.07	.06 [-.02, .15]	.04	.06	.06 [-.02, .15]	.04	.00	.00 [-.11, .11]	.05	.04	.04 [-.04, .11]	.04
Age	-.07	-.01 [-.02, .00]	.01	-.09	-.01 [-.02, .00]	.01	-.05	-.01 [-.02, 0.1]	.01	-.10	-.02* [-.03, .00]	.01	.06	.01 [.00, .02]	.01
BIS	-.01	-.02 [-.17, .14]	.08	-.15	-.25** [-.41, -.08]	.08	.02	.04 [-.13, .22]	.10	.01	.03 [-.18, .24]	.11	-.14	-.23** [-.39, -08]	.08
FFFS	-.07	-.11 [-.26, .05]	.08	-.08	-.14 -.30, -.03]	.09	-.29	-.56*** [-.74, -.38]	.10	-.44	-1.12*** [-1.34,-.90]	.11	-.23	-.39*** [-.55, -.24]	.08
BAS-Imp	.35	.55*** [-.38, .73]	.09	.08	.13 [-.05, .32]	.09	.47	.92*** [.73, 1.11]	.10	.15	.38** [14, .62]	.12	.18	.31*** [.14, .48]	.09
BAS-RR	.04	.06 [-.13, .24]	.10	.12	.20* [.00, .40]	.10	.06	.12 [-.10, .33]	.11	-.03	-.08 [-.34, .18]	.13	-.02	-.04 [-.22, .15]	.09
BAS-RI	-.02	-.03 [-.23, .16]	.10	.17	.27* [.06, .47]	.11	.00	.00 [-.21, .22]	.11	.36	.87*** [.06, 1.14]	.14	.28	.46*** [.27, .65]	.10
BAS-GDP	-.06	-.08 [-.22, .07]	.08	-.05	-.07 [-.23, .08]	.08	-.11	-.18* [-.34, -.02]	.09	-.11	-.24* [-.44, -.04]	.10	.04	.06 [-.08, .21]	.07

Note. β_s = Standardized Beta weights, se = standard error, B = unstandardized Beta weights
* p < .05, ** p < .01, *** p < .001

Table 5 (continued). *Regression models built using the RST-PQ traits and participants' demographics, predicting DOSPERT scores*

Predictor	Ethical			Financial			Health			Recreational			Social		
	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se	β_s	B [95% CI]	se
Model 3		**R^2= .32*** ΔR^2= .18*** **			**R^2= .17*** ΔR^2= .04** **			**R^2= .36*** ΔR^2= .06*** **			**R^2= .52*** ΔR^2= .14*** **			**R^2= .36*** ΔR^2= .05*** **	
Sex	.05	.05 [-.03, .12]	.04	.04	.04 [-.05, .12]	.04	.03	.03 [-.06, .11]	.04	-.03	-.04 [-.13, .06]	.05	.04	.03 [-.04, .11]	.04
Age	-.03	-.00 [-.01, .01]	.01	-.05	-.01 [-.02, .01]	.01	-.03	.00 [-.02, .01]	.01	-.09	-.02* [-.03, .00]	.01	.04	.01 [.00, .02]	.01
BIS	-.03	-.04 [-.22, .14]	.10	-.10	-.15 [-.36, .06]	.11	.08	.15 [-.06, -.22]	.11	.28	.70*** [.46, .95]	.12	-.12	-.20* [-.39, -.01]	.10
FFFS	-.02	-.03 [-.18, .13]	.08	-.04	-.07 [-.25, .12]	.09	-.21	-.41*** [-.60, -.22]	.10	-.26	-.66*** [-.87, -.45]	.11	-.17	-.30** [-.46, -.13]	.08
BAS-Imp	.05	.08 [-.10, .27]	.10	-.11	-.02 [-.24, .20]	.11	.28	.54*** [.32, .77]	.11	-.01	-.03 [-.28, .23]	.13	.04	.07 [-.13, .27]	.10
BAS-RR	.14	.22* [.05, .40]	.09	-.17	.30** [.09, .51]	.11	.07	.14 [-.08, .35]	.11	-.05	-.12 [-.37, .12]	.12	-.07	-.13 [-.30, .06]	.10
BAS-RI	-.04	-.06 [-.23, .12]	.09	.14	.22* [.01, .43]	.11	-.06	-.12 [-.33, .10]	.11	.23	.55*** [.30, .79]	.12	.22	.35*** [.16, .55]	.10
BAS-GDP	.01	.01 [-.23, .14]	.07	-.02	-.03 [-.19, .13]	.08	-.08	-.13 [-.29, .03]	.08	-.10	-.21* [-.39, -.02]	.09	.05	.07 [-.07, .21]	.07
Coldhearted -ness	.18	.27** [.12, .43]	.08	-.05	-.08 [-.27, .10]	.09	-.02	-.05 [-.23, .14]	.10	-.09	-.22* [-.43, .00]	.11	-.08	-.13 [-.30, .03]	.08
Fearless Dominance	-.01	-.02 [-.27, .23]	.13	.14	.26 [-.04, .56]	.15	.20	.45** [.14, .76]	.16	.61	1.78*** [1.43,2.13]	.18	.16	.32* [.05, .59]	.14
Self-Centred Impulsivity	.43	1.06*** [.78, 1.34]	.14	.05	.13 [-.20, .45]	.17	.23	.70*** [.36, 1.04]	.17	.01	.05 [-.34, .43]	.20	.19	.51** [.21, .81]	.15
Callous-Unemotional	.11	.27 [-.02, .56]	.15	.19	.48** [.15, .82]	.17	.03	.09 [-.26, .43]	.18	.08	.34 [-.05, .73]	.20	-.09	-.26 [-.56, .05]	.16

Note. β_s = Standardized Beta weights, se = standard error, B = unstandardized Beta weights
* p < .05, ** p < .01, *** p < .001