


Provided for non-commercial research and education use.  
Not for reproduction, distribution or commercial use.

	Volume 51, issue 4, September 2011	ISSN 0191-8869
<b>PERSONALITY AND INDIVIDUAL DIFFERENCES</b>		
AN INTERNATIONAL JOURNAL OF RESEARCH INTO THE STRUCTURE AND DEVELOPMENT OF PERSONALITY, AND THE CAUSATION OF INDIVIDUAL DIFFERENCES		
Editors-in-Chief Dr T. VERNON, Canada Dr S. B. G. EYSENCK, London		Founding Editor Professor H. J. EYSENCK*
<b>Special issue on Digit Ratio (2D:4D) and Individual Differences Research</b> Guest Editor: Martin Voracek		
Contents:		
	365	The International Society for the Study of Individual Differences (ISSID)
<i>Special Issue Articles on Digit Ratio (2D:4D) and Individual Differences Research</i> M. Voracek	367	Special issue preamble: Digit ratio (2D:4D) and individual differences research
M. Brosnan, V. Gallop, N. Iftikhar and E. Keogh	371	Digit ratio (2D:4D), academic performance in computer science and computer-related anxiety
B. Hell and K. Päßler	376	Are occupational interests hormonally influenced? The 2D:4D-interest nexus
J. Hönekopp and S. Watson	381	Meta-analysis of the relationship between digit-ratio 2D:4D and aggression
J.T. Manning and B. Fink	387	Digit ratio (2D:4D) and aggregate personality scores across nations: Data from the BBC internet study
M.H. McIntyre, A.Y. Li, J.F. Chapman, S.F. Lipson and P.T. Ellison K. Millet	392	Social status, masculinity, and testosterone in young men
S.J. Quinton, A.R. Smith and T. Joiner	397	An interactionist perspective on the relation between 2D:4D and behavior: An overview of (moderated) relationships between 2D:4D and economic decision making
	402	The 2nd to 4th digit ratio (2D:4D) and eating disorder diagnosis in women
<i>[Continued on outside back cover]</i>		
<small>Person, Individ. Diff. is indexed/abstracted in: ASSIA, Curr. Cont. Soc. &amp; Behav. Sci., PASCAL-CNRS Data, Psychol. Abstr., PsycINFO, PsycLIT, Res. Alert, Soc. Sci. Cit. Indx. Also covered in the abstract and citation database SCOPUS®. Full text available on ScienceDirect®.</small>		
<small>ISSN 0191-8869 51(4) 365-548 (2011)</small>		
<small>OFFICIAL JOURNAL OF THE INTERNATIONAL SOCIETY FOR THE STUDY OF INDIVIDUAL DIFFERENCES (ISSID)</small>		

This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

# Personality and Individual Differences

journal homepage: [www.elsevier.com/locate/paid](http://www.elsevier.com/locate/paid)

## The relationship between psychopathy and impulsivity: A multi-impulsivity measurement approach

Joanne E. Morgan<sup>a,\*</sup>, Nicola S. Gray<sup>b,1</sup>, Robert J. Snowden<sup>a</sup>

<sup>a</sup> School of Psychology, Cardiff University, United Kingdom

<sup>b</sup> Ty Catrin Personality Disorder Service, Pastoral Cymru, Cardiff, United Kingdom

### ARTICLE INFO

#### Article history:

Received 15 December 2010

Received in revised form 23 March 2011

Accepted 28 March 2011

Available online 11 May 2011

#### Keywords:

Psychopathy

Impulsivity

PPI-R

Behavioural measures

Personality measures

### ABSTRACT

Psychopathy is a serious personality disorder of which impulsivity is a key component. However, impulsivity is a multidimensional construct, with multiple approaches to measurement, and different measures may be differentially implicated in psychopathy. This study investigated the relationship between psychopathy as assessed by the Psychopathic Personality Inventory-Revised (PPI-R; Lilienfeld & Widows, 2005), a personality measure of impulsivity (Barratt Impulsiveness Scale-11), and four behavioural measures of impulsivity (GoStop Impulsivity Paradigm, Two Choice Impulsivity Paradigm, Delay Discounting Task, Iowa Gambling Task). A nonclinical sample ( $N = 80$ ) was recruited from the local community to advance understanding of psychopathy in non-incarcerated samples. The results indicated that the personality measure of impulsivity was strongly correlated with the PPI-R, while the behavioural measures were either not correlated or only weakly correlated with the PPI-R. The results are discussed in terms of the multifaceted nature of impulsivity and the need for the further development of behavioural measures of impulsivity, given their importance in clinical assessment and intervention.

© 2011 Elsevier Ltd. All rights reserved.

### 1. Introduction

Psychopathy is a personality disorder characterised by a constellation of behavioural, affective and interpersonal traits (Cleckley, 1976; Hare, 1991). It has been described as one of the most important constructs in clinical and forensic psychology (e.g., Snowden & Gray, 2011). The majority of research on psychopathy has been conducted in incarcerated or institutionalised samples. Nevertheless, it has been suggested that there are also “successful” individuals with psychopathy who possess the core personality features of psychopathy yet manage to avoid criminality and function well in the community (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Cleckley, 1976). One of the main factors hindering research in the area of subclinical/community psychopathy has been the lack of valid tools for examining psychopathy in the general population (Benning et al., 2003).

The most widely used and validated measure of psychopathy is the Psychopathy Checklist-Revised (PCL-R; Hare, 1991). However, the PCL-R was specifically designed for use in offender populations

and requires extensive time and collateral information to complete, which is often not available in community settings. These issues have led to the development of self-report measures of psychopathy that are specifically designed for use in community samples. The Psychopathic Personality Inventory-Revised [PPI-R; Lilienfeld & Widows, 2005] is one of the most prominent of these instruments and was used in this study. The PPI-R provides an overall global psychopathy score and also scores on subscales of Fearless Dominance, Self-Centred Impulsivity, and Coldheartedness (see Copestake, Gray, & Snowden, 2011 for information on the relationship of these scales to the PCL-R). Previous work has suggested the importance of examination of the impulsivity at this factor level (e.g., Hart & Dempster, 1997; Sellbom & Verona, 2007; Snowden & Gray, 2011).

Research on impulsivity has emphasised the complexity of the construct. Impulsivity has been variously defined, and definitions include an insensitivity to delayed rewards, the inability to delay gratification, and an inability to inhibit behaviour when inhibition is necessary (e.g., Ainslie, 1975; Cherek, Moeller, Dougherty, & Rhoades, 1997; Gerbing, Ahadi, & Patton, 1987; Schachar & Logan, 1990). Recent research has emphasised the multidimensional nature of impulsivity and has suggested that there are “varieties of impulsivity” (Evenden, 1999; p. 348). Impulsivity measures are often based on vastly different methodological and theoretical approaches and multiple measures are rarely administered in single investigations in order to reflect the multidimensional nature of

\* Corresponding author. Address: School of Psychology, Cardiff University, Tower Building, Park Place, Cardiff, Wales CF10 3AT, United Kingdom. Tel.: +44 29 208 74007; fax: +44 29 208 74858.

E-mail address: [Morganje2@cardiff.ac.uk](mailto:Morganje2@cardiff.ac.uk) (J.E. Morgan).

<sup>1</sup> Professor Nicola Gray held the position of professor at Cardiff University when the research was undertaken.

impulsivity (Dougherty, Mathias, Marsh, & Jagar, 2005; Lane, Cherek, Rhoades, Pietras, & Tcheremissine, 2003; Reynolds, Ortengren, Richards, & DeWit, 2006). As such it is unclear whether the different measures relate to each other, and whether they reflect similar kinds of impairment in disorders in which impulsivity is implicated.

Prominent impulsivity measurement approaches include personality measures (i.e. self-report/psychometric measures) and laboratory behavioural measures. Self-report measures are cheap and easy to administer yet they are limited by the honesty, recall accuracy and insight from the respondents (Dougherty et al., 2005). This may be particularly problematic in a psychopathic sample (Lilienfeld & Fowler, 2006). Behavioural measures are important in the assessment of clinical disorders such as psychopathy given their more objective and state dependent quality, yet more research is required to better understand and validate these measures in a range of populations (Dougherty et al., 2003a, 2005).

### 1.1. The present study

The aim of the present study was to examine what aspects of impulsivity are related to psychopathy. Impulsivity was measured using a well-established self-report questionnaire (the Barratt Impulsiveness Scale [BIS-11; Patton, Stanford, & Barratt, 1995]) and four behavioural measures that aim to measure different conceptualisations of impulsivity, (the GoStop Impulsivity Paradigm [GoStop; Dougherty, Mathias, & Marsh, 2003c], the Two Choice Impulsivity Paradigm [TCIP; Dougherty, Marsh, & Mathias, 2003b], Delay Discounting Task [DD; Bickel, Odum, & Madden, 1999] and Iowa Gambling Task [IGT; Bechara, Damasio, Damasio, & Anderson, 1994]). We measured psychopathy using the PPI-R.

## 2. Method

### 2.1. Participants

Participants were 80 adults recruited from the local community (Cardiff, Wales). Participants were known to the author, the other experimenters, or recruited through word of mouth. Participants were paid £10 for their participation. Participant details are presented in Table 1. Ethical approval was obtained from Cardiff School of Psychology Ethical Committee.

### 2.2. Measures

#### 2.2.1. Personality measures

The Psychopathic Personality Inventory-Revised (PPI-R; Lilienfeld & Widows, 2005) is a self-report questionnaire that contains 154 items for the assessment of global psychopathy and component facets. Each question is answered on a four-point scale (False, Mostly False, Mostly True, True). The PPI-R has been considered to constitute at least two factors (Benning et al., 2003; Lilienfeld & Widows, 2005); PPI:I (Fearless Dominance)-high scores are thought to reflect a lack of anxiety and a high level of interpersonal dominance; PPI:II (Self-Centred Impulsivity)-high scores are thought to reflect a brazen use of others and a reckless impulsivity.

**Table 1**  
Participant demographics.

Age (mean, SD years)	21.16 (2.42)
Sex (male/female)	30/50
Student (yes/no)	68/12
Smoke (yes/no)	13/67
Wechsler Test of Adult Reading IQ (mean, SD)	109.16 (5.77)

Benning et al. (2003) also encourage the interpretation of scores on the Coldheartedness scale (which does not load onto the other factors) as a separate factor. High scores on this represent a lack of emotions and empathy.

The Barratt Impulsiveness Scale-11 (BIS-11; Patton et al., 1995) is a self-report personality questionnaire containing 30 items for the measurement of impulsivity. Each item is answered on a four point scale (Rarely/Never, Occasionally, Often, Almost Always/Always). Items are scored from 1 to 4. The BIS-11 contains three subscales; Motor (which reflects acting without thinking e.g. 'I act on impulse'), Nonplanning (lacking in future plans e.g. 'I plan for job-security') and Attention (poor concentration and distractibility e.g. 'I don't pay attention'). The BIS-11 has good internal consistency (Cronbach's  $\alpha = 0.83$ ) and test-retest reliability (Spearman's  $Rho = 0.83$ ; Stanford et al., 2009).

#### 2.2.2. Behavioural measures

The GoStop Impulsivity Paradigm (GoStop; Dougherty et al., 2003c) is a response inhibition paradigm developed to assess the capacity to inhibit/withhold an already initiated response. Five digit numbers were presented on the screen for 500 ms followed by a 1500 ms inter-stimulus interval consisting of a blank screen. The paradigm consisted of three trial types; nostop, stop and novel trials. The nostop trial consisted of a go signal, a number identical to the previous number presented in black. A stop trial constituted a stimulus that matched the previously presented number, but changed from black to red at a specified interval after go signal onset. A novel trial consisted of a non-matching randomly generated number (e.g., 48953...36214). Participants were required to respond, by clicking the left mouse button, to identically matching numbers while they were still on the screen (i.e. on nostop trials), but not respond to a number that turned red (i.e. on a stop trial) or to a non-matching number (i.e. a novel trial). The variable of interest was the percent inhibition/the proportion of inhibited responses of the total number of stop trials.

The Two Choice Impulsivity Paradigm (TCIP; Dougherty et al., 2003b) is a discrete-choice paradigm, for assessing tolerance for delayed rewards. Based on the delay of reward/gratification model of impulsivity it examines the individual's preference for a smaller reward delivered after a short delay compared to a larger reward delivered after a longer delay. On each trial the participants were required to choose between two shapes (a circle that delivered 5 points after 5 s or a square that delivered 15 points obtainable after a 15 s delay). The total number of smaller-sooner reward choices made out of the 50 trials in the session was measured.

The Delay Discounting Task (DD; Bickel et al., 1999) is a procedure for assessing the subjective value of hypothetical rewards. Participants were required to choose between smaller amounts that could be obtained immediately and £1000 that could be obtained after a specified delay (1 week, 2 weeks, 1 month, 6 months, 1 year, 5 years and 25 years). For instance, on the first trial, the choice is between £1000 delivered now and £1000 delivered in one week from today. Most people clearly pick the right now option. The experimenter then proceeds to reduce the right now amount at intervals from £1000 down to £1 asking whether they would prefer the right now option or the £1000 delivered in one week. When the participant switches to the delayed option the experimenter stops the procedure and record the last right now option chosen prior to the switch.

This procedure is repeated for each of the delays and in reverse sequence (right now amount begins at £1 and ascends to £1000). The indifference points (the points of subjective equality) when the participants switch from choosing one option (e.g., larger, delayed reward) to another option (e.g., smaller, immediate reward), are obtained in both the descending and ascending procedure and averaged. These averaged indifference points are obtained at each

of the seven delays for each participant. The degree of discounting ( $k$ ) was obtained by fitting the hyperbolic equation  $V = A/(1 + KD)$  to each participant's data. Larger  $k$  indicating more rapid discounting or higher levels of impulsivity.

The Iowa Gambling Task (IGT; Bechara et al., 1994) includes four decks of cards presented on a computer screen. Decks A and B were disadvantageous packs; immediate gains were large but at unpredictable points a gain was followed by a high penalty. Decks C and D were advantageous; immediate gains were relatively smaller but eventual losses were also smaller. Participants were free to choose a card from any deck. The total net score was examined; the difference between the total number of cards selected from both the advantageous card decks and the total number of cards selected from the disadvantageous decks. That is [(Deck C + Deck D) – (Deck A + Deck B)].

### 2.3. Intellectual functioning

Despite early conceptualisations that psychopathy may be unrelated to intellectual ability, there is a growing literature that this is not the case. Indeed, some aspects of psychopathy related to interpersonal relationships, may be positively associated with IQ measures, whilst other aspects of psychopathy related to chaotic and antisocial lifestyles may be negatively associated with psychopathy (Vitacco, Neumann, & Wodushak, 2008). Hence, we also measured IQ in order to assess its influence on the relationship between impulsivity and psychopathy. The Wechsler Test of Adult Reading (Wechsler, 2001), was used to assess IQ, this is a test of premorbid intellectual functioning, that involves the pronunciation of 50 words of increasing difficulty.

### 2.4. Procedure

Participants completed the behavioural paradigms in the following order; GoStop, TCIP, IGT, DD. Followed by the PPI-R, BIS-11 and the WTAR. The total session took approximately 1.5 h to complete.

### 2.5. Data analysis

For ease of analysis and interpretation, impulsivity outcome scores were converted so that higher values represent higher levels of impulsivity. Data were inspected for their fit to the assumptions of a normal distribution. As the Delay Discounting Tasks produce non-normally distributed data Spearman's correlation coefficients were used to test the hypotheses and for consistency this test was applied throughout. Secondary analyses involved examining for sex differences by using Mann–Whitney tests to compare scores on all measures across females and males. In addition, the Spearman's correlation coefficients were calculated separately for each sex.

## 3. Results

### 3.1. Preliminary statistics

Descriptive statistics for the personality measures are presented in Table 2 and for behavioural measures in Table 3.

### 3.2. Correlational analyses

Table 4 shows the Spearman's Rho correlation matrix for all of the measures of impulsivity and the PPI-R.

### 3.2.1. Psychopathy and impulsivity

3.2.1.1. *PPI-R and personality measures of impulsivity.* PPI-R total score was correlated with BIS-11 total score ( $r = .40$ ) with a medium effect size (Cohen, 1992). However, it was only the Self-Centred Impulsivity factor that showed this association ( $r = .57$ ) with a large effect size. All three subfactors of the BIS-II (Motor, Planning and Attention) has associations to Self-Centred Impulsivity, with the relation with BIS Nonplanning reaching a large effect size ( $r = .51$ ).

3.2.1.2. *PPI-R and behavioural measures of impulsivity.* No aspect of the PPI-R was significantly correlated with the GoStop score or TCIP score. The Delay Discounting task was not significantly associated with global psychopathy score but was associated with Self-Centred Impulsivity (small effect size;  $r = .29$ ). There was a significant positive association between PPI-R total and the Iowa Gambling Task (small effect size;  $r = .26$ ), but this significant association was not present for any of the PPI-R factors.

### 3.2.2. Intelligence quotient

IQ score did not correlate significantly with any of the measures (all  $ps > .30$ ) and therefore no further analyses were performed.

### 3.3. Secondary analyses based on gender

A comparison of all measures by gender using Mann–Whitney tests showed few gender differences, although males ( $Mdn = 124.50$ ) scored significantly higher than females ( $Mdn = 112$ ) on the PPI-R Fearless Dominance factor,  $U = 459.00$ ,  $p = .004$ , and on the Coldheartedness scale ( $Mdn$  for males = 31;  $Mdn$  for females = 28),  $U = 529.50$ ,  $p = .028$ . However, females ( $Mdn = 65$ ) scored higher than males ( $Mdn = 50$ ) on the GoStop,  $U = 541.50$ ,  $p = .038$ .

Spearman's correlations between psychopathy and impulsivity measures, calculated separately for gender, revealed a similar pattern of correlations as in the mixed sample. The exception being that the Iowa Gambling Task was only found to be significant in the male sample ( $r = .411$ ,  $p = .024$ ) and not for the female sample ( $r = .126$ ,  $p = .38$ ). However, this difference in correlations for the genders was not significantly different ( $p = .20$ ).

## 4. Discussion

### 4.1. Summary of results

Our main findings are that the personality measure of impulsivity correlated with psychopathy, while behavioural measures produced few correlations with psychopathy. This evidence adds to a growing body of literature on impulsivity suggesting that personality and behavioural tasks measure different aspects of impulsivity (e.g., Lane et al., 2003; Reynolds et al., 2006). In addition, the correlations between the different behavioural measures are low indicating that different behavioural tasks measure different components of impulsivity (Dolan & Fullam, 2004; Dom, Wilde, Hulstijn, & Sabbe, 2007; Reynolds et al., 2006). There were few sex differences in the relationship between the PPI-R and personality measures of impulsivity, whereas there was some very limited evidence of differences in behavioural measures.

### 4.2. PPI-R and personality measures of impulsivity

Increased impulsivity as measured by the BIS-11 correlated strongly only with PPI:II (Self-Centred Impulsivity) but not on the other factors of the PPI-R. This result appears similar to that of Snowden and Gray (2011) who found that only Factor 2 of the

**Table 2**  
Descriptive statistics for the PPI-R and BIS-11 personality measures.

Personality measure [total possible score]	Median	Mean	SD	Min	Max
PPI-R total [524]	290.50	292.28	(31.93)	237	394
PPI-R:I Fearless Dominance [180]	117.50	115.96	(17.10)	75	158
PPI-R:II Self-Centred Impulsivity [280]	143.00	145.76	(20.04)	94	193
PPI-R Coldheartedness [64]	30.00	30.55	(06.58)	19	49
BIS-11 total [120]	68.50	68.56	(10.52)	48	94
BIS-11 Motor [44]	24.00	24.56	(04.30)	18	35
BIS-11 Nonplanning [44]	25.50	25.97	(05.20)	14	38
BIS-11 Cognitive [32]	18.00	18.03	(03.40)	11	27

Note: PPI-R, Psychopathic Personality Inventory-Revised; BIS-11, Barratt Impulsiveness Scale-11.

**Table 3**  
Descriptive statistics for the behavioural paradigms.

Measure	Median	Mean	SD	Min	Max
GoStop (percentage disinhibition)	60.00	57.00	21.39	00.00	95.00
TCIP (no. of smaller sooner choices out of 50)	13.50	18.76	16.43	00.00	50.00
Delay discounting (K discounting parameter) <sup>a</sup>	00.03	00.09	00.26	00.00	01.96
IGT (net total reversed –100 to 100)	–12.00	–14.43	27.66	–88.00	30.00

Note: GoStop, GoStop Impulsivity Paradigm; TCIP, Two Choice Impulsivity Paradigm; IGT, Iowa Gambling Task.

<sup>a</sup> The *k* discounting parameter is non-normal and it is standard in the literature for the median and 25th and 75th percentile to be presented. The 25th percentile = 0.009 and 75th percentile = 0.069.

**Table 4**  
Spearman's Rho Correlation Matrix (*N* = 80) comparing all impulsivity measures and the PPI-R.

Scales	1	2	3	4	5	6	7	8	Behavioural paradigms			
									9	10	11	12
1. PPI-R tot	1.0	.657**	.794**	.542**	.404**	.392**	.359**	.292**	–.073	–.093	.180	.263*
2. PPI-R:I (Fea)		1.0	.142	.267*	.039	.105	.038	.026	–.119	–.072	–.065	.173
3. PPI-R:II (Imp)			1.0	.308**	.571**	.466**	.507**	.442**	–.017	–.100	.291**	.216
4. PPI-R:Col				1.0	.044	.091	.028	.017	–.015	–.037	.110	.069
5. BIS total					1.0	.827**	.869**	.687**	.175	.006	.257*	.085
6. BIS motor						1.0	.638**	.425**	.172	.071	.226*	.098
7. BIS nonplan							1.0	.362**	.059	–.016	.272*	.106
8. BIS cognitive								1.0	.193	–.020	.164	–.045
9. GoStop									1.0	–.015	–.088	–.212
10. TCIP										1.0	.010	–.009
11. DD											1.0	–.006
12. IGT												1.0

Note: PPI-R, Psychopathic Personality Inventory-Revised; Tot, Total; Fea, Fearless Dominance, Imp, Self Centred Impulsivity; Col, Coldheartedness; BIS, Barratt Impulsiveness Scale-11; GoStop, GoStop Impulsivity Paradigm; TCIP, Two Choice Impulsivity Paradigm; DD, Delay Discounting Task; IGT, Iowa Gambling Task.

\*\* Correlation is significant at the *p* < .01 level (2 tailed).

\* Correlation is significant at the *p* < .05 level (2 tailed).

PCL-R was related to BIS-11. Our results seem in broad agreement with previous studies on this issue (Newman, MacCoon, Vaughn, & Sadeh, 2005; Ross, Benning, Patrick, Thompson, & Thurston, 2009; Wallace, Malterer, & Newman, 2009).

#### 4.3. PPI-R and behavioural measures of impulsivity

Of most interest in the current study is the relationship between the PPI-R and the behavioural measures of impulsivity. In general, the correlations were variable and generally low. However, the Delay Discounting task was positively correlated with Self-Centred Impulsivity. Past research has found delay discounting to be a valid measure of impulsivity, with increased discounting being found in a number of impulsive populations (e.g., substance misusers, including smokers; Bickel et al., 1999; pathological gamblers; Petry, 2001; and psychiatric patients; Crean, de Wit, & Richards, 2000) as well as in a study examining psychopathy (Miller & Lynam, 2003). However, this 'behavioural task' actually has many features of a 'self-report' task. The person must choose between two hypothetical rewards (e. g., £500 now versus £1000

in 2 years time) and thus we are asking them about their probable behaviour in such a situation rather than recording their actual behaviour. Hence, it may not be surprising that this task has more association to pure self-report questionnaire measurement than other behavioural tasks.

The relationship between psychopathy and poorer performance on the Iowa Gambling Task is supportive of past research (e.g., Mahmut, Homewood, & Stevenson, 2008; Mitchell, Colledge, Leonard, & Blair, 2002) and is consistent with the emerging evidence to suggest that those high in traits of psychopathy possess executive dysfunction on measures related to the ventrolateral/orbitofrontal cortex (Blair et al., 2006; LaPierre, Braun, & Hodgins, 1995). It must be noted that the relationship was relatively weak and further research is required to replicate this finding.

Recent research has suggested that risky impulsivity may be particularly relevant in males, in terms of associations with aggression and externalising disorders (e.g., Campbell & Muncer, 2009). Our study was not designed to examine the issue of gender differences, but a secondary analysis revealed possible differences in the relationship of psychopathy to the Iowa Gambling Task, though the

study was underpowered to establish the statistical significance of this. Further research should analyse for sex differences to assess whether these are replicable findings.

#### 4.4. Limitations

There are a number of limitations of this research that need to be considered. Firstly, we deliberately recruited a non-clinical sample and thus this group tends to have a relatively high IQ and relatively low levels of impulsivity and psychopathy. Hence, the limited variance in these measures limits our ability to find significant correlations. Secondly, participants in the study did not earn real rewards (in the TCIP, IGT, DD) and made choices about hypothetical monetary amounts. There is therefore the possibility that their behaviours would have been different if real (and valuable) rewards were at stake. However, such experiments are not feasible on pragmatic grounds (Bickel et al., 1999) and others have demonstrated that these tasks appear to have face validity using known-groups (e.g., Cherek et al., 1997).

In addition, the fact that all participants completed behavioural tasks in a set order means that order effects cannot be ruled out. However, the measures were considered sufficiently different so that any practice effects were not likely to occur. Furthermore, this order was chosen in an attempt to minimise fatigue effects by presenting the task with the higher demands (e.g., the rapid decision, GoStop task) first, followed by the other measures as suggested by Dougherty et al. (2003a). Finally, it must be noted that given the multitude of approaches to the measurement of impulsivity, this investigation focuses on only a few measures representative of the major approaches (e.g., delay of gratification, response inhibition, etc.) and, therefore, only provides a preliminary understanding of the complexity of the impulsivity construct and its relationship with psychopathy. Further work is needed to explore other formulations of impulsivity using both self-report measures (e.g., Whiteside & Lynam, 2001) and other behavioural measures (e.g., Barkley, 1991).

#### 4.5. Implications and conclusions

Both psychopathy and impulsivity are complex constructs that are plagued with both conceptual and methodological problems. The present study has emphasised this complexity and the need for continued research on both constructs. The research has provided some support for the validity of the PPI-R in the assessment of traits of psychopathy in a community population, by demonstrating some relationships with measures of impulsivity, particularly personality measures of impulsivity (i.e. BIS-11).

By examining psychopathy, and the component facets, it is hoped that this will lead to a better understanding of the disorder in both the community and on a clinical level and eventually lead to the development of more evidence-based intervention strategies. The present study appears to suggest that the elucidation of the relationship is hindered by the incomplete understanding of impulsivity and the difficulties in measuring impulsivity at a behavioural level. The further understanding of behavioural measures of impulsivity are particularly important in relation to psychopathy, given their more objective quality and further research is required in the development of these measures.

#### References

Ainslie, G. (1975). Species reward: A behavioural theory of impulsiveness and impulse control. *Psychological Bulletin*, *82*, 463–496.  
Barkley, R. A. (1991). The ecological validity of laboratory and analogue assessments of ADHD symptoms. *Journal of Abnormal Child Psychology*, *19*, 149–178.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*, 7–15.  
Benning, S. D., Patrick, C. J., Hicks, B. M., Blonigen, D. M., & Krueger, R. F. (2003). Factor structure of the Psychopathic Personality Inventory: Validity and implications for clinical assessment. *Psychological Assessment*, *15*, 340–350.  
Bickel, W. K., Odum, A. L., & Madden, G. J. (1999). Impulsivity and cigarette smoking: Delay discounting in current, never and ex-smokers. *Psychopharmacology*, *146*, 447–454.  
Blair, K. S., Newman, C., Mitchell, D. G. V., Richell, R. A., Leonard, A., Morton, J., et al. (2006). Differentiating among prefrontal substrates in psychopathy: Neuropsychological test findings. *Neuropsychology*, *20*, 153–165.  
Campbell, A., & Muncer, S. (2009). Can 'risky' impulsivity explain sex differences in aggression? *Personality and Individual Differences*, *47*, 402–406.  
Cherek, D. R., Moeller, F. G., Dougherty, D. M., & Rhoades, H. (1997). Studies of violent and non-violent male parolees, II. Laboratory and psychometric measurements of impulsivity. *Biological Psychiatry*, *41*, 523–529.  
Cleckley, H. (1976). *The mask of sanity*. St Louis, MO: Mosby.  
Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 115–119.  
Copestake, S., Gray, N. S., & Snowden, R. J. (2011). A comparison of a self-report measure of psychopathy with the Psychopathy Checklist-Revised in a UK sample of offenders. *Journal of Forensic Psychiatry and Psychology*, *22*, 169–182.  
Crean, J. P., de Wit, H., & Richards, J. B. (2000). Reward discounting as a measure of impulsive behaviour in a psychiatric outpatient population. *Experimental and Clinical Psychopharmacology*, *8*, 155–162.  
Dolan, M., & Fullam, R. (2004). Behavioural and psychometric measures of impulsivity in a personality disordered population. *The Journal of Forensic Psychiatry & Psychology*, *15*, 426–450.  
Dom, G., Wilde, B. D., Hulstijn, W., & Sabbe, B. (2007). Dimensions of impulsive behaviour in abstinent alcoholics. *Personality and Individual Differences*, *42*, 465–476.  
Dougherty, D. M., Bjork, J. M., Harper, R. A., Marsh, D. M., Moeller, F. G., Mathias, C. W., et al. (2003a). Behavioural impulsivity paradigms: A comparison in hospitalized adolescents with disruptive behaviour disorders. *Journal of Child Psychology and Psychiatry*, *44*, 1145–1157.  
Dougherty, D. M., Marsh, D. M., & Mathias, C. W. (2003b). *Two choice impulsivity paradigm (Version 1.0) [Computer program]*. Houston, Texas: Neurobehavioral research laboratory and clinic, University of Texas health science center.  
Dougherty, D. M., Mathias, C. W., & Marsh, D. M. (2003c). *GoStop impulsivity paradigm (Version 1.0) [Computer program]*. Houston, Texas: Neurobehavioral research laboratory and clinic, University of Texas health science center.  
Dougherty, D. M., Mathias, C. W., Marsh, D. M., & Jagar, A. A. (2005). Laboratory behavioral measures of impulsivity. *Behavior Research Methods*, *37*, 82–90.  
Evensen, J. L. (1999). Varieties of impulsivity. *Psychopharmacology*, *146*, 348–361.  
Gerbing, D. W., Ahadi, S. A., & Patton, J. H. (1987). Toward a conceptualisation of impulsivity: Components across the behavioural and self-report domains. *Multivariate Behavioural Research*, *22*, 357–379.  
Hare, R. D. (1991). *The Hare psychopathy checklist-revised*. Toronto, Ontario, Canada: Multi-Health Systems.  
Hart, S. D., & Dempster, R. J. (1997). Impulsivity and psychopathy. In C. D. Webster & M. A. Jackson (Eds.), *Impulsivity: theory, assessment and treatment* (pp. 212–232). New York: The Guilford Press.  
Lane, S. D., Cherek, D. R., Rhoades, H. M., Pietras, C. J., & Tcheremissine, O. V. (2003). Relationships among laboratory and psychometric measures of impulsivity: Implications in substance abuse and dependence. *Addictive Disorders and their Treatment*, *2*, 33–40.  
LaPierre, D., Braun, C. M. J., & Hodgins, S. (1995). Ventral frontal deficits in psychopathy: Neuropsychological test findings. *Neuropsychologia*, *33*, 139–151.  
Lilienfeld, S. O., & Fowler, K. A. (2006). The self-report assessment of psychopathy. Problems, pitfalls and promises. In C. Patrick (Ed.), *Handbook of psychopathy* (pp. 107–132). New York: The Guilford Press.  
Lilienfeld, S. O., & Widows, M. R. (2005). *The psychopathic personality inventory-revised professional manual*. Lutz, FL: PAR.  
Mahmut, M. K., Homewood, J., & Stevenson, R. J. (2008). The characteristics of non-criminals with high psychopathy traits: Are they similar to criminal psychopaths? *Journal of Research in Personality*, *42*, 679–692.  
Miller, J. D., & Lynam, D. R. (2003). Psychopathy and the five-factor model of personality: A replication and extension. *Journal of Personality Assessment*, *81*, 168–178.  
Mitchell, D. G. V., Colledge, E., Leonard, A., & Blair, R. J. R. (2002). Risky decisions and response reversal: Is there evidence of orbitofrontal cortex dysfunction in psychopathic individuals? *Neuropsychologia*, *40*, 2013–2022.  
Newman, J. P., MacCoun, 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 Impulsiveness Scale. *Journal of Clinical Psychology*, *51*, 768–774.  
Petry, N. M. (2001). Pathological gamblers, with and without substance use disorders, discount delayed rewards at high rates. *Journal of Abnormal Psychology*, *110*, 482–487.  
Reynolds, B., Ortengren, A., Richards, J. B., & DeWit, H. (2006). Dimensions of impulsive behaviour: Personality and behavioural measures. *Personality and Individual Differences*, *40*, 305–315.  
Ross, S. R., Benning, S. D., Patrick, C. J., Thompson, A., & Thurston, A. (2009). Factors of the psychopathic personality inventory: Criterion-related validity and relationship with the five-factor model of personality. *Assessment*, *16*, 71–87.

- Schachar, R., & Logan, G. (1990). Impulsivity and inhibitory control in normal development and childhood psychopathology. *Development Psychology*, 26, 710–720.
- Sellbom, M., & Verona, E. (2007). Neuropsychological correlates of psychopathic traits in a non-incarcerated sample. *Journal of Research in Personality*, 41, 276–294.
- Snowden, R. J., & Gray, N. S. (2011). Impulsivity and psychopathy: Associations between the Barrett Impulsiveness Scale and the Psychopathy Checklist revised. *Psychiatry Research*, 187, 414–417.
- Stanford, M. S., Mathias, C. W., Dougherty, D. M., Lake, S. L., Anderson, N. E., & Patton, J. H. (2009). Fifty years of the barratt impulsiveness scale: An update and review. *Personality and Individual Differences*, 47, 385–395.
- Vitacco, M. J., Neumann, C. S., & Woduschek, T. (2008). Differential relationships between the dimensions of psychopathy and intelligence. *Criminal Justice and Behavior*, 35, 48–55.
- Wallace, J. F., Malterer, M. B., & Newman, J. P. (2009). Mapping Gray's BIS and BAS constructs onto factor 1 and factor 2 of Hare's psychopathy checklist – revised. *Personality and Individual Differences*, 47, 812–816.
- Wechsler, D. (2001). *Wechsler test of adult reading*. New York: The Psychological Corporation.
- Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structured model of personality to understand impulsivity. *Personality and Individual Differences*, 30, 669–689.