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Modeling Impulsivity in Forensic Patients: A Three-Dimensional Model of Impulsivity

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The current study investigated whether a multidimensional model could underlie impulsivity and its associations with various disorders in a forensic sample. Data were available from self-report and behavioral impulsivity instruments of 87 forensic patients. Principal component analysis (PCA) was used to derive a dimensional impulsivity model, and the relationship between and possible predictive validity of impulsivity dimensions for psychopathology was investigated using product moment correlations and regression analysis. A 3-dimensional model of impulsivity was derived, with factors labeled impulsive decision making, sensation seeking, and response inhibition. Impulsive decision making was a predictor for a history of drug dependence, the impulsive lifestyle facet of psychopathy, and antisocial personality disorder. Sensation seeking was not related to any psychopathology. Inadequate response inhibition was a predictor for drug dependence, psychopathy, and antisocial personality disorder. Given the importance of the concept of impulsivity with regard to forensic risk assessment, the current results replicated earlier impulsivity models and imply that impulsivity is a crucial target for diagnosis and interventions and underlines the importance to consider impulsivity as a multidimensional construct.

KEYWORDS: principal component analysis (PCA), sensation seeking, decision making, response inhibition, psychopathology, forensic patients, impulsivity

Impulsivity plays a key role in problematic human behavior and mental disorders (American Psychiatric Association [APA], 2013). Despite its importance, there is little consensus regarding the concept of impulsivity (Gay, Rochat, Billieux, D'Acremont, & Van der Linden, 2008). Impulsivity is defined by the International Society for Research on Impulsivity as "behavior without adequate thought, the tendency

to act with less forethought than do most individuals of equal ability and knowledge, or a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions" (<http://impulsivity.org/>). More consensus is rising that impulsivity is a multifaceted construct, and different dimensional models have been proposed (Coskunpinar, Dir, &

Cyders, 2013; Dalley, Everitt, & Robins, 2011). For instance, Reynolds, Ortengren, Richards, and de Wit (2006) and Trent and Davies (2012) described a cognitive, two-dimensional model including impulsive decision making, referring to delay discounting and risk taking, and impulsive disinhibition, referring to inhibitory control. In addition, Harden and Tucker-Drob (2011) described a developmental dual system with impulsivity, defined as the tendency to act immediately on behavioral impulse, and sensation seeking, defined as the tendency to seek novel, exciting situations.

In more recent research Reynolds and colleagues added a third dimension to the two original impulsivity dimensions (impulsive decision making and impulsive disinhibition), which they named impulsive inattention, referring to deficits in sustained attention (Harris et al., 2014). This addition is in line with an earlier three-dimensional model presented by Patton, Stanford, and Barratt (1995) incorporating the behavioral, psychological, social, and medical perspective into motor impulsiveness, referring to perseverance and acting without thinking; nonplanning, covering self-control and cognitive complexity; and attentional impulsiveness, referring to cognitive instability (Barratt, 1993).

Whiteside and Lynam (2001) presented a four-factor model, based on the Five-Factor Model of personality (McCrae & Costa, 1990) and commonly used impulsivity questionnaires resulting in the UPPS model, with urgency (U), defined as a tendency of sudden response to negative affect; premeditation (P), defined as the tendency to think before acting; perseverance (P), defined as the ability of sustained attention; and sensation seeking (S), defined as the tendency to pursue excitement. Another personality-based, four-factor model was introduced earlier by Eysenck and Eysenck (1985), containing the dimensions narrow impulsiveness, reflecting acting without thinking; risk taking, indicating taking a dare; nonplanning, reflecting a failure to plan ahead; and liveliness, reflecting rapid decision making.

All these models support the growing consensus that impulsivity is a multidimensional construct. However, there is still a great discrepancy in assessment related to the theoretical origins of the proposed models (Nigg, 2000). These discrepancies in results may have to do with two important aspects.

First, personality research focuses on measuring impulsivity with self-reports, whereas cognitive

research focuses on measuring impulsivity with behavioral measurements (Roberts, Fillmore, & Milich, 2011). It seems that self-report and behavioral measurements assess different forms of impulsivity that do not always overlap (Cyders & Coskunpinar, 2011; Reynolds et al., 2006) and therefore show low (Heyman & Gibb, 2006; Vonmoos et al., 2013) or even no correlations (Reynolds, Penfold, & Patak, 2008). Surprisingly, only a few studies examined the relationship between self-report and behavioral tasks (Cyders & Coskunpinar, 2011; Vonmoos et al., 2013). However, these studies focused on particular impulsivity dimensions in a specific population (recreational and dependent cocaine users) or on the strength of the relationship between different assessments of impulsivity. Accordingly, the present study examines different impulsivity dimensions using both self-report and behavioral measurements, reflecting the total concept of impulsivity.

Second, the earlier proposed models have been examined only in nonpatients. Research in forensic samples investigating impulsivity merely self-report a specific unidimensional behavioral task. However, in forensic (incarcerated) samples, prevalence of pathological impulsivity is reported to be extremely high (up to 88%; Bjørkly, 2006). Moreover, impulsivity is indicated as an important component of various forms of psychopathology (Fields et al., 2015, p. 1). How different impulsivity dimensions relate to various psychopathology problems in forensic populations is not clear and needs more attention (Fields et al., 2015). Therefore, a clarification of the relationship and possible predictive validity between different impulsivity dimensions and psychopathology most commonly present in forensic populations is needed. Given that a forensic sample shows extreme impulsiveness (Haden & Shiva, 2008; Værøy, Western, & Andersson, 2016), the present study is unique in examining a multidimensional impulsivity model using various assessment methods in a forensic sample. By doing so, the current study contributes to the external validity of earlier proposed impulsivity models.

STUDY

The aims of the present study are twofold. First, we investigate a dimensional structure of impulsivity based on multiple assessments (both self-report and behavioral instruments) related to earlier presented

models. Second, we examine the predictive validity of distinct impulsivity dimensions for psychopathology in a forensic incarcerated sample. Given the extremely high prevalence of pathological impulsivity in forensic populations (Haden & Shiva, 2008), the resulting dimensional model in the current study might be different from other proposed and tested models using samples in a nonpatient population. Moreover, we believe that the resulting impulsivity dimensions should be targets for interventions and risk management specifically in forensic (inpatient) populations.

METHODS

Participants

In the present study, we examined 87 male incarcerated psychiatric patients undergoing mandatory treatment at Forensic Psychiatric Centre de Rooyse Wissel. The Ethical Committee of Maastricht University and the research committee of FPC de Rooyse Wissel approved the research protocol. All participants cooperated on a voluntary basis and were free to withdraw from the study at any time. They received written and oral instruction emphasizing that participation was not related to treatment or prospects for release. Participants ranged in age from 22 to 61 years ($M = 37.9$, $SD = 8.9$).

The Psychopathy Checklist-Revised (PCL-R; Hare, 1991, 2003) from a subsample of 75 forensic offenders was available ($M = 23.1$, range = 10–36, $SD = 6.5$). All interviews were scored for diagnostic purposes by a separate interview and discussed by two trained forensic professionals, resulting in a consensus score. In the sample, 43% were psychopathic ($n = 32$ scoring ≥ 26 , indicating psychopathy).

Regarding the type of offenses, 38% of participants had been convicted for (attempted) manslaughter or murder, 19% for sexual offenses such as rape, 14% for sexual offenses with minors, 11% for property crime with violence, 9% for bodily harm, 7% for arson, and 3% for property crime without violence. Regarding the type of psychopathology, 67% of participants met the diagnostic criteria for substance dependency (in full remission), 64% for antisocial personality disorder (PD), 31% for intermittent explosive disorder, 25% for major depressive disorder (single episode, in full remission), 22% for posttraumatic stress disorder, 18% for paranoid PD, 16% for borderline PD and autism spectrum disorder, and

7% for passive-aggressive PD, obsessive-compulsive PD, narcissistic PD, and pathological gambling, with a comorbidity rate of 58%.

Measures

EXPLICIT MEASURES OF IMPULSIVITY.

The Barratt Impulsiveness Scale-11 (BIS-11; Patton et al., 1995) is a 30-item self-report questionnaire measuring impulsivity. The items are rated on a 4-point Likert scale (1 = *seldom or never*, 4 = *almost always or always*). The BIS-11 contains three subscales: Attention Impulsiveness (AI), measuring quick cognitive decisions and restlessness in items such as “I am restless at the theatre or lectures”; Motor Impulsivity (MI), measuring acting without thinking in items such as “I do things without thinking”; and Non Planning Impulsivity (NPI), measuring willingness to plan the future in items such as “I plan for job security.” Research showed good intrascale reliability ($\alpha = .82$) (Spinella, 2007). Following the George and Mallery (2003) rule for interpreting the Cronbach’s alpha reliability, α in the current sample was questionable to good (.80 BIS-11 total, α AI = .62, α MI = .68, and α NPI = .64).

The Sensation Seeking Scale (SSS; Zuckerman, Kolin, Price, & Zoos, 1964) is a 51-item sensation-seeking questionnaire. Items are rated on a 7-point Likert scale (1 = *totally disagree*, 7 = *totally agree*). The SSS contains four subscales: Thrill-and-Adventure Seeking (SSS-TAS), measuring the desire for activities involving physical danger in items such as “I sometimes like to do things that are a little frightening”; Experience-Seeking (SSS-ES), showing the desire for new experiences in items such as “People should dress in individual ways even if the effects are sometimes strange”; Disinhibition (SSS-DIS), assessing disinhibited social behavior in items such as “I like wild ‘uninhibited’ parties”; and Boredom-Susceptibility (SSS-BS), demonstrating an aversion for routine in items such as “I have no patience with dull or boring persons.” The SSS has good internal reliability (.85) and excellent test-retest reliability (.94) (Feij, van Zuilen, & Gazendam, 1982). Cronbach’s α in the current sample for the SSS-DIS scale was good (.81).

The Impulsiveness-Venturesomeness-Empathy Questionnaire (I7; Eysenck, Pearson, Easting, & Allsopp, 1985) is a 54-item self-report to assess impulsivity via dichotomous (“true” or “false”) answer options. The I7 contains three scales: Impulsiveness (I), indicating acting without thinking in items such as “Do you often long for excitement?”; Venture-

someness (V), indicating welcomeness to new experiences in items such as “Do you quite enjoy taking risks?”; and Empathy (E), containing items such as “Do you often get emotionally involved with your friends’ problems?” The I7 has proven good reliability ($\alpha = .67-.81$; Lijffijt, Caci, & Kenemans, 2005). Cronbach’s α in the current sample was acceptable, with $\alpha = .77$ for the I scale and $\alpha = .78$ for the V scale.

IMPLICIT MEASURES OF IMPULSIVITY.

The GoStop Impulsivity Paradigm (GoStop; Dougherty, Mathias, Marsh, & Jagar, 2005) is a computer task designed to measure response inhibition (Logan, 1983). Participants are presented a series of five-digit numbers in a prompt sequence (600 ms) and must either respond (while the number is still on the computer screen) by pushing a button to a “go” signal (two following identical numbers in black) or withhold a response when a “stop” signal appears (a following identical number changing to red, 250 ms after the go signal). In the current version, a block of 40 no-stop trials, 25 stop trials, and 65 filler trials with nonmatching numbers is used, with an interstimulus interval time of 1,500 ms (default). Moreover, the stop signal onset-delay time was adjusted with steps of 50 ms based on successful or failed inhibition (e.g., a delayed stop signal after a successful trial), resulting in an adjusted optimum stopping rate of 50%. The primary response of interest is the failure to inhibit responding when a go signal is accompanied by a stop signal. The GoStop Latency specifies the time interval between the onset of the stop signal and the response (Figure 1), the GoStop Stop Latency

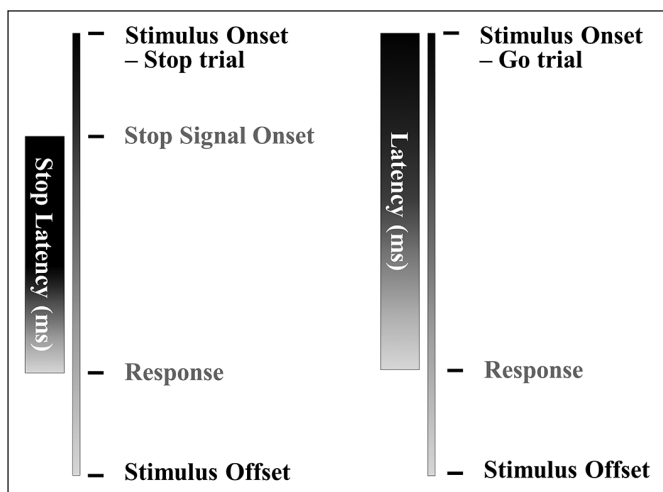


FIGURE 1. GoStop latency and Stop latency of the GoStop Impulsivity Paradigm

represents the time interval between stimulus onset and response with the stop signal timing altered to a successful withholding at 50% of the response, and the GoStop Inhibition indicates the proportion of trials in which the participant withheld response. The GoStop has proven good criterion and concurrent validity (Dougherty et al., 2005).

The Balloon Analogue Risk Task (BART; Lejuez et al., 2002) is a computer task designed to measure risk-taking behavior. The task’s objective is to collect the largest amount of points by pumping 30 balloons up by clicking on a button. Each pump inflates the balloon until a random threshold at which the balloon is overinflated and explodes. Thus the more pumps, the larger the balloon and the greater the reward, but likewise the bigger the risk that the balloon explodes and consequently no reward is given. In the current study, participants could earn a small amount of cash related to the resulting task price (small price = €0.50, bonus prize = €2.50). The BART Explosions represents the number of exploded balloons, indicating risk taking; the BART Pumps shows the total amount of pumps, demonstrating risk appetite. Research has shown the validity of the BART demonstrating a relation with real-life risk taking (Lejuez, Aklin, Zvolensky, & Pedulla, 2003).

MEASURES OF PSYCHOPATHOLOGY.

The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1995) is a semistructured interview based on the fourth edition text revision of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; APA, 2000). All interviews were scored and discussed by two master’s students and a forensic professional trained to administer the interview, resulting in a consensus score arrived at by discussion. Several studies demonstrated superior validity of the SCID-I over standard clinical interviews (Basco et al., 2000).

The Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2003). The SCID-II, like the SCID-I, is a semistructured personality interview based on the DSM-IV-TR (APA, 2000). As already mentioned, all interviews were discussed by two master’s students and a forensic professional, resulting in a consensus score. Research demonstrates good validity (Dreesen & Arntz, 1998) and reliability (Lobbestael, Leurmans, & Arntz, 2011).

The PCL-R (Hare, 1991, 2003) is a 20-item assessment for psychopathy based on an interview and

collateral file records. Each item was evaluated on a 3-point Likert scale (0 = *does not apply*, 2 = *does definitely apply*). The PCL-R contains four facets: an interpersonal facet indicating glibness and grandiose self-worth, an affective facet reflecting a lack of remorse, a behavioral lifestyle facet indicating impulsivity and a lack of long-term goals, and an antisocial facet reflecting poor behavioral control and multifarious criminality. Research has shown good reliability and validity (Cronbach's $\alpha = .83-.87$ and mean interitem correlation of .25; Hildebrand, 2008).

Data Reduction and Analysis

Normality of the raw data was checked by means of skewness, kurtosis, and visual inspection of the distributions. If necessary, outliers were corrected by setting the maximum value in to 2 *SD* plus 1 scale point (or 2 scale points in case of 2 outliers for the more extreme). The dimensional structure of impulsivity was investigated with a second-order principal component analysis (PCA) followed by oblimin rotation. Adequate sample size for PCA was evaluated with the Kaiser-Meyer-Olkin index and Bartlett's Test of Sphericity and analyzed based on the method presented by Winter, Dodou, and Wieringa (2009). Number of factors to be extracted was based on examination of the scree plot and interpretability of the rotated factors. The relationship between psychopathology and impulsivity was investigated with Pearson correlations. An additional Pearson correlation analysis was performed with impulsivity items of certain diagnosis removed (e.g., the item "impulsivity or failure to plan ahead" of antisocial PD) to check for possible tautology. Also, for all significant correlations of psychopathology and impulsivity, the specific predictive value of each impulsivity dimension was investigated by means of a forward regression analysis (logistic or linear depending on the nominal or orthogonal scoring method of the dependent variable).

RESULTS

Normality

Frequency analysis of the distribution of the impulsivity data revealed a normal distribution (skewness = .08-.55, kurtosis = .01-1.0). See Table 1 for impulsivity scores in the current sample and a variety of nonpatient comparison samples (with no norm scores presented).

Validity Impulsivity Model

A PCA was performed to reveal the dimensions underlying the impulsivity tests (Table 2). Although the sample size was above the minimum sample size of $N = 60$ for factor recovery (MacCallum, Widaman, Preacher, & Hong, 2001), within the range of $N = 50-100$ stated as adequate in determining psychometric properties by means of PCA (Sapnas & Zeller, 2002), and in accordance with the rule of number variables per factor of 1:5 (Ford, MacCallum, & Tait, 1986), adequacy of the sample was examined. Results based on the data characteristics of the current sample show that the minimal sample size should be $N = 71$,¹ and so the current sample size ($N = 87$) was large enough. Moreover, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was above the acceptable level of .50 (KMO = .60), and Bartlett's Test of Sphericity was significant ($p = .000$; Tabacknick & Fidell, 2007). Three factors met Kaiser's criteria with an eigenvalue above 1, which was in line with the scree plot test and was further supported by Monte Carlo parallel analysis. The initial eigenvalues showed that the first factor explained 27%, the second 17%, the third 14%, and the three factors cumulatively 57% of the variance, which is within the common range (Pett, Lackey, & Sullivan, 2003). The factor labels were based on the item content of the primary loadings on each factor.

The first factor was labeled impulsive decision making and was loaded by the BIS-11 Motor Impulsiveness scale, the I7 Impulsiveness scale, the BIS-11 Non Planning Impulsivity scale, and the BIS-11 Attention Impulsiveness scale. The second factor was labeled sensation seeking and was determined by high loadings of the BART Explosions, the BART Pumps, and the I7 Venturesomeness scale. The third factor was called response inhibition and was defined by high loadings of the GoStop Latency, the GoStop Inhibition, the SSS-Disinhibition scale, and the Go-Stop Stop Latency, with long reaction times indicating inadequate response inhibition and rapid results indicating adequate response inhibition.

Correlations Between the Impulsivity Factors

Pearson's correlation between the factor scores of the three impulsivity factors showed no significant relations (all r s < .15, all p s > .21), indicating distinct impulsivity components.

TABLE 1. Group Differences for All Impulsivity Scores Between the Current Forensic Sample ($N = 87$) and Nonpatient Comparison Samples: Means and Standard Deviations, Independent-Samples t Tests, and Effect Size (d)

Measurement	Current Sample		Control Sample		t	d
	M	SD	M	SD		
Impulsive decision making						
BIS-11 Motor Impulsiveness ^a	21.1	4.4	22.1	4.4	2.00*	.23
I7 Impulsiveness ^b	7.8	3.5	7.8	4.7	0.00	.00
BIS-11 Non Planning Impulsivity ^a	24.1	4.5	24.9	5.1	1.40	.17
BIS-11 Attention Impulsiveness ^a	16.5	3.4	17.2	3.9	1.60	.19
Sensation seeking						
BART Explosions ^c	8.8	3.7	9.1	4.5	0.40	.07
BART Pumps ^d	904.4	306.8	1,102	337	3.92***	.61
I7 Venturesomeness ^e	11.4	3.3	11.6	3.3	0.47	.06
Inadequate response inhibition						
GoStop Stop Latency (ms) ^f	179.5	66.0	172.7	94.8	0.38	.08
GoStop Inhibition (%) ^g	69.8	14.8	57.0	21.4	4.38***	.69
SSS-Disinhibition ^h	4.3	1.3	4.0	2.4	1.13	.16
GoStop Latency (ms) ⁱ	393.1	94.1	449.5	91.7	3.30***	.61

Note. BART = Balloon Analogue Risk Task; BIS-11 = Barratt Impulsiveness Scale-11; I7 = Impulsiveness-Venturesomeness-Empathy Questionnaire; SSS = Sensation Seeking Scale.

^a M and SD of a control sample ($n = 700$; Spinella, 2007).

^b M and SD of a control sample ($n = 151$; Nagoshi, Wood, Cote, & Abbit, 1994).

^c M and SD of a control sample ($n = 43$; Lejuez et al., 2002).

^d M and SD of a control sample ($n = 77$; Dimitrova et al., 2011).

^e M and SD of a control sample ($n = 193$; Lijffijt et al., 2005).

^f M and SD of a control sample ($n = 22$; Bunch, 2009).

^g M and SD of a control sample ($n = 80$; Morgan, Gray, & Snowden, 2011).

^h M and SD of a control sample ($n = 397$; Herrero & Colom, 2008).

ⁱ M and SD of a control sample ($n = 50$; Billieux et al., 2010).

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

Correlations With Disorders

To prevent tautology in the correlation of psychopathology with different impulsivity dimensions, all significant correlated psychopathology was screened on specific impulsivity items. The three authors independently noted the impulsivity items within substance dependency, antisocial personality disorder, and psychopathy. Results led to a consensus of the following impulsivity items to be deleted: In antisocial PD the item signifying impulsivity or the failure to plan ahead (criteria 3), and in psychopathy the items showing the need for stimulation and proneness to boredom (item 3), poor behavioral control (item 10), and impulsivity (item 14). In sub-

stance dependency, no specific item was deleted. Then, the numbers of items of the significant related disorders were summed without these impulsivity items.²

Pearson's correlation between the impulsivity dimensions and substance dependency was significant, showing an inverse correlation between response inhibition and substance dependency (Table 3). Separate results for alcohol and drug dependency revealed a significant correlation between impulsive decision making and drug dependence, and again an inverse correlation between response inhibition and drug dependency (Table 3). No significant relations with alcohol dependency were found.

Moreover, Pearson's correlations showed a significant inverse correlation between response inhibition and psychopathy (see Table 3). Results on the various psychopathy facets showed a significant inverse correlation between response inhibition and the impulsive lifestyle facet of psychopathy. Also, a significant correlation between impulsive decision making and the impulsive lifestyle facet was found. Furthermore, no correlation between any impulsivity dimension and borderline PD was found.

Predictive Validity of Impulsivity Dimensions for Psychopathology

Results of the forward likelihood ratio logistic regression with all impulsivity dimensions as predictors and drug dependency as target variable show that impulsive decision making and response inhibition predict drug dependency, with both predictors adding a significant value to the prediction model (Table 4).

Results of the forward likelihood ratio logistic regression with all impulsivity dimensions as predictors and antisocial PD as target variable again show that both impulsive decision making and response inhibition predict antisocial PD, with both predictors adding a significant value to the prediction model (see Table 4).

Results of the forward linear regression with all impulsivity dimensions as predictors and the impulsive lifestyle facet of the PCL-R as target variable show that both impulsive decision making and response inhibition predict the PCL-R impulsive lifestyle facet, with both predictors adding a significant value to the prediction model (see Table 4).

DISCUSSION

The first aim of this study was to derive a dimensional impulsivity model based on a broad spectrum of impulsivity tests (self-report and behavioral tasks) completed by a forensic sample. Results showed three distinctive impulsivity dimensions: impulsive decision making (reflecting acting without thinking and nonplanning), sensation seeking (reflecting a risk appetite and venturesomeness), and inadequate response inhibition (reflecting response inhibition dysfunction and disinhibited social behavior). Although some evidence suggests low replication results in psychology research (Baker, 2015), these

TABLE 2. Factor Loadings Based on a Principal Component Analysis With Oblimin Rotation of Impulsivity Assessments (*N* = 87)

Measures	Impulsive decision making	Sensation seeking	Response inhibition
BIS-11 Motor Impulsiveness	.76		
I7 Impulsiveness	.71		
BIS-11 Non Planning Impulsivity	.69		
BIS-11 Attention Impulsiveness	.67		
BART Explosions		.93	
BART Pumps		.93	
I7 Venturesomeness	.32	.49	
GoStop Stop Latency			.75
GoStop Inhibition			.65
SSS-Disinhibition	.45		-.52
GoStop Latency		.39	.51
Eigenvalue	2.96	1.82	1.52
% of variance	26.90	16.57	13.79

Note. Factor loadings < .29 are suppressed. BART = Balloon Analogue Risk Task; BIS-11 = Barratt Impulsiveness Scale-11; I7 = Impulsiveness-Venturesomeness-Empathy Questionnaire; SSS = Sensation Seeking Scale.

TABLE 3. Correlations of Psychopathology Indicators and Factor Scores of Impulsivity (*N* = 87)

Measure	Impulsive decision making	Sensation seeking	Response inhibition
Substance dependence	.22	.08	-.25*
Alcohol dependence	.01	-.01	-.16
Drug dependence	.43**	.14	-.32**
PCL-R Psychopathy	.23	-.07	-.26*
Interpersonal facet	-.12	-.16	-.20
Affective facet	-.06	-.22	-.22
Impulsive lifestyle facet	.40**	-.08	-.28*
Antisocial facet	.26	.05	-.13
Antisocial PD	.24*	.20	-.27*
Borderline PD	.19	.12	-.13

Note. PCL-R = Psychopathy Checklist-Revised; PD = personality disorder. **p* < .05. ***p* < .01.

TABLE 4. Forward Regression Analysis Results of Impulsivity Dimension Predicting Psychopathology ($N = 87$)

Logistic regression		<i>B</i>	SEB	Odds ratio	<i>p</i>	Model	
						<i>R</i> [*]	<i>p</i>
Drug dependence							
Model 1	Constant	0.25	.27	1.29	.34	.25	.00
	Impulsive decision making	1.09	.33	2.98	.00		
Model 2	Constant	0.29	.29	1.34	.31	.36	.00
	Impulsive decision making	1.19	.36	3.28	.00		
	Response inhibition	-0.80	.31	0.45	.01		
Antisocial PD							
Model 1	Constant	0.55	.26	1.73	.03	.10	.02
	Response inhibition	-0.60	.27	0.55	.03		
Model 2	Constant	0.59	.27	1.81	.03	.18	.01
	Response inhibition	-0.63	.28	0.54	.03		
	Impulsive decision making	0.59	.30	1.81	.05		
Linear regression		<i>B</i>	SEB	β	<i>p</i>	Model	
						<i>R</i> (<i>R</i> ²)	<i>p</i>
PCL-R Impulsive Lifestyle Facet							
Model 1	Constant	5.81	.30		.00	.40 (.16)	.00
	Impulsive decision making	1.04	.33	.40	.00		
Model 2	Constant	5.82	.28	.00	.00	.50 (.25)	.00
	Impulsive decision making	1.07	.32	.42	.00		
	Response inhibition	-0.69	.28	-.30	.02		

Note. *Nagelkerke *R*. PCL-R = Psychopathy Checklist-Revised; PD = personality disorder; SEB = standard error of the computed value of *B*.

three dimensions replicate the two-dimensional cognitive behavioral models of Reynolds and colleagues (2006, 2008) and Harden and Tucker-Drob (2011). However, sustained attention, a third dimension added by Reynolds and colleagues in their updated model of impulsivity and incorporated in the three-dimensional model of Patton, Stanford, and Barratt (1995), was not present in our results. Conversely, these three-dimensional cognitive models seem to lack the sensation seeking component.

Furthermore, Eysenck and Eysenck (1985), who presented the personality-based four-dimensional impulsivity model, later developed an assessment for impulsivity as a personality component, splitting impulsivity from sensation seeking (Eysenck et al.,

1985), indicating different personality characteristics instead of different dimensions of a common concept. Still, the current results also fit into the earlier described personality-based four-dimensional model of Whiteside and Lynam (2001), as their urgency facet equals our response inhibition' dimension, their premeditation facet equals our impulsive decision making' dimension, and both models include a sensation seeking' dimension. Moreover, the current results might point to different multidimensional models stemming from specific assessment methods with personality research mainly using only self-report and cognitive research focusing mainly on behavioral measurements (Roberts et al., 2011), whereas the current study combines both assessment

methods within the multidimensional impulsivity model. In addition, research has suggested a different manifestation of (self-reported) impulsivity and aggression in severe violent offenders opposed to nonpatients (Værøy et al., 2016). Second, we intend to examine the predictive validity of distinct impulsivity dimensions for psychopathology, which may reflect a multidimensional model unique for a male forensic population.

In conclusion, a combination of past and present results led to the preference of a four-dimensional model of impulsivity resulting in the following dimensions: impulsive decision making (reflecting acting without thinking and nonplanning), sensation seeking (reflecting a risk appetite and venturesomeness), (inadequate) response inhibition (reflecting response inhibition dysfunction), and sustained attention (reflecting perseverance).

As to the second aim, we found several meaningful relationships between impulsivity dimensions and psychopathology. First, a correlation between substance dependence and inadequate response inhibition was found. Although this correlation was found only in drug dependence and absent for alcohol, these results correspond with research showing a relationship between disruption of inhibition and drugs (Douma, Kolarz, Postma, Olivier, & Groenink, 2011; Halberstadt & Geyer, 2010). Moreover, a relationship between drug dependence and impulsive decision making was found, which is in line with research showing a relationship between impulsive decision making and drug use (Cadet, Bisagno, & Milroy, 2014). As to the predictive value of impulsivity dimensions for drug dependency, we found that a combination of both impulsive decision making and inadequate response inhibition shows a significant predictive value for drug dependency. No relationship between or predictive value for drug dependence and sensation seeking was found. However, this is in line with previous research into developmental vulnerability components of (drug) dependency, showing that sensation seeking indicates the tendency to experiment with drugs but not necessary frequent use leading to dependency, whereas impulsive decision making (referred to as general impulsivity) indicates an addictive lifestyle, and inadequate response inhibition (referred to as compulsivity) indicates a tendency toward continued use (Ersche, 2013; Ersche et

al., 2013). Also, no relationship between alcohol and any impulsivity dimension was found, which could indicate that the mechanisms underlying alcohol dependency may not be associated predominantly with impulsivity. Alternatively, we might have overlooked impulsivity dimensions that are relevant in relation to alcoholism.

Second, a significant correlation between inadequate response inhibition and psychopathy was found. Results on the specific psychopathy facets showed a significant correlation between inadequate response inhibition and the impulsive lifestyle facet of psychopathy. This is in line with research showing poor response inhibition in psychopathy (Kiehl, Smith, Hare, & Liddle, 2000; Masui & Nomura, 2010). Additionally, in line with a study by Miranda, MacKillop, Meyerson, Justus, and Lovallo (2009) showing decision-making problems in impulsive antisocial psychopathic people, we found a significant correlation between impulsive decision making and the impulsive lifestyle facet of psychopathy. As to the predictive value of impulsivity dimensions for the impulsive lifestyle facet of psychopathy, it can be concluded that a combination of impulsive decision making and inadequate response inhibition showed a significant predictive value for the impulsive facet of psychopathy.

Third, we found a significant correlation between inadequate response inhibition and antisocial PD, which is in line with research showing antisocial PD is characterized by “increased rapid-response impulsivity” (Swann, Lijffijt, Lane, Steinberg, & Moeller, 2009, p. 1) and recent research showing a relationship between PD severity and Whiteside and Lynam’s (2001) urgency facet, which equals our response inhibition dimension (Howard & Khalifa, 2016). In addition, a significant correlation between impulsive decision making and antisocial PD was found, indicating more acting without thinking in antisocial PD. This is in correspondence with research showing decision-making deficits in antisocial PD (Coccaro, Sripada, Yanowitch, & Phan, 2011). Again, as to the predictive value of impulsivity dimensions for antisocial PD, a combination of inadequate response inhibition and impulsive decision making have significant predictive value for antisocial PD. The current finding that both impulsive decision making and inadequate response inhibition show a predictive value for specific

pathology might indicate shared risk factors in drug dependency, antisocial PD, and secondary psychopathy (Cadoret, Yates, Woodworth, & Stewart, 1995; Skeem, Johansson, Andershed, Kerr, & Louden, 2007).

Fourth, no correlation between or predictive value for any impulsivity dimension and borderline PD was found. This could be due to comorbid patient characteristics. All participants meeting the criteria for borderline PD also showed a history of substance dependence. Earlier research on attention and decision-making deficits controlling for a past history of substance abuse in borderline PD showed impairments only in patients with borderline PD without past history of substance abuse (Feliu-Soler et al., 2013).

In sum, the first dimension, impulsive decision making, showed a predictive value for drug dependence, the impulsive lifestyle facet of psychopathy, and antisocial personality disorder. The second dimension, sensation seeking, was not related to any psychopathology. The third dimension, (inadequate) response inhibition, showed a predictive value for drug dependence, psychopathy, and antisocial personality disorder. These findings indicate a relationship between all impulsivity dimensions but sensation seeking in psychopathology and prompting allocations of these impulsivity dimensions as a target component for interventions toward pathology. This is in line with research in a nonpatient population showing a relationship between all (UPPS) impulsivity dimensions but sensation seeking and increased troublesome behavior (Sperry, Lynam, Walsh, Horton, & Kwapil, 2016). Moreover, sensation seeking assessment by means of the BART pumps (Lejuez et al., 2002) is the only dimension showing significantly lower scores for the forensic sample in comparison with nonpatient control samples from the literature indicating less extreme risk appetite in the current sample (see Table 1). Furthermore, the aforementioned research showed a unique manifestation of (self-reported) impulsivity in extremely violent offenders (Værøy et al., 2016), indicating a central role for inadequate response inhibition (UPPS urgency) driving impulsive behavior. The current findings show significant response inhibition difficulties in the current forensic sample in comparison with nonpatient control samples (see Table 1) and suggest that

both impulsive decision making and inadequate response inhibition are specific impulsivity risk factors in a male forensic population.

In line with research in clinical populations, implementing research in response to clinical needs and scientific demands (Rubin, Lazar, Gaich, & Haray, 2008), the following limitations to the present study should be mentioned. First, not all psychopathology was prevalent enough, so many DSM categories were excluded from analysis. Second, because the focus of the current study was the forensic field, in which prevalence of pathological dysfunctional impulsivity is very high, no control groups were included. We recommend that future research include nonpatient and nonforensic clinical control groups. Third, unfortunately only the dimensions sensation seeking and inadequate response inhibition included a combination of self-report and behavioral measurements. It cannot be excluded that rather than content, method variance influenced the formation of the other factor. Fourth, from the current study nothing can be concluded about the causal status of the reported relationships. However, other research found that not only does chronic drug exposure cause impulsivity, but impulsivity also represents a vulnerability factor for substance dependency (Cadet et al., 2014). Thus, impulsivity could be a crucial target in drug interventions.

Impulsivity is an important risk factor in different forensic risk assessments (Hare, 2003). Future research should focus on possible relations between impulsivity dimensions and risk for criminal behavior, because impulsivity is linked to high and stable levels of offending (Higgings, Kirchner, Ricketts, & Marcum, 2013). For practical purposes, individual risk profiles could be generated for risk management. After all, Einstein's remark that "all primary impulses, not easily described in words, are the springs of man's actions" also holds for forensic patients (Einstein, 1950, p. 15).

NOTES

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1. Results can be obtained on request from the first author.
2. Impulsivity item-corrected results were comparable to the reported results. Both results can be obtained on request from the first author.

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