Journal of Affective Disorders 201 (2016) 8–14

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Negative urgency and reward/punishment sensitivity in intermittent explosive disorder

Alexander A. Puhalla [a], Brooke A. Ammerman [a], Lauren L. Uyeji [a], Mitchell E. Berman [b], Michael S. McCloskey [a,*]

[a] Department of Psychology, Temple University, Philadelphia, PA, USA
[b] Department of Psychology, Mississippi State University, Mississippi State, MS, USA

ARTICLE INFO

Article history:
Received 5 November 2015
Received in revised form
24 March 2016
Accepted 23 April 2016
Available online 27 April 2016

ABSTRACT

Intermittent explosive disorder (IED) is the sole psychiatric diagnosis in which affective aggression is the cardinal symptom. Previous research has been equivocal with regard to the relationship between IED and impulsivity. This inconsistency may reflect the varied facets of impulsivity, with some aspects of impulsivity (e.g. negative urgency) as well as some overlapping, albeit distinct constructs (e.g. reward and punishment sensitivity) yet to be studied.

Methods: The present study compared individuals diagnosed with IED (n=81) with psychiatric controls (PCs; n=52) and healthy volunteers (HVs; n=58) on the impulsivity domains of negative and positive urgency, perseverance, sensation seeking, and premeditation, as well as on reward and punishment sensitivity. We hypothesized that individuals with IED would show greater negative and positive urgency, reward sensitivity, punishment sensitivity, with negative urgency independently predicting IED status. We also hypothesized that negative urgency would predict levels of anger, aggression, and aggression control among those with IED.

Results: The IED participants reported greater negative urgency than both comparison groups, and greater levels of positive urgency, reward sensitivity, and punishment sensitivity compared to HVs. Further, heightened negative urgency was the sole predictor an IED diagnosis. Within the IED group negative urgency uniquely predicted decreased aggression control and increased trait anger.

Limitations: Limitations included reliance on self-report measures to assess RS/PS, impulsivity, and aggression.

Conclusions: These findings suggest that negative urgency is a key factor associated with IED and is associated with dampened control of aggression within those with IED.

1. Introduction

Aggression, defined as a behavior directed toward others with the intent to cause harm (Geen and Donnerstein, 1998), is a worldwide public health problem with potentially devastating consequences for perpetrators, victims, and society (Krug et al., 2002). Though occasional mild acts of aggression may be normative (Kulper et al., 2015), excessive aggression is associated with several psychological disorders. Intermittent explosive disorder (IED) is the only psychiatric disorder for which excessive affective aggression is the defining symptom (American Psychological Association [APA], 2013). Although initially thought to be rare, IED is a relatively common and underdiagnosed disorder existing in about 5% of the population (Kessler et al., 2006). Further, IED is associated with considerable impairment, including workplace difficulties, relationship problems, legal difficulties, family transmission of aggressive behaviors (Kulper et al., 2015; McCloskey et al., 2006), and potentially long-term health problems (McCloskey et al., 2010).

IED is also associated with several cognitive-affective deficits. For example, individuals with IED are characterized by increased emotion dysregulation (Coccaro et al., 1998; Fettich et al., 2015; McCloskey et al., 2006, 2008b), which can be due to dysfunction in the amygdala-orbitofrontal cortex network that is involved in both experiencing and regulating emotions. Individuals with IED demonstrate irregularities within this network, with hyper-reactivity within the amygdala, hypo-activation within the orbitofrontal cortex (OFC), and reduced functional coupling between these areas

* Correspondence to: Department of Psychology, Temple University, 1701 N. 13th Street Philadelphia, PA 19122, USA.
E-mail address: mikemccloskey@temple.edu (M.S. McCloskey).

http://dx.doi.org/10.1016/j.jad.2016.04.045
0165-0327/

compared to healthy individuals in response to social threat signals (i.e., angry faces, Coccaro et al., 2007; McCloskey et al., 2016; New et al., 2007). As the amygdala is crucial for emotion processing (Kringelbach and Rolls, 2004), and the OFC is implicated in decision making and processing of reward/punishment (Rolls and Grabenhorst, 2008), this pattern of activation suggests the possibility that individuals with IED are vulnerable to intense negative emotion and have a deficit in their ability to regulate and control their emotions thereafter. Exacerbating difficulties regulating emotions, individuals with IED also appear to show significant deficits in interpreting their emotions and determining how to resolve emotional conflict (Coccaro et al., 2015b) and possibly a propensity for impulsivty (McCloskey et al., 2008b).

Individuals with IED consistently show increased self-reported impulsivity relative to non-psychiatric and psychiatric comparison groups (Best et al., 2002; Coccaro, 1998; Coccaro et al., 2015a; McCloskey et al., 2008a). However, studies using behavioral measures of impulsivity are more equivocal (e.g., Best et al., 2002; Coccaro, 1998). Most self-report measures examine overall trait impulsivity, whereas behavioral impulsivity measures (e.g., the Go No-Go Task) sample specific impulsive behaviors (e.g., motor impulsivity). Furthermore, the behavioral tasks are typically administered in a calm, controlled setting. This may be problematic as though some facets of impulsivity are not strongly affect dependent (e.g., sensation seeking, lack of premeditation, lack of perseverance), others (i.e., negative urgency [NU] and positive urgency [PU], which are the tendency to behave impulsively when experiencing negative and positive emotions, respectively) are (Cyders et al., 2007; Whiteside and Lynam, 2001).

NU and PU are positively associated with aggression (Lynam and Miller, 2004; Seibert, et al., 2010; Settles et al., 2012). If IED is likewise associated with NU or PU, this would potentially explain why many behavioral impulsivity tasks fail to show differences between IED and control groups, as there is typically very little strong negative or positive affect associated with completing these behavioral tasks. Indirect evidence supports this as individuals with IED have increased levels of emotion dysregulation (Fettich et al., 2015) and lack control when experiencing anger (Kulper et al., 2015), which may reflect heightened levels of NU (and possibly PU). However, no study to date has directly assessed the relationship between IED and NU or PU, nor has any study directly assessed the relationship between IED and the related constructs of reward and punishment sensitivity.

Reward sensitivity (RS) and punishment sensitivity (PS) are the products of two unique motivational systems that respond to differing types of reinforcement (Gray, 1970; Gray and McNaughton, 2000): (1) the Behavioral Activation System, which is activated when approach behavior towards a reward is engaged (RS); and (2) the Behavioral Inhibition System, which is activated when an individual engages in either inhibition of a behavior that would lead to punishment and/or engaging in a behavior to avoid punishment (PS). RS and PS are associated with, but distinct from, impulsivity. Factor analyses and other correlational research support the dissociable relationship between RS/PS and facets of impulsivity such as NU/PU (Carlson et al., 2013; Caseras et al., 2003; Franken et al., 2006; Seibert et al., 2010). Thus, RS/PS may help explain additional variability in related psychological disorders and behaviors not previously captured by impulsivity measures.

RS and PS have been linked to psychopathology, with RS most commonly associated with externalizing behaviors and disorders (e.g., substance use disorders; Franken and Muris, 2006; Johnson et al., 2003; Kimbrel et al., 2008), while increased PS has been found in both anxiety disorders (e.g., social anxiety, obsessive compulsive disorder; Fullana et al., 2004; Johnson et al., 2003) and major depressive disorder (Johnson et al., 2003; Pinto-Meza et al., 2006). Further, heightened RS and decreased PS are linked to symptoms of psychiatric disorders such as anger and aggression (e.g., Bjornebekk, 2007; Carlson et al., 2013; Harmon-Jones, 2003), whereas dampened RS is associated with control of aggressive impulses (Cooper et al., 2008). This would suggest that a similar pattern may be found in IED, as those with IED exhibit heightened anger/aggression and reduced aggression control (Look et al., 2015; McCloskey et al., 2008a). However, individuals with IED also show a hyper-sensitivity to threat (Kulper et al., 2015), which would suggest increased PS. Thus, in addition to increased NU (and possibly PU), we would expect increased RS/ PS among those with IED. Likewise, we would expect RS/PS, NU (and possibly PU) to be associated with levels of aggression among those with IED. Less clear is the extent to which these constructs uniquely predict IED status and aggression amongst those with IED, though the intensity of negative emotion dysregulation in IED (Fettich et al., 2015) suggests that NU may play a prominent role in facilitating aggression in IED.

The present study is the first to examine NU/PU and RS/PS among individuals diagnosed with IED. We hypothesized that, in comparison to both psychiatric and non-psychiatric control groups, the IED group would have significantly elevated levels of NU (and possibly PU), as well as greater levels of RS and PS. We further hypothesized that among these variables, NU would uniquely predict IED status. Finally, we hypothesized that within the IED group NU would be associated with increased anger and aggression as well as decreased aggression control.

2. Methods

2.1. Participants

Participants consisted of 191 individuals (85 men and 106 women) between the ages of 18 and 55 ($M=28.41$, $SD=10.43$) recruited from at a large northeastern university via advertisements (e.g., flyers, radio ads, public transportation ads) looking for healthy volunteers and individuals with anger problems. Exclusion criteria for all groups included lifetime history of psychosis, organic disorders (e.g., traumatic brain injury), intellectual disabilities, and/or current psychotropic medication use. 7 potential participants were excluded for psychosis or TBI and an additional 6 were excluded for current psychotropic medication use. Written informed consent was provided by all participants and all procedures were approved by the university Institutional Review Board.

Participants were predominately Caucasian (50%) or African American (32.8%), and were relatively well educated (84.4% had some level of college education). The participants were categorized into three diagnostic groups. Participants in the healthy volunteer (HV) group ($n=58$) denied any lifetime psychiatric disorders defined by the DSM-IV (American Psychiatric Association, 2000). Participants in the psychiatric control (PC) group ($n=52$) reported one or more psychiatric disorders defined by the DSM-IV, while not meeting criteria for IED. Finally, individuals in the IED group ($n=81$) met for current DSM-5 IED (APA, 2013). All group assignments were based on the results of a psychiatric interview.

2.2. Psychiatric interview measures

2.2.1. Structured clinical interview for DSM-IV (SCID)

The SCID (First et al., 1996) was used to assess for and assign diagnoses of current and lifetime mood disorders, psychotic disorders, substance use disorders, anxiety disorders, somatoform disorders, eating disorders, and adjustment disorders. The SCID has been shown to have adequate inter-rater reliability with kappa values varying from module to module (.70–1.00; First et al., 1996).

2.2.2. Structured interview for DSM-IV personality disorders (SID-P)

The SID-P (Pfohl et al., 1995) was used to assess for personality disorders; the SIDP-IV was shown to have good inter-rater reliability ranging from .88 to .99 (Pfohl et al., 1995).

2.2.3. Intermittent explosive disorder interview-revised for DSM-5 (IEDI-5)

The IEDI (Coccaro, unpublished instrument) is a reliable and validated (k=.84; McCloskey and Coccaro, 2003) structured diagnostic interview that provides the necessary diagnostic information in order to diagnose both DSM-IV IED (APA, 2000) and IED-Integrated Research criteria (Coccaro, 2011). This includes qualitative and quantitative information about an individual's verbal and physical aggression and any resulting distress/impairment due to their aggression. For the current study, the IEDI was slightly modified to assess DSM-5 IED aggression severity/frequency criteria. This was done by assessing for minor aggression (verbal aggression and/or physical with no damage) over a 3-month period and major aggression (physical aggression with damage to persons or objects) over a 12-month period. The IEDI-5 has demonstrated good construct validity for DSM-5 criteria (Kulper et al., 2015).

2.3. Questionnaires

2.3.1. The sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ)

The SPSRQ (Torrubia et al., 2001) is a 48-item self-report measure that is split into two 24-item subscales that assess an individual's avoidance of punishment (i.e., PS) and approach of reward (i.e., RS). The SPSRQ has been shown to be a valid instrument with good test re-test reliability (Torrubia et al., 2001). A 5-point Likert scale version of the SPSRQ was adapted from the child version (Luman et al., 2012) to increase variability on each construct, and its psychometrics have been supported (Conner et al., 2010).

2.3.2. State-trait anger expression inventory-2 (STAXI-2)

The STAXI-2 (Spielberger, 1999) is a 57-item self-report measure of anger and anger expression. The STAXI-2 has been shown to be a valid and internally consistent instrument (α=.72–.94; Culhane and Morera, 2010). The subscales of trait anger, anger expression-out and anger control-out were used as measures of trait anger, aggression, and ability to control aggressive impulses, respectively.

2.3.3. UPPS-P impulsive behavior scale

The UPPS-P (Whiteside and Lynam, 2001; Cyders et al., 2007) is a 59-item self-report of impulsive behavior across the domains of premeditation, negative urgency, positive urgency, sensation seeking, and perseverance. The UPPS-P has demonstrated good internal consistency (α=.82–.91; Whiteside and Lynam, 2001) and validity (Whiteside et al., 2005; Cyders et al., 2007).

2.4. Procedure

Participants completed a 3-h diagnostic interview conducted by trained graduate-level diagnosticians who were blind to study hypotheses. IED diagnoses were made by using the IEDI-5. All other syndromal diagnoses were assigned using the SCID, and all personality disorders were assigned using the SID-P. Diagnoses were confirmed using a best estimate procedure (Klein et al., 1994; Leckman et al., 1982), where a written diagnostic report for each participant is presented and reviewed by a team of diagnosticians, and is supervised by a licensed clinical psychologist. Overall, this type of procedure yields strong inter-rater reliabilities (k=.84, range: .79–.93) across psychiatric disorders. Upon successful completion of the diagnostic interview, participants completed a set of questionnaires online, including the SPSRQ, UPPS-P, and STAXI-2.

Table 1
Demographic variables for diagnostic groups.

	HV (N=58)	PC (N=52)	IED (N=81)
Age Mean (SD)*** a, b	24.72 (6.81)	21.69 (3.18)	35.27 (11.46)
Gender N (%)*** a, c			
Female	32 (55%)	42 (81%)	32 (40%)
Male	26 (45%)	10 (19%)	49 (60%)
Race N (%)** a, b			
White	27 (47%)	33 (63%)	36 (44%)
African American	17 (29%)	8 (15%)	37 (46%)
Asian	11 (19%)	5 (10%)	3 (4%)
Other	3 (5%)	6 (12%)	5 (6%)
Education N (%) * a, c			
Some College	49 (84%)	50 (96%)	62 (77%)
No College	9 (16%)	2 (4%)	19 (24%)

Note: Healthy Volunteers = HV; Psychiatric Controls = PC; Intermittent explosive disorder group = IED.

* p <.05.
** p <.01.
*** p <.001.
[a] IED ‡ PC.
[b] IED ‡ HV.
[c] PC‡ HV.

2.5. Data analytic plan

All statistical analyses were performed using SPSS 21 software (IBM Corp, 2012) and all p-values were set to .05. Demographic variables (i.e., sex, age, race, and education) were assessed as a function of diagnostic group. Any demographic variable found to be significantly different among diagnostic groups were controlled for in subsequent MANCOVAs. Trait anger, anger expression-out, and anger control-out were also assessed as a function of diagnostic group to validate diagnostic group differences on anger and aggression. Bivariate zero-order Pearson correlations were then performed on the RS/PS indexes, impulsivity domains, and aggression variables to determine the simple relationships between the variables.

To determine if the diagnostic groups differed on the impulsivity domains and RS/PS indexes, a pair of one-way MANCOVAs, covarying for relevant demographic variables, were performed. Significant univariate group effects were probed using

Table 2
Prevalence of lifetime psychiatric diagnoses for IED & PC groups.

	PC (N=51)	IED (N=81)	X^2
Mood disorder	26 (51%)	30 (37%)	2.49
Substance use disorder	10 (20%)	25 (31%)	2.04
Anxiety disorder**	21 (41%)	15 (19%)	8.10
Personality disorder*	18 (35%)	43 (53%)	3.99

Note: Psychiatric Controls = PC; Intermittent explosive disorder group = IED.

* p <.05.
** p <.01.

Table 3
MANCOVA results for STAXI anger/aggression variables.

	IED	PC	HV	*F*	η_p^2
Trait anger [a, b, c]	24.92 (6.21)	17.40 (4.24)	13.96 (4.30)	52.66***	49
Anger control-out [a, b]	18.63 (4.13)	22.45 (5.03)	22.73 (3.96)	13.12***	33
Anger expression-out [a, b]	18.43 (2.96)	15.74 (2.97)	16.96 (2.67)	8.59***	17

Note: Covarying for age, gender, race, and education All group means are adjusted; For all significant differences between groups, $p < .05$.

*** $p < .001$.
[a] IED ‡ PC.
[b] IED ‡ HV.
[c] PC‡ HV.

post-hoc Tukey HSD tests. To determine which variables uniquely predicted IED status, we conducted logistic regressions with IED versus HV and/or PC as the criterion, and all significant impulsivity domains and RS/PS indexes as the predictor variables.

To assess which of the impulsivity and RS/PS variables were associated with trait anger, aggression (i.e., anger expression-out) and aggression control (i.e.. anger control-out) among those diagnosed with IED, we conducted bivariate zero order correlations among IED participants. Where multiple impulsivity and/or RS/PS measures were associated with anger, aggression, or aggression control, linear regressions were performed to determine which variables uniquely predicted anger, aggression, or aggression control within the IED group.

3. Results

All continuous variables were tested for skewness (Skewness within ± 2) and kurtosis (Kurtosis within ± 2) and fell within an acceptable range, thus they meet the assumptions of normality and no transformations were performed.

Groups significantly differed on gender [$X^2(2)=21.84$, $p < .001$], race [$X^2(6)=21.41$, $p < .01$], age [F (2, 188)=49.43, $p < .001$], and education [$X^2(2) = 9.20$, $p < .05$]. The IED group had a greater proportion of African American participants and was older than the HV and PC groups. The IED group also had a greater proportion of male participants and a lower proportion of college education participants than the PC group (see Table 1). Participants in the IED group were more likely to have a personality disorder and less likely to have a lifetime anxiety disorder than those in the PC group, but groups did not differ with regard to rates of lifetime substance use disorders or mood disorders (see Table 2). Due to anxiety and personality psychopathology differing among the IED and PC groups, the MANCOVAs were also conducted with anxiety and personality disorders as covariates and results did not vary. Thus, the original results are discussed and presented below. Due to significant group gender, race, age, and education differences, these variables were included as covariates in the primary MANCOVA analyses.

Table 5
MANCOVA results for motivational system indexes and the impulsivity domains.

	IED	PC	HV	*F*	η_p^2
Motivational system indexes					
Reward sensitivity [b, c]	46.87 (14.03)	49.66 (10.91)	34.43 (16.25)	20.30***	.20
Punishment sensitivity [b, c]	46.59 (16.81)	49.40 (16.21)	30.40 (17.63)	22.02***	.23
Impulsivity domains					
Premeditation	33.26 (5.52)	32.08 (5.50)	32.95 (5.89)	.49	.00
Negative urgency [a, b, c]	33.39 (6.81)	29.05 (6.09)	21.20 (7.27)	42.75***	.34
Sensation seeking	31.93 (7.74)	32.16 (6.68)	32.25 (7.15)	.26	.08
Perseverance	30.47 (5.39)	29.03 (5.76)	31.53 (5.05)	2.77	.03
Positive urgency [b, c]	25.09 (8.35)	27.26 (9.03)	17.86 (5.49)	21.64***	.18

Note: Covarying for age, gender, race, and education All group means are adjusted; For all significant differences between groups, $p < .05$.

*** $p < .001$.
[a] IED ‡ PC.
[b] IED ‡ HV.
[c] PC‡ HV.

Table 6
Logistic Regression of IED versus HV Status on RS/PS and trait impulsivity measures.

	B	*SE* (B)	Wald	OR	95% CI
Reward Sensitivity	−.02	.03	.40	.98	.94 – 1.04
Punishment Sensitivity	.01	.02	.27	1.01	.97– 1.05
Negative Urgency	.21	.05	16.69***	1.23	1.12– 1.37
Positive Urgency	.07	.05	2.40	1.07	.98 – 1.17

Note: Covarying for age, gender, race, and education; Regression coefficients are standardized; Reward Sensitivity = RS; Punishment Sensitivity = PS.

*** $p < .001$.

Table 4
Diagnostic group correlations.

	PS	RS	Pre	NU	SS	Per	PU	Anger	AO	ACO
PS	1	.52***	.10	.46***	−.10	−.33***	.50***	.15	−.07	−.07
RS		1	.13	.37***	.29***	−.03	.44***	.32***	.06	−.10
Pre			1	−.11	.08	.55***	−.24**	.03	−.00	.24**
NU				1	.06	−.27***	.50***	.63***	.30***	−.48***
SS					1	.26***	.02	−.05	−.00	.18*
Per						1	−.40***	.04	.05	.22**
PU							1	.23***	−.05	−.26**
Anger								1	.52***	−.52***
AO									1	−.37***
ACO										1

Note: Punishment Sensitivity = PS; Reward Sensitivity = RS; Pre = Premeditation; Negative Urgency = NU; Sensation Seeking = SS; Per = Perseverance; Positive Urgency = PU; STAXI Trait Anger subscale = Anger; STAXI Anger Expression-out = AO; STAXI Anger Control-Out = ACO.

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

Groups differed on self-reported anger, aggression, and aggression control, Wilks' λ (6, 328) = 17.30, $p < .001$. Univariate analyses revealed significant main effects of group on trait anger, anger control-out, and anger expression-out. Trait anger and anger expression-out were significantly greater among the IED group compared to both the PC and HV groups; anger control was lower among IED participants relative to the comparison groups (see Table 3).

Table 4 provides zero-order correlations and significant values. PS was positively associated with RS. Among the impulsivity domains, premeditation was positively associated with perseverance and negatively associated with PU. NU was positively associated with PU, while negatively associated with perseverance. Sensation Seeking (SS) was positively associated with perseverance. Perseverance was negatively associated with PU. Trait anger and anger expression-out were also positively correlated and negatively associated with anger control-out. Across measures, PS was positively associated with NU and PU, while negatively associated with perseverance. RS was positively associated with NU, SS, and PU. Premeditation, SS, and perseverance were all found to be positively associated with anger control-out. NU was positively associated with trait anger and anger expression-out and was negatively associated with anger control-out. PU was positively associated with trait anger, while negatively associated with anger control-out.

A MANCOVA examining the impulsivity domains revealed a significant multivariate effect of group, Wilks' λ (10, 338) = 10.04, $p < .001$. Subsequent univariate analyses revealed significant main effects of group for NU and PU. NU was significantly greater among the IED group compared to both the PC and HV groups, while PU was significantly greater among the IED group compared to only the HV group (see Table 5). The PC group was also significantly greater on both PU and NU compared to the HV group.

A second MANCOVA examining RS/PS showed a significant multivariate effect of group, Wilks' λ (4, 366) = 13.59, $p < .001$. Subsequent univariate analyses revealed a significant main effect of group for both RS and PS, with IED and PC participants reporting significantly greater RS and PS than HV participants (see Table 5). There were no significant differences between the IED and PC groups on either RS or PS.

Given the only significant group difference between IED and PC groups was for NU, no IED versus PC regression was conducted. Variance Inflation Factors (VIF) were examined to determine multicollinearity within the logistic regression and were within acceptable limits (1.02–1.92). For the logistic regression predicting to IED versus HV, the omnibus tests of the demographic variables that were entered in the first step were significant ($\chi^2(4) = 35.85$, $p < .001$), as was the omnibus test for the RS/PS indexes and impulsivity domains entered in step two, $\chi^2(4) = 56.24$, $p < .001$. In the final model, only heightened levels of NU uniquely predicted IED status (see Table 6).

Among IED participants, anger control-out was positively associated with premeditation ($r = .31$, $p < .05$) and SS ($r = .29$, $p < .05$), while negatively associated with NU ($r = -.36$, $p < .01$). Trait anger was positively associated with NU ($r = .29$, $p < .05$) and at a non-significant trend level with perseverance ($r = .23$, $p = .05$). Anger expression-out was not significantly correlated with any of the impulsivity or RS/PS variables (all $p > .09$).

In the linear regression with anger control-out as the dependent variable and premeditation, NU, and SS as predictor variables, it was found that the overall model was significant ($R^2 = .30$, F (3, 66) = 9.55, $p < .001$). Premeditation ($B = .20$, t (66) = 2.39, $p < .05$) and SS ($B = .19$, t (66) = 3.41, $p < .01$) were found to both uniquely predict increased anger control-out, while NU ($B = -.22$, t (66) = −3.14, $< .01$) uniquely predicted decreased anger control-out among those diagnosed with IED. No linear regression was required for trait anger due to only NU being significantly associated with it. However, an exploratory regression with both NU and perseverance as predictors found that only NU was a significant predictor of trait anger.

4. Discussion

The current study examined the relationship between impulsivity, RS/PS and IED. We predicted that those diagnosed with IED would report greater NU (and possibly PU), as well as heightened RS and PS, compared to individuals in a psychiatric control group and a healthy volunteer group. We further hypothesized that among these variables NU would be uniquely associated with IED and would predict trait anger, aggression, and aggression control levels among those with IED. The data partially supported these hypotheses. Individuals diagnosed with IED endorsed greater NU compared to individuals with other disorders and psychologically healthy individuals. Those with IED were also found to report heightened PS, RS, and PU compared to healthy volunteers, but not compared to psychiatric controls; NU was the only variable that uniquely predicted IED status relative to either psychiatric or healthy controls. Among IED individuals, NU uniquely predicted trait anger but not aggression. Finally, NU, premeditation, and SS all uniquely predicted aggression control.

Of all the study variables, only NU differentiated IED participants from both psychiatric and healthy control groups, suggesting those with IED act more impulsively in response to negative affect but otherwise are not more impulsive than other clinical populations (or non-clinical populations, for the most part). These findings provide a possible explanation for the inconsistent trait versus behavioral impulsivity results associated with IED, suggesting a general tendency to be more impulsive when affectively dysregulated, which does not typically occur during behavioral impulsivity tasks. This is consistent with research showing that IED is linked to poor affect regulation (e.g., Fettich et al., 2015) and a greater ("out of control") urge to aggress when angry (Kulper et al., 2015). These findings also lend support to previous studies showing that, though previously grouped as an "impulse control" disorder, IED shows little comorbidity with other impulse control disorders (e.g., kleptomania, compulsive gambling; Coccaro et al., 2005). Thus, individuals with IED may not have difficulties with motoric impulsivity seen in those with "impulse control" disorders (i.e. rapid response impulsivity; Hamilton et al., 2015a), but have acute difficulty with delaying gratification (i.e., choice impulsivity; Hamilton et al., 2015b) when faced with strong negative affect or frustration (i.e., aggressing towards a provocation to alleviate tension when angry or frustrated). This is consistent with previous literature that finds those with IED have increased emotion dysregulation, which corresponds with hyper-reactivity within the amygdala and hypo-activity within the OFC (Coccaro et al., 2007; McCloskey et al., 2016; New et al., 2007). This dysregulation within the amygdala-orbitofrontal network provides a possible neurofunctional basis for the increased sensitivity to negative emotion and corresponding inability to regulate negative emotion. As NU is acting rash in response to negative emotion, it corresponds to this dysregulation within the amygdala-orbitofrontal network, and may explain why those with IED are more impulsive in response to anger. This dysfunctional amygdala-orbitofrontal network may also be associated with a depletion of serotonin, as impaired serotonergic functioning has been consistently implicated in impulsive aggression (Coccaro et al., 2015b), and reduction of serotonin via tryptophan depletion has reduced functional coupling between the prefrontal cortex and amygdala among healthy individuals while observing social threat signals (Passamonti et al., 2012).

PU only differentiated IED participants from healthy volunteers (and this differences was eliminated when controlling for other variables; i.e., RS, PS, and NU), while premeditation, SS, and perseverance failed to show any group differences. Though we did not expect to find group difference in the non-affective impulsivity scales, the lack of significant difference between IED and psychiatric control group on PU was somewhat surprising in light of past research showing that aggression is associated with PU (Carlson et al., 2013; Seibert et al., 2010). Individuals with IED reported lower quality of life and greater impairment across several psychosocial domains relative to psychiatric control groups; therefore, it may be that the relative paucity of positive emotional experiences led to somewhat suppressed PU scores in the IED group. Another possible (and we believe more likely) explanation is that positive emotions simply do not result in greater impulsive actions among IED participants relative to other clinical groups. Although those with IED demonstrate mild OFC hypo-activation in response to positive emotional stimuli (i.e., happy faces) compared to healthy controls, they do not show corresponding amygdala hyper-activity (Coccaro et al., 2007), suggesting a much more limited deficit during positive emotion. Relatedly, though IED subjects report more reactivity to positive emotion than healthy volunteers, they did not differ from psychiatric control subjects (Fettich, 2015), suggesting that any rashness in the face of positive emotion (i.e., PU) found in IED may be less unique to IED, and more a general vulnerability for psychopathology (Cyders and Smith, 2008). However, further research is needed to confirm this hypothesis.

IED participants showed increased RS and PS relative to healthy volunteers. However, IED and psychiatric control participants did not differ, suggesting that the increased RS/PS in IED may reflect a general vulnerability associated with psychopathology that is not specific to IED. Heightened degrees of RS and PS are linked to emotional and behavioral difficulties, such as increased impulsivity, negative affect, substance use problems, and self-harm (Bjornebekk, 2007; Carlson et al., 2013; Jenkins et al., 2013; Seibert et al., 2010; Tapper et al., 2015) that are shared by many psychological disorders, including IED (Fullana et al., 2004; Johnson et al., 2003; Pinto-Meza et al., 2006). Alternately, if RS/PS are associated specifically with IED, this could be hidden in the present study if there was increased RS/PS related psychopathology (e.g., substance use disorders, anxiety disorders) in the psychiatric control versus IED group. In fact, the psychiatric control group did have more lifetime anxiety disorders and marginally more lifetime mood disorders. However, further analyses controlling for these disorders did not change the outcome for PS. With regard to RS, the IED group had slightly more substance use disorders than the psychiatric control group and when controlling for this difference the IED group actually reported slightly less RS compared to the psychiatric control group, furthering the argument that neither reward nor punishment sensitivity is uniquely associated with IED.

Among those with IED, NU predicted both increased trait anger and decreased anger control, suggesting that IED individuals with higher NU may represent a more severe subgroup with greater anger and anger dyscontrol. There was no association, however, between aggression and NU among those with IED. One possible explanation for this discrepancy is that the high levels of aggression that define IED reduced aggression variability within this group, creating a “ceiling effect.” It also may be possible that NU does not affect aggression severity among those with IED, though this would be surprising in light of the relationship between NU and trait anger / anger control among those with IED.

Sensation seeking and premeditation were also found to predict increased aggression control among those with IED. Previous studies show that premeditation (i.e., ability to think and plan ahead) is associated with decreased aggression (Carlson et al., 2013), suggesting that the ability to think and plan ahead improves one's control of their aggression. The finding that sensation seeking was positively associated with anger control among IED participants is in contrast to research showing sensation seeking being positively associated with aggression in general samples (Carlson et al., 2013), and may suggest that individuals with IED engage in other arousing behaviors as a method of dealing with their anger. This is indirectly supported by the increased level of substance abuse among those with IED (Kessler et al., 2006).

Some of the strengths of this study included the utilization of a clinically assessed sample that was demographically diverse and the inclusion of both healthy volunteer and psychiatric control groups that allowed us to differentiate constructs associated psychopathology in general versus IED specifically. The study also had limitations, including the sole reliance on self-report measures to assess RS/PS, impulsivity, and aggression. Future studies may benefit from the addition of behavioral measures of these constructs (e.g., Taylor Aggression Paradigm (Taylor, 1967) for aggression). Relatedly, to confirm the role of NU in IED, the use of acute negative mood manipulations in combination with measures of behavioral impulsivity would be useful.

This study is the first to focus on a contemporary conceptualization of impulsivity and RS/PS measures in IED. The results suggest that those with IED do not suffer from a global problem with impulsivity, but rather are prone to impulsive behavior in response to negative emotion. These findings, if replicated, can help clarify the disparate finding on IED and impulsivity and better delineate the central deficits associated with the disorder. In turn, this information can inform prevention and intervention efforts, both pharmacological and psychosocial leading to more focused effective treatments.

References

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. American Psychiatric Association Press, Washington, D.C.

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. American Psychiatric Publishing, Arlington, VA.

Best, M., Williams, J.M., Coccaro, E.F., 2002. Evidence for a dysfunctional prefrontal circuit in patients with an impulsive aggressive disorder. Proc. Natl. Acad. Sci. Usa. 99, 8448–8453.

Bjornebekk, G., 2007. Dispositions related to sensitivity in the neurological basis for activation of approach-avoidance motivation, antisocial attributes and individual differences in aggressive behavior. Soc. Behav. Personal. 35, 1251–1264.

Carlson, S.R., Pritchard, A.A., Dominelli, R.M., 2013. Externalizing behavior, the UPPS-P impulsive Behavior scale and Reward and Punishment Sensitivity. Personal. Individ. Differ. 54, 202–207.

Caseras, X., Avila, C., Torrubia, R.A., 2003. The measurment of individual differences in behavioral inhibition and behavioral activation systems: a comparison of personality scales. Personal. Individ. Differ. 34, 999–1013.

Coccaro, E.F., 1998. Impulsive aggression: a behavior in search of clinical definition. Harv. Rev. Psychiatry 5, 336–339.

Coccaro, E.F., 2011. Intermittent explosive disorder: development of integrated research criteria for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. Compr. Psychiatry 52, 119–125. http://dx.doi.org/10.1016/j.comppsych.2010.05.006.

Coccaro, E.F., Posternak, M.A., Zimmerman, M., 2005. Prevalence and features of intermittent explosive disorder in a clinical setting. J. Clin. Psychiatry 66, 1221–1227.

Coccaro, E.F., Kavoussi, R.J., Berman, M.E., Lish, J.D., 1998. Intermittent explosive disorder-revised: development, reliability, and validity of research criteria. Compartive. Psychiatry 39, 368–376.

Coccaro, E.F., McCloskey, M.S., Fitzgerald, D.A., Phan, K.L., 2007. Amygdala and orbitofrontal reactivity to social threat in individuals with impulsive aggression. Biol. Psychiatry 62, 168–178.

Coccaro, E.F., Fanning, J.R., Phan, K.L., Lee, R., 2015a. Serotonin and impulsive aggression. CNS Spectr. 20, 295–302. http://dx.doi.org/10.1017/S1092852915000310.

Coccaro, E.F., Solis, O., Fanning, J., Lee, R., 2015b. Emotional intelligence and impulsive aggression in Intermittent Explosive Disorder. J. Psychiatr. Res. 61, 135–140.

Conner, B.T., Jenkins, A.L., Seelbach, A.C., 2010. November. Improving Measurement

of Behavioral Activation and Inhibition: A Revised Version of the Sensitivity to Punishment Sensitivity to Reward Questionnaire. Poster presented at the 44th Annual Convention of the Association of Behavioral and Cognitive Therapies San Francisco, CA.
Cooper, A., Gomez, R., Buck, E., 2008. The relationship between the BIS and BAS, anger, and response to anger. Personal. Individ. Differ. 44, 403–413.
Culhane, S.E., Morera, O.F., 2010. Reliability and Validity of the Novaco Anger Scale and Provocation Inventroy (NAS-PI) and State-Trat Anger Expression Inventory-2 (STAXI-2) in Hispanic and Non-Hispanic White Student Samples. Hisp. J. Behav. Sci. 32, 586–606.
Cyders, M.A., Smith, G.T., 2008. Emotion-based dispositions to rash action: positive and negative urgency. Psychol. Bull. 134, 807.
Cyders, M.A., Smith, G.T., Spillane, N.S., Fischer, S., Annus, A.M., Peterson, C., 2007. Integration of impulsivity and positive mood to predict risky behavior: development and validation of a measure of positive urgency. Psychol. Assess. 19, 107–118.
Fettich, K.C., McCloskey, M.S., Look, A.E., Coccaro, E.F., 2015. Emotion Regulation Eficits in Intermittent Explosive Disorder. Aggress. Behav. 41, 25–33.
First, M.B., Gibbon, M., Spitzer, R.L., Williams, J.B., 1996. User's Guide for the SCID-I (Research Version). Biometrics Research, New York.
Franken, I.H.A., Muris, P., 2006. BIS/BAS personality characteristics and college student's substance use. Personal. Individ. Differ. 40, 1497–1503.
Franken, I.H.A., Muris, P., Georgieva, I., 2006. Gray's model of personality and addiction. Addict. Behav. 31, 399–403.
Fullana, M., Mataix-Cols, D., Caseras, X., Alonso, P., Menchon, J.M., Vallejo, J., Torrubia, R.A., 2004. High sensitivity to punishment and low impulsivity in obsessive-compulsive patients with hoarding symptoms. Psychiatry Res. 129, 21–27.
Geen, R.G., Donnerstein, E.I., 1998. Human Aggression: Theories, Research, and Implications for Social Policy. Academic Press, San Diego, Calif.
Gray, J.A., 1970. The psychophysiological basis of introversion-extraversion. Behav. Res. Ther. 8, 249–266.
Gray, J.A., McNaughton, N., 2000. The Neuropsychology of Anxiety: An Enquiry into the Functions of the septo-hippocampal System, 2nd ed Oxford University, New York.
Hamilton, K.R., Littlefield, A.K., Anastasio, N.C., Cunningham, K.A., Fink, L.H., Wing, V.C., Mathias, C.W., Lane, S.D., Schütz, C.G., Swann, A.C., Lejuez, C.W., Clark, L., Moeller, F.G., Potenza, M.N., 2015a. Rapid-response impulsivity: definitions, measurement issues, and clinical implications. Personal. Disord. 6, 168–181.
Hamilton, K.R., Mitchell, M.R., Wing, V.C., Balodis, I.M., Bickel, W.K., Fillmore, M., Lane, S.D., Lejuez, C.W., Littlefield, A.K., Luijten, M., Mathias, C.W., Mitchell, S.H., Napier, T.C., Reynolds, B., Schütz, C.G., Setlow, B., Sher, K.J., Swann, A.C., Tedford, S.E., White, M.J., Winstanley, C.A., Yi, R., Potenza, M.N., Moeller, F.G., 2015b. Choice impulsivity: definitions, measurement issues, and clinical implications. Personal. Disorders: Theory, Res., Treat. 6, 182.
Harmon-Jones, E., 2003. Anger and the behavioral approach system. Personal. Individ. Differ. 35, 995–1005.
IBM Corp, 2012. Released IBM SPSS Statistics for Windows, Version 21 2012 IBM Corp, Armonk, NY 0.
Jenkins, A.L., Sellbach, A.C., Conner, B.T., Alloy, L.B., 2013. The roles of behavioral activation and inhibition among young adults engaging in self-injury. Personal. Ment. Health 7, 39–55.
Johnson, S.L., Turner, R.J., Iwata, N., 2003. Bis/bas levels of psychiatric disorders: an epidemiological study. J. Psychopathol. Behav. Assess. 25, 25–26.
Kessler, R.C., Coccaro, E.F., Fava, M., Jaeger, S., Jin, R., Walters, E., 2006. The prevalence and correlates of DSM-IV intermittent explosive disorder in the National Comorbidity Survey Replication. Arch. Gen. Psychiatry 63, 669–678.
Kimbrel, N.A., Cobb, A.R., Mitchell, J.T., Hundt, N.E., Nelson-Gray, R.O., 2008. Sensitivity to punishment and low maternal care account for the link between bulimic and social anxiety symptomatology. Eat. Behav. 9, 210–217.
Klein, D.N., Ouimette, P.C., Kelly, H.S., Ferro, T., Riso, L.P., 1994. Test-retest reliability of team consensus best-estimate diagnoses of axis I and II disorders in a family study. Am. J. Psychiatry 151, 1043–1047.
Kringelbach, M.L., Rolls, E.T., 2004. The functional neuroanatomy of the human orbitofrontal cortex: Evidence from neuroimaging and neuropsychology. Prog. Neurobiol. 72, 341–372.
Krug, E.G., Mercy, J.A., Dahlberg, L.L., Zwi, A.B., 2002. World report on violence and health. Biomedica 22, 327–336.
Kulper, D., Kleiman, E.M., McCloskey, M.S., Berman, M.E., Coccaro, E.F., 2015. The experience of aggressive outbursts in intermittent explosive disorder. Psychiatry Res. 225, 710–715.
Leckman, J.F., Sholomskas, D., Thompson, W.D., Belanger, A., Weissman, M.M., 1982. Best estimate of lifetime psychiatric diagnosis: a methodological study. Arch. Gen. Psychiatry 39, 879–883.
Look, A.E., McCloskey, M.S., Coccaro, E.F., 2015. Verbal versus physical aggression in Intermittent Explosive Disorder. Psychiatry Res. 225, 531–539.
Luman, M., vanMeel, C.S., Oosterlaan, J., Geurts, H.M., 2012. Reward and punishment sensitivity in children with ADHD: validating the sensitivity to punishment and sensitivity to reward questionnaire for children (SPSRQ-C). J. Abnorm. child psych. 40, 145–157.
Lynam, D.R., Miller, J.D., 2004. Personality pathways to impulsive behavior and their relations to deviance. Results from three samples. J. Quant. Criminol. 20, 319–341.
McCloskey, M.S., Coccaro, E.F., 2003. Questionnaire and Interview Measures of Aggression in Adults. In: Coccaro, E.F. (Ed.), Aggression: Psychiatric Assessment and Treatment. Marcel Dekker, New York, pp. 167–193.
McCloskey, M.S., Berman, M.E., Noblett, K.L., Coccaro, E.F., 2006. Intermittent explosive disorder-integrated research diagnostic criteria: convergent and discriminant validity. J. Psychiatr. Res. 40, 231–242.
McCloskey, M.S., Ben-Zeev, D., Lee, R., Coccaro, E.F., 2008a. Prevalence of suicidal and self-injurious behavior among subjects with intermittent explosive disorder. Psychiatry Res. 158, 248–250.
McCloskey, M.S., Lee, R., Berman, M.E., Noblett, K.L., Coccaro, E.F., 2008a. The relationship between impulsive verbal aggression and intermittent explosive disorder. Aggress. Behav. 34, 51–60.
McCloskey, M.S., Noblett, K.L., Deffenbacher, J.L., Gollan, J.K., Coccaro, E.F., 2008b. Cognitive-behavioral therapy for intermittent explosive disorder: a pilot randomized clinical trial. J. Consult. Clin. Psychol. 76, 876–886.
McCloskey, M.S., Kleabir, K., Berman, M.E., Chen, E.Y., Coccaro, E.F., 2010. Unhealthy aggression: Intermittent explosive disorder and adverse physical health outcomes. Health Psychol. 29, 324–332.
McCloskey, M.S., Phan, K.L., Angstadt, M., Fettich, K.C., Coccaro, E.F., 2016. Amygdala hyperactivation to angry faces in intermittent explosive disorder. Manuscr. (Submitt. Publ.).
New, A.S., Hazlett, E.A., Buchsbaum, M.S., Goodman, M., Mitelman, S.A., Newmark, R., Trisdorfer, R., Haznedar, M.M., Koenigsberg, H.W., Flory, J., Siever, L.J., 2007. Amygdala-prefrontal disconnection in borderline personality disorder. Neuropsychopharmacology 32, 1629–1640.
Passamonti, L., Crockett, M.J., Apergis-Schoute, A.M., Clark, L., Rowe, J.B., Calder, A.J., Robbins, T.W., 2012. Effects of acute tryptophan depletion on prefrontal-amygdala connectivity while viewing facial signals of aggression. Biol. Psychiatry 71, 36–43.
Pfohl, B., Blum, N., Zimmerman, M., 1995. Structured Clinical Interview for DSM-IV Personality. University Of Iowa College Of Medicine, Iowa City.
Pinto-Meza, A., Caseras, X., Soler, J., Puigdemont, D., Perez, V., Torrubia, R.A., 2006. Behavioral inhibition and behavioural activation systems in current and recovered major depression participants. Personal. Individ. Differ. 40, 215–226.
Rolls, E.T., Grabenhorst, F., 2008. The orbitofrontal cortex and beyond: from affect to decision-making. Prog. Neurobiol. 86, 216–244.
Seibert, L.A., Miller, J.D., Pryor, L.R., Reidy, D.E., Zeichner, A., 2010. Personality and laboratory-based aggression: comparing the predictive power of the five-factor model, BIS/BAS, and impulsivity across context. J. Res. Personal. 44, 13–21.
Settles, R.E., Fischer, S., Cyders, M.A., Combs, J.L., Gunn, R.L., Smith, G.T., 2012. Negative urgency: a personality predictor of externalizing behavior characterized by neuroticism, low conscientiousness, and disagreeableness. J. Abnorm. Psychol. 121, 160–172.
Spielberger, C.D., 1999. STAXI-2 State Trait Anger Expression Inventory-2, Professional Manual. Psychological Assessment Resources, Inc, Lutz, FL.
Tapper, K., Baker, L., Jiga-Boy, G., Haddock, G., Maio, G.R., 2015. Sensitivity to reward and Punishment: associations with diet, alcohol, consumption, and smoking. Personal. Individ. Differ. 72, 79–84.
Taylor, S.P., 1967. Aggressive behavior and physiological arousal as a function of provocation and the tendency to inhibit aggression. J. Personal. 35, 297–310.
Torrubia, R.A., Avila, C., Molto, J., Caseras, X., 2001. The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. Personal. Individ. Differ. 31, 837–862.
Whiteside, S.P., Lynam, D.R., 2001. The five factor model and impulsivity: unsing a strcutural model of personlaity to understand impulsivity. Personal. Individ. Differ. 30, 669–689.
Whiteside, S.P., Lynam, D.R., Miller, J.D., Reynolds, S.K., 2005. Validation of the UPPS impulsive behaviour scale: a four-factor model of impulsivity. Eur. J. Personal. 19, 559–574.