



Emotion processing in intermittent explosive disorder

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ABSTRACT

Intermittent explosive disorder (IED), a disorder characterized by outbursts of affective aggression, is associated with deficits in regulating emotions. However, less is known about specific deficits in understanding and processing emotions in IED. This study sought to fill that gap by examining components of emotion processing (rumination, alexithymia, and empathy) in those with IED. Participants completed diagnostic interviews and self-report measures, and were categorized into three diagnostic groups: IED ($n = 177$), Psychiatric Control (PC; $n = 171$), and Healthy Volunteer (HV; $n = 144$). Those with IED reported more anger rumination and greater difficulty identifying their feelings than PC or HV participants. Interestingly, those with IED reported higher affective empathy scores than those in the HV group, with no other group differences on measures of empathy. Amongst those with IED, increased anger rumination and decreased sadness rumination predicted greater lifetime aggression, while increased sadness rumination predicted poorer quality of life. These findings suggest that although those with IED have a harder time recognizing their emotions, once they identify feeling angry, they spend more time focused this emotion than those with other disorders. These findings also suggest that cognitive intervention techniques may be beneficial for those with IED.

1. Introduction

Intermittent explosive disorder (IED) is characterized by outbursts of impulsive and/or affective (i.e., anger-based) aggression (Kulper et al., 2015) and is the only psychological disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) defined by frequent episodes of excessive aggression (American Psychiatric Association, 2013; Coccaro, 2012). These aggressive acts range from frequent heated verbal outbursts to intense physical altercations resulting in property destruction or injury, often leading to significant distress for the individual (Coccaro, 2012). IED often leads to substantial negative outcomes, including increased difficulties in occupational and social functioning, legal problems, (Kulper et al., 2015) and physical health problems (McCloskey et al., 2010). IED is also associated with affective and cognitive deficits including emotion regulation difficulties (Fettich et al., 2015; McCloskey et al., 2008a) and hostile attribution biases (Coccaro et al., 2009, 2015). However, less is known about the relationship between processing of emotions and IED.

Emotional awareness, whether it is difficulties understanding one's own emotions (alexithymia), or deficits in relating to the emotions of others (limited empathy), is a key facet of emotional processing. The extant research suggests alexithymia is associated with increased aggression. Studies of non-clinical samples suggest that difficulty

identifying one's emotions and a tendency to focus attention on external stimuli (two subdomains of alexithymia; Fossati et al., 2009), as well as overall alexithymia (Robertson et al., 2012) are associated with greater trait aggression. The association between alexithymia and aggression has been replicated in other studies using both community and general clinical samples (e.g., Velotti et al., 2016). This relationship also appears to extend to clinical populations at high risk for aggression. For example, among veterans with post-traumatic stress disorder alexithymia is a unique predictor of affective (impulsive) aggression (Teten et al., 2008).

Relatedly, there is limited evidence that individuals with higher levels of aggression tend to show less empathy for others. Initial results in college samples suggest greater levels of cognitive (i.e., perspective-taking) empathy is associated with aggression (Richardson et al., 1994). However, studies of clinical populations were more mixed (e.g., Harris and Picchioni, 2013). The inconsistent findings may reflect a weak relationship between empathy and aggression. However, it may also be associated with measure of empathy used. A review of over fifty empirical studies across both community and clinical / high-risk samples (e.g., incarcerated “delinquents”, patients in psychiatric hospital for criminal offenders) found that self-report measures of affective empathy (empathic concern) were negatively associated with aggression, while behavioral empathy tasks (e.g., facial affect, picture or story

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methods) were not (Miller and Eisenberg, 1988). The relationship between empathy and aggression could also vary as function of the aggression form; however, a recent meta-analysis of over 100 published and unpublished effects across community, clinical, and criminal samples found consistently weak associations between cognitive/affective empathy across aggression form (i.e., physical, sexual, and “general” aggression; Vachon et al., 2014). With regard to aggression function, the relationship between empathy and aggression may be stronger for proactive/instrumental aggression (Euler, Steinlin, and Stadler, 2017). This includes research suggesting reduced empathy in psychopathy is associated with proactive aggression (Woodworth and Porter, 2002). However, the relationship between reactive aggression and empathy is still not fully clear.

The emotional process of rumination, defined as perseverative, aversive focus about a particular event or theme, has been associated with aggression in community samples (Collins and Bell, 1997; Bettencourt et al., 2006), at least with respect to anger rumination. The extent to which one ruminates on angering situations correlates with both self-report (García-Sancho et al., 2016) and behavioral aggression (Bushman et al., 2005; Denson et al., 2011) in non-clinical samples. In clinical samples at high risk for aggression (e.g., those with borderline personality disorder), anger rumination predicted aggression propensity even beyond emotion regulation (Martino et al., 2015). In contrast, rumination about sadness seems to inhibit aggression, as seen in an undergraduate sample (Peled and Moretti, 2010). Although sadness rumination has been associated with severity of symptoms in clinical samples at high risk for depression (i.e., BPD), it is not clear how this is associated with aggressive symptoms specifically (Baer et al., 2012). Thus, the affective (i.e., anger vs. other emotion) content of the rumination may be critical for determining the role of rumination on aggression. If so, one might expect those with IED to ruminate over anger rather than sadness.

Alexithymia, anger rumination, and to a lesser extent empathy, appear to be associated with aggression in both community and clinical / at-risk samples. Therefore, individuals with IED, a severe aggressive disorder, may also show deficits with regard to these emotional processes. Supporting the link with decreased empathy, individuals with IED are less accurate at identifying facial expressions than healthy volunteers (Best et al., 2002; Coccaro et al., 2007). However, these studies had small samples and did not include any psychopathology comparison groups. Furthermore, no studies have assessed rumination or alexithymia in IED. If individuals with IED do show deficits with regard to these emotional processes, the severity of these deficits may relate to level of impairment among those with IED. This would suggest a potential target for intervention efforts to treat this serious disorder for which there are currently no empirically supported treatments.

The current study sought to directly examine the relationship between IED and cognitive-emotional deficits by comparing self-report and (for empathy) behavioral measures of overall rumination, anger and sadness rumination, alexithymia and empathy across individuals with IED, a non-IED psychological diagnosis (Psychiatric Controls, PC), or no psychological diagnosis (Healthy Volunteers, HV). It was hypothesized that anger rumination, alexithymia, and empathy deficits would be significantly higher in the IED group than PC or HV groups. It was also hypothesized that among those with IED, higher levels of anger rumination, alexithymia, and deficits in empathy would predict more aggression and lower quality of life, while sadness rumination would predict lower levels of aggression.

2. Methods

2.1. Participants

Participants consisted of 492 individuals (329 identified as female, 163 identified as male) aged 18 to 55 ($M = 25.97$, $SD = 9.57$) recruited from a large northeastern university and the surrounding community

through a university online recruitment system, as well as flyers and advertisements on public transportation for individuals with emotional problems as a part of larger ongoing aggression studies. Participants identified predominately as White (50.6%) or African American (28.3%) and were well-educated (90.3% reported at least some college education).

Participants were classified into three groups: IED (met criteria for DSM-5 IED, $n = 177$), Psychiatric Control (PC; met lifetime criteria for another DSM disorder but not IED, $n = 171$), and Healthy Volunteer (HV; never met criteria for any DSM disorder, $n = 144$) based on a clinical interview (see below). Notably, although this is a community-based sample, 77.8% of IED participants and 67.3% of PC participants reported that they either received and/or felt they needed psychological treatment, compared to 18.3% of HV participants. Thus, the IED and PC groups were predominately a treatment / treatment seeking sample, were recruited specifically for studies of aggression and other emotion problems.

2.2. Measures

2.2.1. Structured diagnostic interview for DSM-IV (SCID-I; First et al., 1996) or DSM-5 (First et al., 2015)

The SCID-I is a semi-structured interview assessing for non-personality psychiatric disorders and has demonstrated fair to good ($\kappa = 0.66$ – 0.83) inter-rater reliability (Lobbstaal et al., 2011). The SCID-I was used to diagnose non-IED psychiatric (i.e., DSM-IV Axis I) disorders.

2.2.2. Structured interview for DSM-IV personality disorders (SIDP; Pfohl et al., 1995)

The SID-P is a semi-structured interview that groups personality disorder criteria by theme, rather than disorder. The SID-P was used to diagnose personality disorders. The SID-P has good inter-rater reliability ($\kappa = 0.61$ – 1.0 ; Zimmerman et al., 2005).

2.2.3. IED interview (IED-I, Coccaro, unpublished instrument)

The IED-I is a semi-structured interview assessing criteria for DSM-5 IED and integrated research criteria for IED. The IED-I has good reliability ($\kappa = 0.84$, (McCloskey and Coccaro, 2003). The IED-I was used to diagnose DSM-5 IED.

2.2.4. Sadness and anger rumination inventory (SARI; Peled and Moretti, 2010)

The SARI is a 22-item questionnaire that includes 11 items assessing the extent of each type of rumination (anger and sadness) on a 5-point Likert-type scale. The SARI demonstrates good internal consistency (anger: $\alpha = 0.91$, sadness: $\alpha = 0.92$; Peled and Moretti, 2010), and was used to assess anger and sadness rumination. The subscales also demonstrated good internal consistency for this sample (anger: $\alpha = 0.95$, sadness: $\alpha = 0.95$).

2.2.5. Ruminative response scale (RRS-10; Treynor et al., 2003)

The RRS-10 is a 10-item questionnaire that assesses general tendencies to ruminate and produces two subscales: brooding and reflection. These subscales demonstrate good internal consistency (brooding: $\alpha = 0.77$, reflection: $\alpha = 0.72$) and adequate one-year test-retest reliability (brooding: ICC = 0.62, reflection: ICC = 0.60; Treynor et al., 2003). The subscales also demonstrated good internal consistency for this sample (brooding: $\alpha = 0.82$, reflection: $\alpha = 0.92$).

2.2.6. Toronto alexithymia scale (TAS-20; Bagby et al., 1994a, 1994b)

The TAS-20 asks respondents to rate their agreement with 20 statements on a 5-point Likert-type scale. The statements assess three domains of alexithymia: difficulty identifying feelings, difficulty describing feelings, and externally-oriented thinking. The TAS-20 produces scores on those three subscales as well as a combined overall

alexithymia score. The TAS-20 has adequate internal consistency in both a student ($\alpha = 0.66$ – 0.80) and psychiatric ($\alpha = 0.64$ – 0.83) sample as well as good test-retest reliability ($ICC = 0.77$; Bagby et al., 1994a). The total scale and subscales also demonstrated adequate internal consistency for this sample (total score: $\alpha = 0.79$, difficulty identifying feelings: $\alpha = 0.88$, difficulty describing feelings: $\alpha = 0.77$, externally oriented thinking: $\alpha = 0.61$).

2.2.7. Reading the mind in the eyes task (RMET; Baron-Cohen et al., 2001)

The RMET includes 36 photographs of faces cropped around the eye area. The participant labels the mental state expressed in this photograph from a choice of four options. The RMET has adequate internal consistency ($\alpha = 0.61$) and one-month test-retest reliability ($\alpha = 0.83$; Vellante et al., 2013). The score also demonstrated good internal consistency for this sample ($\alpha = 0.68$).

2.2.8. Basic empathy scale (BES; Jolliffe and Farrington, 2006)

The BES includes 20 statements related to “understanding and sharing in another’s emotional state or context” (Cohen and Strayer, 1996) to which respondents rate their agreement on a 5-point Likert-type scale. The BES produces affective and cognitive subscale scores, as well as a total empathy score. The BES has demonstrated good internal consistency (cognitive: $\alpha = 0.79$, affective: $\alpha = 0.85$; Jolliffe and Farrington, 2006). The total score and subscales also demonstrated good internal consistency for this sample (total score: $\alpha = 0.85$, affective empathy: $\alpha = 0.84$, cognitive empathy: $\alpha = 0.75$). The RMET total score and BES subscales were used as indicators of empathy in this study.

2.2.9. Quality of life enjoyment and satisfaction questionnaire – short form (Q-LES-Q-SF; Stevanovic, 2011)

The Q-LES-Q-SF is a 16-item self-report questionnaire that assesses overall satisfaction and enjoyment in a variety of domains on a 5-point Likert-type scale, with higher scores indicating more satisfaction and enjoyment in life. The first 14 items (excluding two about medication and overall satisfaction) are summed to create a total score, which was used here as the indicator of overall quality of life. The Q-LES-Q-SF has demonstrated good internal consistency ($\alpha = 0.90$) and test-retest reliability ($ICC = 0.93$; Stevanovic, 2011).

2.2.10. Life history of aggression interview (LHA; Coccaro et al., 1997)

The LHA is a 10-item semi-structured interview assessing frequency of a variety of aggression and antisocial behaviors. The LHA produces subscales indicating lifetime levels of other-directed aggression, self-aggression, antisocial actions, and a total score, which have demonstrated adequate internal consistency (total score $\alpha = 0.88$, subscales $\alpha = 0.48$ – 0.87), inter-rater reliability (total score $ICC = 0.95$, subscales $ICC = 0.84$ – 0.94), and test-retest reliability (total score $ICC = 0.91$, subscales $ICC = 0.80$ – 0.97 ; Coccaro et al., 1997). The Aggression subscale score also demonstrated good internal consistency for this sample ($\alpha = 0.88$). For the current study, the aggression scale of the LHA was used as a measure of lifetime aggressive behavior among those with IED.

2.3. Procedures

Study procedures were reviewed and approved by the university’s Institutional Review Board, and the procedures and treatment of the participants were conducted in accordance with the declaration of Helsinki. All participants provided informed consent after the nature of procedures was fully explained. Participants completed all self-report and behavioral measures online, and later participated in an in-person clinical interview conducted by a graduate researcher or post-doctoral scholar, trained by the senior author, a licensed clinical psychologist. All interviewers were blind to the self-report and behavioral data. Measures were completed in a fixed order. Please note that the

rumination measures were included in the online battery later in the study, so not all participants completed those measures. Overall, participants spent between 3.5–4.5 h completing the study procedures. Participants received either monetary compensation or research credit for their time. Diagnoses were confirmed using a best estimate procedure (Klein et al., 1994), in which a diagnostic report for each participant is presented and reviewed by a team of diagnosticians (blind to the self-report and behavioral data), supervised by a licensed clinical psychologist, to enhance the accuracy of diagnoses.

2.4. Data analytic plan

Preliminary analyses investigated diagnostic group (IED, PC, HV) differences on demographic factors (age, gender, and race) and psychiatric comorbidity as well as differences in demographic factors on outcome (rumination, empathy, and alexithymia) variables, to determine appropriate covariates. Primary analyses consisted of three separate one-way (diagnostic group: IED, PC, HV) MANCOVAs for rumination (RRS-10, SARI), empathy (BES, RMET) and alexithymia (TAS-20). Bonferroni corrected ($\alpha = 0.05/3$) post-hoc pairwise comparisons were conducted to determine specific differences between diagnostic groups. Secondary analyses specific to those in the IED group ($n = 177$) consisted of linear regressions with life history of aggression and quality of life as the dependent variables and each of the study constructs (rumination, alexithymia, empathy) as predictors, to explore the relationship between each construct and IED symptom severity.

3. Results

3.1. Preliminary analyses

Due to small sample size in the Native American/Alaskan, Other, and More Than One Race cells in the race variable, these participants were combined into an “Other” category. Preliminary analyses indicated that there were significant group differences between diagnostic groups in age ($F [2, 489] = 35.97, p < 0.001$), gender ($\chi^2 [2] = 15.92, p < 0.001$), and race ($\chi^2 [10] = 37.35, p < 0.001$). As seen in Table 1, the PC group had a higher proportion of Caucasian and a lower proportion of African American participants than either the IED or HV group, and the IED group had a lower proportion of Asian participants than either of the other two groups. Further, the IED group had a higher proportion of males than either the PC or HV groups. Finally, the IED group was significantly older than the HV group, which was significantly older than the PC group.

With regard to comorbidity, individuals with IED were more likely to have a personality disorder than those in the PC group (see Table 2). There was no IED vs. PC difference in the prevalence of any other

Table 1
Demographic variables as a function of diagnostic group.

	IED N = 177	PC N = 171	HV N = 144
Age: M(SD)*	30.44(11.60) ^a	22.65(6.36) ^b	24.41(7.78) ^c
Gender: N(%)**			
Male	78 (44.1%) ^a	42 (24.6%) ^b	43 (29.9%) ^b
Female	99 (55.9%) ^a	129 (75.4%) ^b	101 (70.1%) ^b
Race: N(%)*			
White	81 (45.8%) ^a	102 (59.6%) ^b	66 (45.8%) ^a
African American	70 (39.5%) ^a	25 (14.6%) ^b	44 (30.6%) ^a
Asian	14 (7.9%) ^a	26 (15.2%) ^b	27 (18.8%) ^b
Other	12 (6.8%)	18 (10.5%)	7 (4.9%)

** = $p < 0.01$, * $p < 0.05$ ^{a,b,c} Different superscripts across rows denote significant group differences; IED = Meets lifetime criteria for DSM-5 Intermittent Explosive Disorder; PC = Psychiatric Control (meets lifetime criteria for a non-IED psychiatric disorder); HV = Healthy Volunteer (has not met lifetime criteria for a DSM disorder).

Table 2
Comorbid diagnoses among IED and PC groups.

	PC N(%)	IED N(%)	χ^2	<i>p</i>
Personality disorder	40(26.0%)	78(46.2%)	14.15	<0.001
Mood disorder	102(60.4%)	97 (55.4)	0.86	0.36
Substance use disorder	72(42.1%)	82(46.6%)	0.71	0.40
Anxiety disorder	65(38.0%)	50(28.4%)	3.61	0.57
Trauma/Stressor disorder	22(12.9%)	24(13.6%)	0.05	0.83
Somatiform disorder	4(2.6%)	3(1.8%)	0.20	0.65
Other disorder	1(0.6%)	0(0.0%)	1.03	0.31

IED = Meets lifetime criteria for DSM-5 Intermittent Explosive Disorder; PC = Psychiatric Control (meets lifetime criteria for a non-IED psychiatric disorder).

disorders. To assess the impact of the IED vs. PC differences in personality disorder prevalence on the primary study findings, we reran the primary analyses on IED and PC groups, adding presence of a personality disorder to the other covariates. This did not change the pattern of results (i.e., all previously significant IED vs. PC group difference remained significant, and no new significant IED vs. PC effect emerged).

Significant demographic differences across the outcome variables were then examined. ANOVAs (for race), t-tests (for gender), and correlations (for age) were run to determine significant associations between these demographic factors and each construct of interest (rumination, alexithymia, and empathy). As seen in Table 3, female participants scored significantly higher on sadness rumination and brooding subscales, as well as the affective and cognitive subscales of the BES and the RMET score. There was also a significant effect of race for the empathy variables, such that Caucasian ($p < 0.001$) and Asian ($p = 0.007$) participants scored higher than African American participants on the BES affective subscale, Caucasian participants scored higher than African American participants on the RMET ($p < 0.001$), and Caucasian participants scored higher than African American participants on the BES cognitive subscale ($p = 0.001$). Race also differed significantly on some alexithymia variables, particularly difficulty describing feelings ($p = 0.047$) and difficulty identifying feelings ($p = 0.045$), for which those in the Other race category scored higher than African American participants. Age was also significantly associated with all constructs: older participants reported lower sadness rumination and brooding, lower affective empathy, cognitive empathy, and RMET scores, and greater difficulty identifying feelings. Given these significant associations, demographic variables were used as covariates in the primary MANCOVAs. Specifically, gender was a covariate in the rumination and empathy analyses, race was as a covariate

Table 3
Rumination, alexithymia, and empathy as a function of demographic variables.

	Age <i>r</i>	Gender Male <i>M</i> (<i>SD</i>)	Female <i>M</i> (<i>SD</i>)	<i>t</i>	White <i>M</i> (<i>SD</i>)	AA <i>M</i> (<i>SD</i>)	Race Asian <i>M</i> (<i>SD</i>)	Other <i>M</i> (<i>SD</i>)	<i>F</i>
Rumination									
SARI: anger	-0.07	26.38 (9.88)	28.18 (9.47)	-1.37	27.24 (9.47)	29.35 (11.49)	26.74 (7.98)	27.22 (7.19)	0.87
SARI: sadness	-0.24***	28.80 (10.64)	32.79 (10.80)	-2.70**	32.17 (10.95)	30.39 (11.96)	31.56 (9.73)	32.26 (9.90)	0.40
RRS: brooding	-0.17**	10.51 (3.42)	11.57 (3.81)	-2.08*	11.21 (3.77)	11.56 (4.37)	10.91 (2.89)	11.48 (3.10)	0.30
RRS: reflection	-0.19**	10.84 (4.01)	11.76 (3.80)	-1.74	11.55 (3.87)	11.65 (4.25)	10.93 (3.59)	11.87 (3.45)	0.41
Alexithymia									
TAS-20: difficulty identifying feelings	-0.14**	14.49 (6.07)	15.61 (6.67)	-1.73	15.27 (6.41)	14.06 (6.51) ^a	16.23 (6.17)	17.28 (7.09) ^b	3.04*
TAS-20: difficulty describing feelings	-0.08	12.86 (3.25)	13.23 (3.55)	-1.07	13.06 (3.37)	12.88 (3.63) ^a	12.88 (3.22)	14.58 (3.65) ^b	2.49 ⁺
TAS-20: externally oriented thinking	-0.08	25.01 (3.98)	25.02 (4.35)	-0.03	25.42 (4.00)	24.19 (4.88)	25.18 (4.06)	24.72 (3.42)	2.31
Empathy									
BES: affective empathy	-0.15**	34.45 (7.51)	39.90 (7.33)	-7.37***	39.35 (7.47) ^a	35.36 (8.52) ^b	39.15 (7.22) ^a	38.19 (6.13)	7.76***
BES: cognitive empathy	-0.12**	32.74 (4.97)	34.15 (4.38)	-3.09**	34.46 (4.24) ^a	32.52 (5.02) ^b	33.67 (4.56)	32.78 (4.87)	5.43**
RMET	-0.16**	24.13 (4.66)	25.10 (4.15)	-2.26*	25.81 (3.97) ^a	23.19 (4.35) ^b	24.03 (4.79) ^b	24.74 (4.18) ^b	11.11***

*** = $p < 0.001$, ** = $p < 0.01$, * $p < 0.05$, ⁺ $p = 0.06$; ^{a,b} Different superscripts across rows denote significant group differences; SARI = Sadness and Anger Rumination Inventory; RRS = Ruminative Response Scale; TAS-20: Toronto Alexithymia Scale; BES = Basic Empathy Scale; RMET = Reading the Mind in the Eyes Task; AA = African American.

in the empathy and alexithymia analyses, and age was a covariate in the rumination, empathy, and alexithymia analyses.

3.2. Primary analyses (see Table 4)

3.2.1. Rumination

A MANCOVA adjusting for gender and age found a multivariate effect of group, $F(8,502) = 10.22$, $p < 0.001$, Wilks' $\Lambda = 0.74$, partial $\eta^2 = 0.14$. Follow-up ANCOVAs showed group effects for all rumination variables (all $p < 0.001$; See Table 4). Post-hoc analyses (See Table 4) found that IED participants endorsed significantly greater anger rumination than PC ($t(256) = 3.08$, $p = 0.002$) or HV ($t(256) = 7.50$, $p < 0.001$) participants. IED participants also reported significantly higher sadness rumination ($t(256) = 7.46$, $p < 0.001$), brooding ($t(256) = 5.98$, $p < 0.001$), and reflection scores than HV ($t(256) = 3.05$, $p = 0.003$), but not PC ($t(256) = 0.74-1.44$, $p = 0.107-0.459$) participants.

3.2.2. Alexithymia

A MANCOVA adjusting for race and age found a multivariate effect of group, $F(6,900) = 17.36$, $p < 0.001$, Wilks' $\Lambda = 0.803$, partial $\eta^2 = 0.104$. Follow-up ANCOVAs showed group effects for all alexithymia factors (all $p < 0.05$; See Table 4). Post-hoc analyses (See Table 4) demonstrated that IED participants endorsed greater difficulty identifying feelings than HV ($t(456) = 9.89$, $p < 0.001$) and PC participants ($t(456) = 2.82$, $p = 0.005$). IED participants also reported more difficulty describing feelings ($t(456) = 7.46$, $p < 0.001$) and more externally oriented thinking than HV ($t(456) = 2.93$, $p = 0.004$), but not PC ($t(456) > 1.41$, $p > 0.111$), participants.

3.2.3. Empathy

A MANCOVA adjusting for gender, race, and age found a multivariate effect of group, $F(6,834) = 2.24$, $p = 0.038$, Wilks' $\Lambda = 0.97$, partial $\eta^2 = 0.016$. Follow-up ANCOVAs showed a significant effect of group on affective empathy ($p = 0.014$; See Table 4), but not cognitive empathy or behavioral (RMET) empathy (both $p > 0.34$; See Table 4). Post-hoc analyses (See Table 4) demonstrated that those with IED ($t(424) = 2.60$, $p = 0.010$) and in the PC group ($t(424) = 2.53$, $p = 0.012$) reported significantly higher affective empathy scores than those in the HV group. PC and IED groups did not differ in affective empathy ($t(424) = 0.23$, $p = 0.812$).

3.3. Secondary analyses among IED participants

As shown in Table 5, among those with IED, anger rumination

Table 4
Rumination, alexithymia, and empathy as a function of diagnostic group.

	IED M(SD)	PC M(SD)	HV M(SD)	F	partial η^2
Rumination	N = 83	N = 110	N = 66		
SARI: anger rumination	32.15(8.15) ^a	28.16(9.46) ^b	21.19(8.47) ^b	28.85***	0.184
SARI: sadness rumination	35.53(10.31) ^a	33.51(10.42) ^a	23.67(8.92) ^b	31.95***	0.210
RRS: reflection	11.81(3.72) ^a	12.22(3.60) ^a	9.05(4.13) ^b	19.44***	0.133
RRS: brooding	12.50(3.39) ^a	11.68(3.69) ^a	9.05(3.44) ^b	8.41***	0.062
Alexithymia	N = 154	N = 166	N = 139		
TAS-20: difficulty identifying feelings	18.50(6.40) ^a	16.55(6.40) ^b	11.54(4.78) ^c	53.01***	0.190
TAS-20: difficulty describing feelings	14.43(3.33) ^a	13.88(3.35) ^a	11.51(3.05) ^b	32.26***	0.125
TAS-20: externally oriented thinking	25.59(3.32) ^a	24.88(4.34) ^a	24.10(4.89) ^b	4.31*	0.019
Empathy	N = 143	N = 162	N = 122		
BES: affective empathy	38.58(7.91) ^a	38.37(7.56) ^a	36.15(7.87) ^b	4.31*	0.020
BES: cognitive empathy	33.71(4.44)	32.91(4.89)	33.25(4.41)	1.07	0.005
RMET	24.35(3.99)	24.33(4.54)	24.60(4.26)	0.16	0.001

Means are adjusted; *** = $p < 0.001$, * $p < 0.05$; ^{a,b,c} Different superscripts across rows denote significant group differences; IED = Meets lifetime criteria for DSM-5 Intermittent Explosive Disorder; PC = Psychiatric Control (meets lifetime criteria for a non-IED psychiatric disorder); HV = Healthy Volunteer (has not met lifetime criteria for a DSM disorder); SARI = Sadness and Anger Rumination Inventory; RRS= Ruminative Response Scale; TAS-20: Toronto Alexithymia Scale; BES = Basic Empathy Scale; RMET = Reading the Mind in the Eyes Task.

predicted greater lifetime aggression while sadness rumination predicted less lifetime aggression. However, sadness rumination also predicted poorer quality of life (see Table 6). No other variables were associated with lifetime aggression or quality of life (all $p > 0.10$).

4. Discussion

This study examined emotion processing in IED relative to psychiatric and healthy controls. We found that those with IED showed greater alexithymia and rumination than HVs, though only anger rumination and difficulty describing feelings distinguished IED and PC groups. However, contrary to our hypotheses the only group effect for empathy was that IED participants actually showed greater affective empathy than HV participants. Among those with IED, only increased anger and decreased sadness rumination were associated with greater aggression, with only increased sadness rumination also associated with poorer quality of life.

The results of this study indicate that IED (and frequency of aggression within IED, as discussed below) is associated with rumination about angering events. These findings support and extend previous research that anger rumination is related to increased affective/reactive aggression (Denson et al., 2011), the hallmark symptom of IED. It is noteworthy that it is anger rumination specifically, not sadness rumination or rumination in general, that is elevated in IED. This supports the notion that, despite showing global emotion dysregulation (e.g.,

Fettich et al., 2015), those with IED have a trait tendency to focus on anger beyond other emotions.

Further, those with IED reported heightened difficulty identifying emotions compared to healthy volunteers as well as those with a non-IED psychological diagnosis. This is supported by previous research suggesting that alexithymia in general (Velotti et al., 2016), and problems in identifying emotions specifically (Fossati et al., 2009), are related to aggression. This is also not surprising given that those with IED have demonstrated a deficit in the related construct of strategic emotional intelligence, which includes understanding and managing one's own emotions (Coccaro et al., 2015). Thus, these findings contribute to mounting evidence that the emotion deficits that seem to be central to IED include limited insight into one's own emotions.

Whereas difficulty identifying one's emotion distinguished individuals with IED from those with other psychiatric disorders, other facets of alexithymia (describing one's own emotions and focusing on external stimuli) only distinguished between those with (IED, PC) and without (HV) a history of psychopathology. Thus, although those with IED demonstrated a uniquely severe deficit in recognizing their own emotions, they are no more impaired than those with general psychopathology in communicating their own emotions and (possibly relatedly) focusing on external cues. This is supported by research suggesting that alexithymia is a strong predictor of a range of psychopathology (Grabe et al., 2004). Taken together with the above findings, this suggests that there may be something distinct about

Table 5
Relationship between rumination, alexithymia, empathy and aggression in IED.

LHA - aggression scale	B	SE	Beta	t	p	95% CI
Rumination (N = 82)						
SARI: anger rumination	0.17	0.07	0.33	2.35	0.02	(0.03, 0.32)
SARI: sadness rumination	-0.13	0.06	-0.33	-2.20	0.03	(-0.26, -0.01)
RRS: brooding	-0.14	0.17	-0.11	-0.80	0.43	(-0.49, 0.21)
RRS: reflection	-0.06	0.16	-0.05	-0.38	0.71	(-0.37, 0.25)
Alexithymia (N = 151)						
TAS-20: difficulty identifying feelings	-0.12	0.08	-0.17	-1.53	0.13	(-0.28, 0.04)
TAS-20: difficulty describing feelings	0.17	0.16	0.12	1.09	0.28	(-0.14, 0.48)
TAS-20: externally oriented thinking	-0.07	0.12	-0.05	-0.57	0.57	(-0.30, 1.7)
Empathy (N = 141)						
BES: affective empathy	-0.04	0.06	-0.07	-0.70	0.48	(-0.15, 0.07)
BES: cognitive empathy	-0.13	0.11	-0.13	-1.2	0.23	(-0.34, 0.08)
RMET	0.06	0.11	0.05	0.53	0.60	(-0.15, 0.27)

SARI = Sadness and Anger Rumination Inventory; RRS= Ruminative Response Scale; TAS-20: Toronto Alexithymia Scale; BES = Basic Empathy Scale; RMET = Reading the Mind in the Eyes Task; LHA = Life History of Aggression.

Table 6
Relationship between rumination, alexithymia, empathy, and quality of life in IED.

Q-LES-Q-SF - Quality of Life	B	SE	Beta	t	p	95% CI
Rumination (N = 83)						
SARI: anger rumination	−0.16	0.16	−0.14	−1.03	0.31	(−0.48, 0.15)
SARI: sadness rumination	−0.30	0.13	−0.31	−2.26	0.03	(−0.56, −0.04)
RRS: brooding	−0.58	0.38	−0.20	−1.5	0.13	(−1.33, 0.17)
RRS: reflection	0.35	0.34	1.3	1.04	0.30	(−0.32, 1.02)
Alexithymia (N = 141)						
TAS-20: difficulty identifying feelings	−0.24	0.18	−0.15	−1.32	0.19	(−0.61, 0.12)
TAS-20: difficulty describing feelings	−0.48	0.35	−0.16	−1.39	0.17	(−1.17, 0.20)
TAS-20: externally oriented Thinking	0.09	0.26	0.03	0.36	0.72	(−0.42, 0.61)
Empathy (N = 142)						
BES: affective empathy	0.02	0.13	0.02	0.17	0.87	(−0.23, 0.27)
BES: cognitive empathy	0.02	0.24	0.01	0.07	0.95	(−0.46, 0.49)
RMET	−0.05	0.24	−0.01	−0.20	0.84	(−0.52, 0.42)

Q-LES-Q-SF: Quality of Life Enjoyment and Satisfaction Questionnaire; SARI = Sadness and Anger Rumination Inventory; RRS = Ruminative Response Scale; TAS-20: Toronto Alexithymia Scale; BES = Basic Empathy Scale; RMET = Reading the Mind in the Eyes Task; LHA = Life History of Aggression.

impairment in identifying internal emotions that is associated with IED-specific symptoms (such as aggression), while difficulty communicating feelings and external cognitive focus may represent more transdiagnostic risk factors. It may be that individuals with IED are not aware of their anger until it escalates to the point of feeling compelled to aggress. Though this hypothesis needs to be tested, it is consistent with the finding that those with IED, relative to other psychiatric groups, more often report being their aggressive outbursts as “out of control” (Kulper et al., 2015), or “going from ‘0 to 100.’” In fact, one facet of a treatment for IED is to help individuals with IED gain awareness of lower levels of anger, which they often do not notice (McCloskey et al., 2008b).

Surprisingly, those with IED demonstrated no deficits in understanding and relating to the internal experiences of other people. Indeed, the data suggest that those with IED may demonstrate a heightened affective empathy compared to those without a psychological disorder. Thus, increased sensitivity to others’ emotions may contribute to hyper-sensitivity to negative emotions, which occurs in several psychiatric disorders in which negative affect is a primary symptom (e.g., depression, borderline personality disorder; Domes et al., 2009; Koster et al., 2005) and may explain why participants in both the IED and PC groups reported greater empathy than those in the HV group. For individuals with IED, this sensitivity to others’ negative emotion, coupled with a bias toward hostile attribution (“they are upset with me”), and a tendency to ruminate on possible subsequent anger may ultimately facilitate anger, which leads to aggressive responding.

Among those with IED, greater anger rumination predicted greater lifetime aggression. A likely reason for this is that perseverating on angering events maintains negative affect, predisposing or “priming” one for aggression. Experimental research on non-IED samples supports this, showing that rumination mediates the relationship between previous provocation and later aggression (Bushman et al., 2005). However, it is also possible that higher levels of aggression leads to greater rumination on anger- (and aggression-) inducing events, or perhaps that these two tendencies interact in those with IED to perpetuate an aggression-rumination cycle. Despite the yet unclear causal relationship, this association suggests rumination as a potentially important target for intervention to reduce pathological aggressive behavior.

Among those with IED, a propensity to ruminate on sadness-inducing events was associated with not only reduced aggression, but also reduced life satisfaction and enjoyment. The finding of reduced aggression among those with greater sadness rumination supports earlier research in non-clinical samples (Peled and Moretti, 2010). As IED is associated with greater dysregulation across emotions and has many psychiatric comorbidities (Coccaro, 2012), high rumination on sadness-inducing events could limit motivation and perceived energy to engage

in acts of aggression, which might inhibit aggressive behavior for these individuals. The association with poorer life satisfaction suggests that sadness rumination may contribute other mood symptoms to the experience of IED that increases distress or decreases functioning, and indicates that an increased focus on negative affect, even when that affect is something other than anger, is associated with a worse of quality of life. This mixed effect of sadness rumination in IED serves as an important reminder that although aggression is the hallmark of IED, additional impairing affective symptoms are common and should not be ignored.

The present study is the first to demonstrate that anger rumination and deficits in identifying one’s own emotions are heightened in those with IED relative to individuals with other psychiatric disorders. This study also showed that contrary to expectations, those with IED seem to have intact to possibly enhanced affective empathy, and once they have identified an emotion they appear no more impaired at communicating their own emotions than those with other psychological disorders. Notably, the relationship between the potential demographic confounds and rumination/alexithymia was not in the same direction as the relationship between IED and these outcome variables, which reduces the likelihood that demographic differences explain the effects of interest. Strengths of the study included the use of a fairly large sample that was formally diagnosed using structured clinical interviews, as well as the use of empirically supported measures of the constructs of interest. However, the study also had some limitations, including utilizing only self-report measures of rumination and alexithymia, which led to some missing data due to participant error (e.g., skipping online questionnaires), and an over-representation of women in the sample. Further, although all participants were formally diagnosed and met DSM-5 criteria for the disorders noted, this study utilized a community sample, which may limit generalizability.

These findings bolster support for utilizing cognitive intervention techniques that support distraction or reappraisal (Offredi et al., 2016), or mindfulness techniques (Borders et al., 2010) to reduce anger rumination, and thus aggression in IED. Indeed, a pilot study of cognitive behavioral therapy (CBT) for IED, which emphasized relaxation and cognitive restructuring techniques, demonstrated significant effects at reducing anger and aggression (McCloskey et al., 2008b). Additionally, interventions that help individuals with IED identify their emotions may contribute to the reduction of aggression in IED. Research suggests that CBT may be useful for decreasing alexithymia in general, and problems with emotion identification specifically (Baker et al., 2012), suggesting that the aforementioned treatment for IED may already be targeting this deficit, though this particular outcome has not yet been examined. Given the high personal and societal costs associated with pathological aggression, further investigation and implementation of

these techniques could be integral to reducing the negative consequences of IED.

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