A latent class analysis of intermittent explosive disorder symptoms

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ABSTRACT

Intermittent explosive disorder (IED), the sole diagnosis in the DSM-5 for which the cardinal symptom is recurrent affective aggressive outbursts, is a common and substantially impairing disorder. IED is also associated with several cognitive and affective impairments. However, little is known about the heterogeneity of the disorder and how this may correspond to aggression severity and related adverse outcomes. The current study employed a latent class analysis (LCA) among individuals diagnosed with lifetime DSM-5 IED to derive distinct subgroups that differed in the quality and/or frequency of cognitive-affective symptoms. These subgroups were then externally validated on a number of adverse outcomes. Statistical and clinical indicators supported a four-class model. Classes were distinguished mainly by the level of emotion dysregulation participants endorsed, with two moderate emotion dysregulation classes differing on their emotional information processing and impulsive tendencies. The external validation analysis revealed that classes differed in terms of various adverse outcomes (e.g., interpersonal problems, life satisfaction, suicide risk). Overall, the present study suggests distinct cognitive-affective symptom profiles among those with IED that differ meaningfully with regard to risk for adverse outcomes. These findings provide evidence of the heterogeneity within IED and may suggest a more personalized therapeutic approach to patients with IED.

Aggression poses substantial health-related and financial burden to societies worldwide, including billions of dollars annually in medical expenses and lost productivity (Corso et al., 2007). Some aggression is normative, such as defending oneself when being physically attacked. However, recurrent, excessive aggression may warrant a diagnosis of Intermittent Explosive Disorder (IED), which is defined by pathological affective aggression (American Psychiatric Association, 2013). Individuals with IED show high levels of minor (i.e., verbal aggression or physical aggression with no damage or injury) and/or major (i.e., physical aggression with damage or injury) aggression that is disproportionate to the provocation, leads to significant distress and/or impairment, and is not better accounted for by another psychological disorder, substance use, or medical condition (American Psychiatric Association, 2013). IED is a chronic and common psychological condition, affecting approximately 3%−5% of the population and is associated with significant impairment across several domains (Coccaro and McCloskey, 2019).

Individuals with IED are at increased risk for a host of adverse physical and psychological outcomes (McCloskey et al., 2010; Rynar and Coccaro, 2018). For example, IED is associated with substantial interpersonal dysfunction across romantic, friendship, and occupational settings (Kulper et al., 2015; Rynar and Coccaro, 2018), which contributes to lower overall life satisfaction (Rynar and Coccaro, 2018). Individuals with IED are also at greater risk for several psychiatric comorbidities, including mood, anxiety, alcohol, and other substance use disorders (Coccaro et al., 2016; Coccaro and McCloskey, 2019); moreover, number of alcohol use disorder symptoms is associated with aggression frequency (Puhalla et al., 2020). Though not part of the IED criteria, those with IED also report higher levels of relational aggression (Jenkins et al., 2015; Murray-Close et al., 2010) and are more likely to engage in both non-suicidal self-injury and suicide attempts (Jenkins et al., 2015; McCloskey et al., 2008a). Thus, IED is a highly impairing condition, which is further supported by studies showing individuals with IED have greater psychosocial impairment relative to psychiatric comparison groups (McCloskey et al., 2006, 2008b; Rynar and Coccaro, 2018). Considering the impairment associated with IED, it would be useful to identify profiles that may suggest a more or less severe IED course.

The few studies that have examined heterogeneity within IED have focused on differences as a function of aggression type and/or severity. Individuals who met a previous IED research criteria set based on frequent verbal aggression (i.e., two or more verbal aggressive outbursts

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a week on average for one month or more) did not differ from participants who met DSM-IV IED criteria (i.e., multiple acts of physical aggression) on measures of trait aggression, affect lability, or psychosocial impairment (McCloskey et al., 2006, 2008b). More recent studies of DSM-5 IED, which can be diagnosed via frequent minor and/or less frequent major aggression, found that individuals with IED who met both minor and major aggression criteria showed greater impairment and a poorer quality of life than those who met criteria for only minor or major aggression (Coccaro et al., 2014b; Look et al., 2015), with no difference between the minor and major aggression only groups (Look et al., 2015). Thus, greater and more varied aggressive behavior seems to be associated with more impairment. However, little else is known about how heterogeneity within IED may be related to outcome. Unlike many other disorders, IED has few inclusion symptoms beyond the two aggression criteria, precluding any more nuanced analyses of heterogeneous IED symptom presentations.

However, IED is also associated with impairments in psychological difficulties other than aggression that may be informative. Individuals with IED tend to show a pattern of cognitive, affective, and behavioral difficulties, particularly with regard to social interactions and emotionality. Prominent among these is poor emotion regulation. Individuals with IED show both elevated levels of anger (Coccaro et al., 2014a), and more global problems with emotion regulation, including greater affect lability, intensity, and (compared to healthy control participants) reactivity (Fettich et al., 2015; Look et al., 2015; McCloskey et al., 2006, 2008b). Individuals with IED also report difficulty identifying their own feelings, though they may show *greater* affective empathy than healthy controls (Fahlgren et al., 2019). Those with IED also report more negative cognitions as evidenced by increased hostility (cynical, suspicious, or resentful thoughts); anger rumination (perseveration on angering events or themes); and, to a lesser extent, overall rumination (Fahlgren et al., 2019; McCloskey et al., 2006). Behaviorally, those with a diagnosis of IED also consistently report higher levels of impulsivity (Best et al., 2002; McCloskey et al., 2008a), with impulsivity responses to heightened negative emotion (negative urgency) particularly salient in discriminating those with IED from other psychiatric groups (Puhalla et al., 2016).

Although the aforementioned psychological processes have been examined when comparing IED samples to healthy or psychiatric control groups, they have never been examined *within* a group of individuals with IED. Variability in profiles for these associated cognitive and affective symptoms among those with IED may provide insights into the heterogeneity of IED and how this relates to impairment and outcome. In the present study, we used a person-centered approach to identify distinct subgroups of individuals with IED that vary based on their cognitive-affective symptoms and subsequently examine whether IED subgroups differ in terms of various adverse life outcomes. This study will be the first to employ a latent class analysis (LCA) on a sample of individuals who meet criteria for a lifetime diagnosis of DSM-5 IED using data across a number of cognitive-affective predictor variables. As this is an exploratory, person-centered analysis, we did not have *a priori* hypotheses about the number or types of distinct IED subgroups we would find. After completing the LCA, we used an external validation (auxiliary) analysis to examine whether and to what extent outcomes and impairment differ across the various IED subgroups.

1. Method

1.1. Participants

Participants consisted of 105 adults (69% women) age 18 to 61 ($M = 21.13$, $SD = 5.75$) who identified as predominantly Caucasian (52.4%), African American (23.8%), or Asian (11.4%); non-Hispanic/Latinx (69.5%); and heterosexual (79%). Participants were included in the study if they received a lifetime DSM-5 IED diagnosis. There were no exclusionary criteria. All participants were undergraduate students

recruited from an ethnically and socioeconomically diverse university in Philadelphia, with a student body of 26,247 undergraduates who identify as 55% female, 55.8% Caucasian, 12.4% African American, 12.2% Asian, and 7.7% Hispanic/Latinx. Participants were recruited as a part of a larger study of affective, cognitive, and behavioral correlates of impulsive other- and self-directed aggression. Participants received either research credit or monetary compensation for their involvement.

1.2. Procedure

All study procedures were reviewed and approved by Temple University's Institutional Review Board. Written informed consent was obtained prior to completing the online battery of self-report measures relating to affect, cognition, and behavior, after which participants completed in-person diagnostic interview conducted by graduate-level diagnosticians who were trained and supervised by the senior author, a licensed clinical psychologist. IED and other major DSM-5 diagnoses were evaluated and confirmed using a best estimate procedure wherein following the clinical interview, a diagnostic report for each participant was written, presented, and reviewed by a team of diagnosticians under the supervision of a licensed clinical psychologist, after which formal diagnoses were determined (Klein et al., 1994). This team also assessed each participant's Global Assessment of Functioning (GAF; Jones et al., 1995), a single-score evaluation of symptom severity and functional impairment. The best estimate procedure yields strong inter-rater reliabilities in previous studies (kappa = 0.79–.93) across psychiatric diagnoses (Klein et al., 1994; Leckman et al., 1982).

1.3. Measures

1.3.1. Diagnostic interview

Demographics Interview. Participants answered a number of questions relating to demographic information such as age, gender identity, race, and ethnicity.

Intermittent Explosive Disorder Interview-Modified (IED-M). The IED-M (Coccaro and McCloskey, 2004) is a semi-structured clinical interview used to diagnose DSM-5 IED, which has been shown to be a valid and reliable instrument (Kulper et al., 2015). The IED-M obtains quantitative (e.g., frequency) and qualitative (e.g., description of most severe events) information regarding a variety of aggressive acts as well as resultant distress, psychosocial impairment, and exclusionary information.

Structured Clinical Interview for the DSM-5 (SCID-5). The SCID-5 (First et al., 2015) is a semi-structured clinical interview which was used to assess for non-IED, non-personality psychiatric disorders. It has demonstrated good to excellent (kappa = 0.70–1.0) inter-rater reliability for all diagnoses (Osório et al., 2019).

1.3.2. LCA predictors: cognitive and affective symptoms

Predictor variables are cognitive and/or affective symptoms shown to be empirically related to IED. The predictors are used in the LCA to indicate subgroup membership, such that distinct subgroups of IED are identified based on varying cognitive-affective symptom profiles.

Anger and Hostility. The Buss-Perry Aggression Questionnaire (BPAQ; Buss and Perry, 1992) is a 30-item self-report measure of trait-like tendencies of anger, hostility, verbal aggression, and physical aggression. Only the anger and hostility subscales were used as predictors in the present study. Both subscales have shown good retest reliability (anger, $r = 0.72$; hostility, $r = 0.72$) and internal consistency (anger, $\alpha = 0.83$; hostility, $\alpha = 0.77$) in prior research (Buss and Perry, 1992), and good internal consistency in the current sample ($\alpha = 0.76$–0.79).

Emotion Dysregulation. The Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004) is a 39-item self-report measure of six dimensions of emotion regulation that are summed to create a total emotion dysregulation score. The DERS total score has demonstrated

strong internal consistency (α = 0.93) and test–retest reliability (p_I = 0.88; Gratz and Roemer, 2004) and excellent internal consistency in the current sample (α = 0.94).

Emotional Reactivity. The Emotion Reactivity Scale (ERS; Nock et al., 2008) is a 21-item self-report measure of three facets of emotional reactivity (i.e., sensitivity, arousal/intensity, persistence), which are summed in a total score. The ERS total score has demonstrated good internal consistency (α = .85; Nock et al., 2008) and excellent internal consistency in the present sample (α = 0.94).

Alexithymia. The Toronto Alexithymia Scale (TAS; Bagby et al., 1994) is a 20-item self-report measure of difficulty identifying and describing one's own emotions. The overall score has shown adequate internal consistency and good retest reliability (ICC = 0.77; Bagby et al., 1994) and demonstrated excellent internal consistency in the present sample (α = 0.86).

Empathy. The Basic Empathy Scale (BES; Jolliffe and Farrington, 2006) is a 20-item self-report measure of cognitive and affective empathy. The BES total score has demonstrated strong internal consistency in previous work (α = 0.85; Jolliffe and Farrington, 2006) and in the present sample (α = 0.85). Scores on the BES were reverse coded such that higher scores indicated poorer empathy, consistent with the scoring on all other predictor variables.

General Adaptive and Maladaptive Rumination. The Ruminative Response Scale (RRS; Treynor et al., 2003) is a 10-item questionnaire assessing reflective pondering (i.e., adaptive rumination) and brooding (i.e., maladaptive rumination). Both subscales were used in the present study, which have demonstrated good internal consistency (reflection: α = 0.72, brooding: α = 0.77) and retest reliability (reflection: ICC = 0.60, brooding: ICC = 0.62; Treynor et al., 2003), as well as good internal consistency in the present sample (α = 0.80–0.81).

Affective (Anger) Rumination. The Sadness and Anger Rumination Inventory (SARI; Peled and Moretti, 2010) is a 22-item measure of perseverative anger or sadness-related thoughts. Only the anger rumination subscale was used in the present study. The anger rumination subscale has demonstrated excellent internal consistency in previous research (α = 0.95; Peled and Moretti, 2010) and the current sample (α = 0.94).

Impulsivity. The UPPS-P Impulsive Behavior Scale (Whiteside and Lynam, 2001) is a 59-item questionnaire assessing five facets of impulsivity: negative urgency and positive urgency (i.e., the tendency to act rashly during negative/positive emotional states), sensation-seeking (i.e., the motivation to experience novelty), [lack of] premeditation (i.e., the tendency to act rashly without forethought), and [lack of] perseverance (i.e., the tendency to not complete tasks or projects). All UPPS-P scales were used in the present study, and have demonstrated both good internal consistency (α = 0.82–.91) and criterion validity (Whiteside and Lynam, 2001). They also demonstrated good internal consistency in the present sample (α = 0.78–0.94).

1.3.3. External validators: life/behavioral outcomes of IED

External validators were selected as behavioral manifestations and/ or life outcomes associated with IED. These analyses investigated whether and to what extent distinct cognitive-affective profiles (i.e., subgroups) within IED differ in terms of various adverse outcomes.

Physical and Verbal Aggression. The BPAQ (Buss and Perry, 1992) was also used to evaluate two facets of trait aggressiveness (i.e., verbal and physical aggression) to examine if different IED subgroups differ on the type of aggression they tend to engage in. The physical and verbal aggression subscales of the BPAQ demonstrate good retest reliability (r = 0.80 and 0.76 respectively) and internal consistency (α = 0.85 and 0.72 respectively; Buss and Perry, 1992). The subscales also demonstrated good internal consistency in the present sample (both αs = 0.80).

Relational Aggression. The Relational Aggression Questionnaire (RAQ; Murray-Close et al., 2010) is a 16-item self-report measure of proactive, reactive, and intimate partner relational aggression. These subscales have demonstrated strong internal consistency (proactive: α = 0.80; reactive: α = 0.83; intimate partner: α = 0.78), as well as excellent retest reliability (r = 0.92; Murray-Close et al., 2010). The subscales demonstrated adequate to good internal consistency in the present sample (proactive: α = 0.68; reactive: α = 0.66; intimate partner: α = 0.77).

Cyber Aggression. The Life History of Aggression-Cyber (LHAC) is a 4-item self-report measure of cyber aggression (e.g., sending an electronic instant message intended to threaten or insult another person). The LHAC was developed as an addition to the well-validated Life History of Aggression measure (internal consistency α = 0.88; inter-rater reliability ICC = 0.95; Coccaro et al., 1997). The LHAC demonstrated adequate internal consistency in the present sample (α = 0.64).

Interpersonal Problems. The Inventory of Interpersonal Problems (IIP-PD; Kim and Pilkonis, 1999) is a 25-item self-report measure of five domains of interpersonal difficulties each representing its own subscale: lack of sociability, aggression, need for social approval, interpersonal ambivalence and interpersonal sensitivity. The subscales have demonstrated good internal consistency (α = 0.80–0.88; Kim and Pilkonis, 1999), as well as good to excellent internal consistency in the present sample (α = 0.78–0.89).

Life Satisfaction. The Quality of Life Enjoyment and Satisfaction Questionnaire (QLESQ; Stevanovic, 2011) is a 16-item self-report instrument assessing overall life satisfaction and enjoyment in a variety of domains. The QLESQ total score demonstrated excellent internal consistency (α = 0.90) and retest reliability (ICC = 0.93; Stevanovic, 2011), as well as excellent internal consistency in the present sample (α = 0.87).

Drug Abuse. The Drug Use Disorder Identification Test (DUDIT; Berman et al., 2005) is an 11-item self-report screening instrument intended to briefly assess DSM criteria for a substance use disorder. The DUDIT total score has demonstrated good internal consistency (α = 0.80) and strong predictive validity regarding diagnoses of non-alcohol substance use disorders with high sensitivity and specificity (Berman et al., 2005). The total score demonstrated excellent internal consistency in the present sample (α = 0.91).

Alcohol Abuse. The Alcohol Use Disorder Identification Test (AUDIT; Carey et al., 2003) is a 10-item self-report screening instrument to briefly assess DSM criteria for alcohol use disorder. The AUDIT total score has demonstrated good to excellent internal consistency (α = 0.75–0.94) and demonstrates strong predictive validity regarding diagnoses of alcohol use disorders with high sensitivity and specificity (Carey et al., 2003). The total score demonstrated good internal consistency in the present sample (α = 0.84).

Non-Suicidal Self-Injury (NSSI). The Forms and Functions of Self-Injury Scale (FAFSI; Jenkins et al., 2011) is a self-report measure of lifetime history of various self-injurious behaviors (e.g., self-cutting, self-burning, self-hitting). The FAFSI has demonstrated good internal consistency (KR-20 = 0.83) for NSSI behaviors (Brickman et al., 2014). Only the lifetime frequency of overall NSSI behaviors was considered.[1]

Suicidal Behavior. The Suicidal Behavior Questionnaire-Revised (SBQ-R; Osman et al., 2001) is a four-item self-report measure assessing lifetime and recent suicidal thoughts and attempts, and likelihood of future suicidal behavior. The SBQ-R total score has demonstrated good internal consistency (α = 0.76 - 0.88), as well as adequate predictive validity for suicide-related behaviors (Osman et al., 2001). The total score demonstrated good internal consistency in the present sample (α = 0.79).

Psychiatric comorbidity. The SCID-5 was used to identify comorbid psychiatric disorders, specifically mood, substance use, anxiety, eating and psychotic disorders, as well as attention deficit hyperactivity disorder.

Diagnostic remission status. The IED-M was used to assess the presence of a lifetime (i.e., current or remitted) IED diagnosis.

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[1] As the lifetime NSSI frequency ranged from zero to 5,000+ acts with several outliers, this variable was Winsorized for use in further analysis.

1.4. Data analytic plan

All continuous variables met assumptions of normality and linearity. See Table 1 for raw mean, median, standard deviation, and interquartile range for each variable. Prior to analysis, bivariate correlations were run to assess the relationships among all predictor variables, then all continuous predictor variables were z-scored. Mplus [Version 8.3] statistical software was used to complete the latent class and auxiliary analyses.

1.4.1. Latent class analysis

To handle missing data, Mplus employs Full Information Maximum Likelihood

(FIML) estimation, which involves using all available data but does not impute values to estimate model parameters. FIML keeps participants with missing data in the model estimation, thus producing smaller standard and parameter estimate errors relative to other methods for handling missing data (Enders, 2001; Graham, 2008) After assessment of the variables in the final LCA dataset, it was determined that the requirements for FIML (i.e., data missing at random or missing completely at random) were fulfilled, with percent of missing data ranging from 3% to 37% for the predictor variables and 0% to 17% for the external validators. Further analyses revealed that participants with missing data

Table 1
Descriptive statistics for cognitive-affective symptoms and external validators.

Predictors: cognitive-affective traits	Mean	SD	Median	IQR
BPAQ Anger	18.69	5.78	18	8
BPAQ Hostility	23.05	6.65	23	9
DERS Total Score	91.26	23.36	91	33
SARI Anger Rumination	31.30	9.33	31	12
TAS Total Score	57.37	10.91	57	16
UPPS-P Premeditation	32.96	5.18	32	6
UPPS-P Negative Urgency	29.97	6.27	29	7
UPPS-P Sensation Seeking	33.43	6.92	33	8
UPPS-P Perseverance	28.75	4.58	28	7
UPPS-P Positive Urgency	27.12	9.69	24	17
BES Total Score	73.33	9.68	73	13
ERS Total Score	37.65	18.29	38	29
RRS Brooding	12.33	3.58	12	5
RRS Reflection	11.67	3.55	11	5
External validators: behavioral/life outcomes	Mean	SD	Median	IQR
BPAQ Physical Aggression	23.36	7.61	22	11
BPAQ Verbal Aggression	16.06	4.43	16	6
LHAC Total Score	4.39	3.64	3	6
RAQ Peer-directed proactive aggression	7.22	2.61	6	3
RAQ Peer-directed reactive aggression	12.02	3.56	11	5
RAQ Intimate partner aggression	9.9	3.93	9	6
IIP Interpersonal Sensitivity	1.73	0.99	1.6	1.8
IIP Interpersonal Ambivalence	0.91	0.75	0.7	1.4
IIP Aggression	1.16	0.97	0.9	1.7
IIP Need for Social Approval	1.84	0.94	1.8	1.3
IIP Lack of Sociability	1.44	0.95	1.4	1.6
GAF Score	61.03	9	60	13
QLESQ Total Score	35.69	8.83	36	10
AUDIT Total Score	5.68	5.1	4	7
DUDIT Total Score	3.68	6.08	1	5
SBQ-R Total Score	6.86	3.5	6	6
FAFSI Total # lifetime NSSI acts (Winsorized)	74.57	493.8	2	27

Note. IQR = Interquartile Range; BPAQ = Buss Perry Aggression Questionnaire; DERS = Difficulties in Emotion Regulation Scale; SARI = Sadness and Anger Rumination Inventory; TAS = Toronto Alexithymia Scale; UPPS-*P* = Urgency, Premeditation, Perseverance, Sensation-Seeking, Positive Urgency Impulsive Behavior Scale; BES = Basic Empathy Scale; ERS = Emotion Reactivity Scale; RRS = Ruminative Response Scale; LHAC = Life History of Aggression-Cyber; RAQ = Relational Aggression Questionnaire; IIP = Inventory of Interpersonal Problems; GAF = Global Assessment of Functioning; QLESQ = Quality of Life Enjoyment and Satisfaction Questionnaire; AUDIT = Alcohol Use Disorders Identification Test; DUDIT = Drug Use Disorders Identification Test; SBQ-*R* = Suicidal Behavior Questionnaire-Revised; FAFSI = Form and Function of Self-Injury Scale; NSSI = Non-suicidal self-injury.

significantly differed from those with complete data only on the GAF scores ($p < .05$), wherein participants with complete data had lower scores than those with missing data. No other significant differences between those with and without missing data were found.

Latent class analysis (LCA; Muthén and Muthén, 2000) was used to identify subgroups based on their cognitive-affective symptoms. Unlike variable-centered approaches (e.g., factor analysis), LCA is a person-centered approach, which considers relations among individuals to classify them into homogeneous groups that differ in terms of their psychological features. LCA is an iterative model-building procedure that utilizes a variety of statistical fit indices to identify the best-fitting model for the data (Nylund et al., 2007). Practical and conceptual considerations are taken into account to determine the most appropriate model. The LCA procedure begins with a one-class (i.e., unconditional) model, after which the number of classes increases until there are no additional improvements to model fit based on the statistical fit indices, or the results are no longer useful or conceptually sound. Fit indices examined are the Akaike Information Criteria (AIC; Akaike, 1987), the Bayesian Information Criterion (BIC; Schwarz, 1978) and the sample size adjusted BIC (ABIC; Sclove, 1987). Smaller values on these indices indicate better-fitting models. Next, the Bootstrap Likelihood Ratio Test (BLRT; Nylund et al., 2007) is examined to compare the fit of the model with *k* classes versus that with *k*-1 classes, with significant BLRT indicating that the *k* class model is a better fit for the data than the *k*-1 class model (Nylund et al., 2007). Entropy, an indicator of class separation, is also considered; entropy values close to 1 indicate clearer delineation among classes. Lastly, interpretability and practical/clinical utility are considered to determine the optimal number of classes.

1.4.2. External validation

Following determination of the best-fitting model, tests of equality of means were used to examine the external validity of the identified latent classes. The test of equality of means holds class membership constant and provides χ^2 statistics for omnibus and pairwise comparisons across the latent classes. Analyses considered demographic variables (i.e., age, gender, race, ethnicity) and the life/behavioral outcomes. If omnibus tests were significant ($p < .05$), pairwise comparisons were interpreted.

2. Results

2.1. Descriptive statistics

See Table 1 for overall sample raw means, medians, standard deviations, and interquartile ranges for the predictor and auxiliary variables.

2.2. Latent class analysis

Results of the LCA indicate the BIC was minimized in the four-class model (Table 2), suggesting this model fit the data best. The AIC and ABIC indicated that the five-class model might be a better fit for the data; however, this model did not reveal clinically meaningful or substantively distinct classes. The four-class model demonstrated strong delineation among classes as indexed by entropy (0.871). Lastly, the smallest class size ($n = 13$, 12.5% of sample) was adequate for continued analysis. Overall, multiple statistical fit indices as well as qualitative examination of the classes suggest that the four-class model best fit the data.

Class mean scores for each of the cognitive-affective traits are presented in Table 3 and Fig. 1. Higher scores on each measure indicate greater impairment in that particular facet of cognitive-affective functioning. Thus (for example) higher empathy scores indicate greater deficits in empathy. Consistent with conventional LCA procedures, we named these classes based on the qualitative differences observed among the four classes regarding the cognitive-affective profiles of individuals with a lifetime diagnosis of IED. The *lower emotional dysregulation* (LED) class ($n = 13$) exhibited the greatest affective stability, as

Table 2

Fit indices for latent class analysis models with 1–5 classes.

Number of classes	1	2	3	4	5
Number of Free Parameters	28	43	58	73	88
Log-Likelihood	−1753.862	−1652.989	−1615.207	−1577.106	−1553.712
AIC	3568.725	3391.977	3346.415	3300.211	3283.423
BIC	3637.768	3505.686	3499.790	3493.252	3516.130
ABIC	3549.316	3369.849	3316.567	3262.644	3238.137
BLRT	N/A[a]	0.000	0.000	0.000	0.000
Entropy	1	0.848	0.870	0.871	0.879
Smallest Class [n]	104	46	15	13	9
Smallest Class [%]	[100.0%]	[44.2%]	[14.4%]	[12.5%]	[8.7%]

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ABIC = Adjusted BIC; BLRT = Bootstrap Likelihood Ratio Test.

[a] BLRT is not available for the one-class model.

Table 3

Z-standardized class means and standard deviations for predictor variables.

Predictors	LED Class		ERNP Class		LERDP Class		HED Class	
	Mean (Z)	SD	Mean (Z)	SD	Mean (Z)	SD	Mean (Z)	SD
BPAQ Anger	−1.294	0.980	−0.410	1.055	0.226	0.970	0.977	1.593
BPAQ Hostility	−1.856	1.597	−0.404	1.243	0.042	0.945	1.397	1.429
DERS Total Score	−1.577	1.357	−0.357	1.605	0.250	0.927	1.077	1.836
SARI Anger Rumination	−1.484	1.661	0.181	1.374	−0.410	1.201	0.854	1.524
TAS Total Score	−1.391	1.999	−0.267	1.274	0.246	1.035	0.812	1.302
UPPS-P Premeditation	0.017	1.479	0.538	1.318	−1.231	0.916	0.305	1.291
UPPS-P Negative Urgency	−2.183	2.102	−0.639	1.386	0.120	0.930	1.709	1.355
UPPS-P Sensation Seeking	0.179	1.166	0.097	1.286	−0.114	0.725	−0.113	1.222
UPPS-P Perseverance	0.475	2.205	0.450	1.012	−0.593	0.851	−0.305	1.254
UPPS-P Positive Urgency	−0.736	1.871	−0.713	1.218	0.898	1.525	0.509	1.302
BES Total Score	0.607	1.039	−0.672	1.255	1.051	0.966	−0.305	1.233
ERS Total Score	−2.280	1.146	−0.026	1.486	−0.926	1.028	1.961	1.333
RRS Brooding	−1.606	1.342	0.110	1.499	−0.201	1.085	0.797	1.561
RRS Reflection	−0.941	2.170	0.492	1.724	−0.576	0.836	0.303	1.487

Note. LED = Low emotional dysregulation; ERNP = Empathic, reflective, not planful; LERDP = Lacking empathy, reward-driven, planful; HED = High emotional dysregulation; BPAQ = Buss Perry Aggression Questionnaire; DERS = Difficulties in Emotion Regulation Scale; SARI = Sadness and Anger Rumination Inventory; TAS = Toronto Alexithymia Scale; UPPS-P = Urgency, Premeditation, Perseverance, Sensation-Seeking, Positive Urgency Impulsive Behavior Scale; BES = Basic Empathy Scale; ERS = Emotion Reactivity Scale; RRS = Ruminative Response Scale.
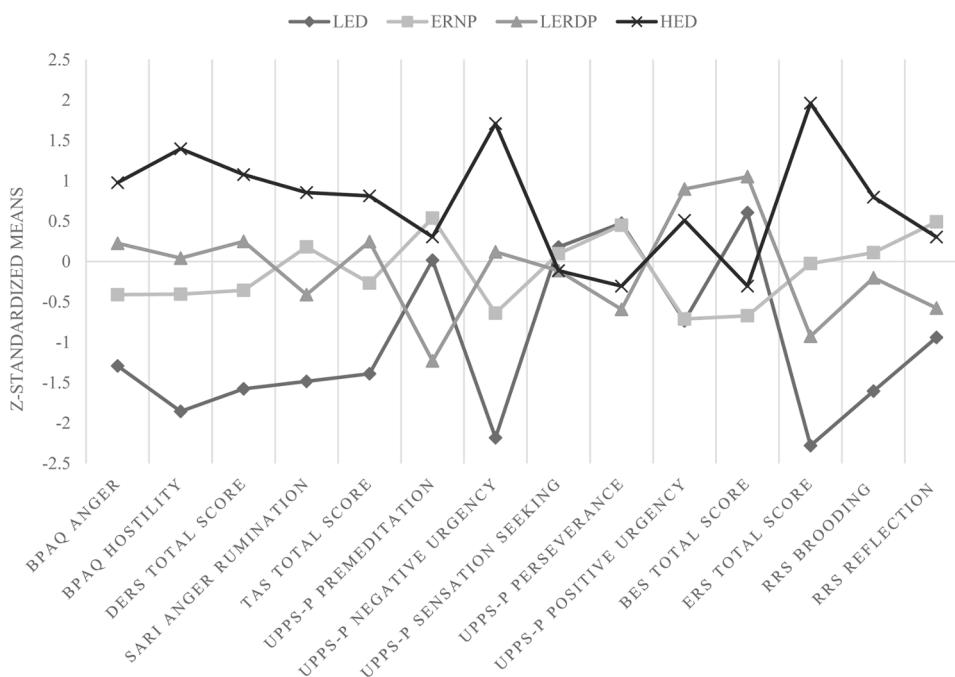
Fig. 1. *Mean scores (z-standardized) for each cognitive-affective trait are presented for each class in the four-class model*

Note: LED = Low emotional dysregulation; ERNP = Empathic, reflective, not planful; LERDP = Lacking empathy, reward-driven, planful; HED = High emotional dysregulation; BPAQ = Buss Perry Aggression Questionnaire; DERS = Difficulties in Emotion Regulation Scale; SARI = Sadness and Anger Rumination Inventory; TAS = Toronto Alexithymia Scale; UPPS-P = Urgency, Premeditation, Perseverance, Sensation-Seeking, Positive Urgency Impulsive Behavior Scale; BES = Basic Empathy Scale; ERS = Emotion Reactivity Scale; RRS = Ruminative Response Scale.

well as low levels of both adaptive and maladaptive rumination. The *empathic, reflective, and non-planful* (ERNP) class (*n* = 39) exhibited moderate impairment in emotion regulation, but displayed the highest levels of empathy and reflection (adaptive rumination), as well as the lowest levels of premeditation or forethought in action. The *lacking empathy, reward-driven, and planful* (LERDP) class (*n* = 24) displayed the greatest deficits in empathy, the highest levels of premeditation or calculated action, and the highest levels of positive urgency, which is the tendency to act impulsively when experiencing positive affect. Lastly, the *high emotional dysregulation* (HED) class (*n* = 28) demonstrated the greatest affective instability across all measures, as well as brooding (maladaptive rumination).

2.3. External validation

Classes did not differ on demographic variables, but differed on a number of adverse outcomes, supporting the external validity of the four-class model. Table 4 contains class means for each external validator, as well as the omnibus and follow-up pairwise comparisons of means across the four classes. Table 5 contains details about psychiatric comorbidity, across the whole sample and four classes. We highlight below the significant results of the external validation.

2.3.1. Aggression

The LED class engaged in the least amount of physical aggression and peer-directed reactive relational aggression compared to all other groups, consistent with their milder emotion dysregulation tendencies. Likewise, the HED class reported engaging in the greatest amount of verbal and cyber aggression, consistent with their more severe emotion regulation difficulties.

2.3.2. Interpersonal problems

The HED class experienced the greatest amount of interpersonal difficulties compared to all other classes and across all facets of

Table 5
Percent of sample that endorsed a current comorbid disorder and pairwise results.

Current Psychiatric Disorder	Full Sample	LED	ERNP	LERDP	HED	Pairwise comparisons*
Mood Disorder	19	0	20.5	20.8	25	2,3,4 > 1
Depressive Disorder	12.4	0	15.4	16.7	10.7	2,3 > 1
Bipolar Disorder	5.7	0	2.6	4.2	14.3	–
Substance Use Disorder	20	7.7	17.9	37.5	14.3	3 > 1
Anxiety Disorder	35.2	15.4	33.3	25	57.1	4 > 1,2,3
Eating Disorder	4.8	0	5.1	8.3	3.6	–
ADHD	5.7	15.4	5.1	0	3.6	–
Psychotic Disorder	1	0	0	4.2	0	–

Note: LED = Low emotional dysregulation; ERNP = Empathic, reflective, not planful; LERDP = Lacking empathy, reward-driven, planful; HED = High emotional dysregulation.
* 1 = LED; 2 = ERNP; 3 = LERDP; 4 = HED.

interpersonal problems (interpersonal sensitivity, ambivalence, aggression, lack of sociability and need for social approval). The LED class reported the least difficulties with interpersonal sensitivity and need for social approval compared to all other classes.

2.3.3. Life satisfaction

Although there were no significant differences among classes on interviewer-reported impairment (GAF score), the LED class reported the highest quality of life and satisfaction compared to all other classes.

2.3.4. Substance use risk

The LERDP class scored the highest on the AUDIT, meaning this

Table 4
Auxiliary analysis results with overall and class means, χ2 omnibus and pairwise results.

External Validators	LED Class		ERNP Class		LERDP Class		HED Class		Omnibus χ2 statistic (p-value)	Pairwise comparisons*
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Aggression										
BPAQ Physical Aggression	16.503	7.824	22.497	8.243	24.799	5.041	26.489	8.980	22.043 (0.000)	2,3,4 > 1
BPAQ Verbal Aggression	13.534	6.712	15.577	4.596	15.534	3.541	18.629	4.455	13.592 (0.004)	4 > 1,2,3
LHA Cyber Aggression	2.704	5.041	3.817	3.647	4.276	3.029	6.084	3.715	9.429 (0.024)	4 > 1, 2
Relational Aggression (RAQ)										
Proactive aggression	6.391	4.100	6.428	1.836	8.464	3.353	7.638	2.551	7.364 (0.061)	--
Reactive aggression	8.741	3.419	11.764	3.741	12.686	3.382	13.352	3.910	23.612 (0.000)	2,3,4 > 1
Intimate partner aggression	8.249	4.605	9.002	3.728	11.632	4.388	10.443	4.381	6.414 (0.093)	--
Interpersonal Problems (IIP)										
Interpersonal Sensitivity	0.900	0.980	1.530	1.074	1.337	0.447	2.722	0.767	75.309 (0.000)	4 > 1,2,3; 2 > 1
Interpersonal Ambivalence	0.604	0.916	0.711	0.793	0.945	0.599	1.280	0.783	11.134 (0.011)	4 > 1,2
Interpersonal Aggression	0.617	0.970	0.813	0.949	0.957	0.537	2.018	1.021	32.595 (0.000)	4 > 1,2,3
Need for Social Approval	0.936	1.156	1.780	1.030	1.586	0.487	2.565	0.825	40.068 (0.000)	4 > 2; 3 > 1
Lack of Sociability	0.961	1.220	1.198	0.849	1.114	0.541	2.248	1.053	26.211 (0.000)	4 > 1,2,3
Impairment/Life satisfaction										
GAF Score	68.833	11.689	61.320	10.048	60.794	7.096	59.056	8.969	2.761 (0.43)	--
QLESQ Total Score	43.409	8.441	35.654	9.249	34.008	7.186	33.405	9.535	20.685 (0.000)	1 > 2,3,4
Substance Use										
AUDIT Total Score	4.868	9.141	4.177	4.009	9.404	4.792	4.745	4.413	11.735 (0.008)	3 > 1,2,4
DUDIT Total Score	4.817	13.805	2.103	3.859	4.559	4.950	4.333	6.540	4.567 (0.206)	--
Self-Aggression										
SBQ-R Total Score	5.028	2.601	6.857	3.591	5.619	2.491	8.884	4.016	18.951 (0.000)	4 > 1,2,3; 2 > 1
FAFSI Total # lifetime NSSI acts	50.715	186.994	35.951	87.293	15.950	42.704	26.859	43.009	1.507 (0.681)	--

subgroup is most likely to have an alcohol use disorder as defined by the DSM. Risk for non-alcohol substance use (DUDIT scores) did not differ among classes.

2.3.5. Self-aggression

The LED class displayed the least and the HED class displayed the most suicidal ideation, behavior, and risk among the four classes, as indexed by scores on the SBQ-R. Classes did not differ in their lifetime frequency of non-suicidal self-injury (FAFSI).

2.3.6. Psychiatric comorbidity

Compared to the other classes, the LED class demonstrated the lowest rates of comorbid mood disorders, specifically depressive disorders. Consistent with the AUDIT scores, the LEDRP class had the highest rates of comorbidity with a substance use disorder (including alcohol use disorder). Finally, the HED class demonstrated the highest rates of comorbidity with an anxiety disorder (e.g., generalized anxiety, posttraumatic stress, and panic disorders). The classes did not differ on comorbidity with bipolar, eating, psychotic, or attention deficit hyperactivity disorders.

2.3.7. Diagnostic remission status

Although individuals with current IED were found in each of the four classes, the LED class demonstrated higher rates of past, as opposed to current, IED diagnoses compared to other classes. No further class differences in diagnostic remission status were found.

3. Discussion

The goals of this study were to investigate the cognitive-affective heterogeneity within IED and examine how IED subgroups differ in terms of adverse outcomes. Results support four distinctive subgroups of IED that differed across facets of emotionality and cognition, as well as across behavioral and life outcomes. Overall, our findings reveal that the four classes represent low (LED), moderate (ERNP and LERDP), and high (HED) emotion-dysregulated subgroups of IED.

The *lower emotional dysregulation* (LED) class had a less severe presentation, likely related to their relatively low scores across all measures of emotionality and trait hostility. Individuals in the LED group tended to be less aggressive, have fewer interpersonal problems, have lower suicide risk, have lower comorbidity with mood disorders, and report greater life satisfaction. Thus, we would consider individuals in this class to be the least impaired and most well-adjusted among those with IED. Additionally, though participants with current IED were represented in all four classes, the LED class had higher rates of past IED diagnoses compared to the other classes. This result further validates the LED profile in suggesting that remitted IED is associated with fewer adverse outcomes and emotion regulation difficulties, consistent with the reduced aggression frequency or intensity that led to diagnostic remission. Taken together, these findings extend previous dimensional studies demonstrating that among aggressive individuals (both with and without IED), less overall aggression (Coccaro et al., 2014b; Look et al., 2015) and fewer global emotion regulation difficulties (Fahlgren et al., 2019; Puhalla et al., 2016) are associated with life satisfaction and psychological adjustment, by showing that these individuals may represent a distinct subgroup among those with IED.

The two moderate groups, the *empathic, reflective, and not planful* (ERNP) group and the *lacking empathy, reward-driven, and planful* (LERDP) group, show similar levels of emotional dysregulation (e.g., trait anger, general emotion regulation difficulties, anger rumination, negative urgency, and emotional reactivity), although they seem to display other notable cognitive and affective differences, such as empathic and impulsive tendencies. For example, the ERNP group displayed the highest levels of empathy. Previous research has shown normal to enhanced empathy overall among those with IED relative to other diagnostic or control groups (Fahlgren et al., 2019). The LERDP

group displayed the lowest empathy of the four groups, suggesting differences in their emotional perspective-taking abilities or motivations and, though speculative, possibly in the way they relate to others. Additionally, the ERNP group reported the least premeditation and the greatest reflective rumination, whereas the LERDP group demonstrated the greatest premeditation and scored lower on reflective rumination. Thus, though the ERNP group may tend to act rashly without forethought, they may reflect on their behavior more so after the fact. Conversely, those in the LERDP group may be more planful before acting but often do not reflect on their behavior afterward. The ERNP group also showed among the lowest positive urgency whereas the LERDP group displayed the highest positive urgency, suggesting that they are likely to engage in risky behavior when experiencing heightened positive affect. These results are consistent with the finding that the LERDP group demonstrated the highest risk for an alcohol use disorder and highest comorbidity rates with a substance use disorder, as positive urgency has been shown to predict a wide range of risky behaviors such as binge drinking, drug use, and gambling (Cyders et al., 2009, 2007; Zapolski et al., 2009). Similarities between these groups on all other adverse outcomes may in part be due to their similar (moderate) emotion dysregulation profiles. Taken together, these findings suggest the two moderate emotion dysregulation subgroups displayed distinct empathy and impulsivity profiles, with one subgroup showing the more "typical" IED pattern (high empathy and decreased planfulness), while the other subgroup showed decreased empathy, high positive urgency, and increased planfulness that may be more characteristic of those with more callous, unemotional traits and/or instrumental aggression (Coccaro et al., 2014a; Fanti et al., 2008; Muñoz and Frick, 2012).

The *high emotional dysregulation* (HED) class had the highest scores across all aforementioned indices of affective functioning and the most severe life outcomes compared to all other classes. Compared to the other IED subgroups, the HED group reported the highest levels of verbal and cyber aggression, had the highest rates of comorbidity with an anxiety disorder, and experienced the most interpersonal difficulties across all domains. Additionally, the HED group demonstrated the highest risk for engagement in suicidal behavior. These findings add to previous dimensional studies (Coccaro et al., 2014b; Fahlgren et al., 2019; Look et al., 2014) showing that greater impairments in emotion regulation and increased frequency of aggression are associated with overall functional impairment within IED by suggesting that these highly aggressive and emotionally dysregulated individuals with IED may represent a distinct subgroup. The present results also highlight specific negative outcomes (i.e., interpersonal difficulties, comorbid anxiety disorders, suicide risk) associated with this HED subgroup. Though comprehensive theoretical models of IED are yet to be presented, research has focused on emotion dysregulation as a key potential mechanism in the development and maintenance of IED, including evidence of neurochemical and neurofunctional deficits and psychosocial antecedents commonly associated with poor emotion regulation (Coccaro, 2015; McCloskey et al., 2016). The present study suggests that the level of emotion dysregulation present may also distinguish subgroups of individuals with IED.

The present findings have potential implications for targets of IED treatment above and beyond the problematic aggressive behavior itself. Specifically, this preliminary evidence of four unique subgroups of IED suggests that treatments tailored to the individual's unique cognitive and affective tendencies may enhance treatment efficacy. For example, an individual who falls within the HED class could potentially be bettersuited for a treatment that involves mitigating intense, angry emotions and modifying hostile cognitions, whereas an individual whose cognitive-affective profile resembles that of the LERDP class could potentially benefit more from interventions that focus on increasing empathy and attenuating impulsive tendencies in response to positive emotion. However, these possibilities must be considered in conjunction with the study's strengths and limitations.

The present study demonstrated several strengths. Each participant

underwent a comprehensive diagnostic evaluation of IED symptoms and related impairment, with diagnoses confirmed by the research team under the supervision of a licensed clinical psychologist (Leckman et al., 1982). Additionally, participants underwent a fairly comprehensive assessment of the cognitive, affective, and behavioral constructs of interest in this study. Regarding limitations, all measures used in this study were self-report. Even clinical interviews are contingent upon proper reporting by the participant, from which concerns such as faulty memory and social desirability arise. Additionally, we had a relatively small sample size that was comprised of predominantly non-treatment-seeking college students, which may limit generalizability to older populations and/or more severe IED presentations. Relatedly, possibly owing in part to the college sample, the current study had a higher proportion of females (69%) than typical clinical IED samples, which tend to have equal to larger proportions of males to females (Coccaro and McCloskey, 2019). Finally, individuals with a lifetime diagnosis of DSM-5 IED comprised the sample for this study, meaning a past or current IED diagnosis would suffice for inclusion in the study (62.5% of the sample met diagnostic criteria for current IED). Taken together, interpretation and generalization of the results of this study may be limited. Thus, study replication with larger, more severe, gender balanced, and only current IED samples, possibly including behavioral measures, would strengthen confidence in the study's findings. Despite the limitations, the present study provides preliminary evidence of distinct cognitive-affective subtypes within IED that are differentially associated with various adverse outcomes. If replicated in larger samples, this may support the use of more targeted intervention efforts to better treat this serious disorder.

Author statement

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Contributors

The study was designed by NC and MM. Data were collected by MM and analyzed by NC and DD. The manuscript was first drafted by NC and revised by MM, DD, and NC.

Declaration of Competing Interest

None.

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