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ORIGINAL ARTICLE

# The Role of Criticism in Expressed Emotion Among Psychoactive Substance Users: an Experimental Vignette Study

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**Abstract**
Expressed emotion (EE) is a rating of criticism, hostility, and emotional over-involvement from a carer towards a person experiencing mental distress. High EE denotes family stress and is associated with greater severity of substance use. Little is known about how EE is perceived by patients with a history of substance use disorder (SUD). The aim of the present study was to investigate perceived EE among substance users and its association with substance use, schizotypy, and depression. Ratings of arousal and relevance of auditory criticism and praise depicting EE, and self-report measures of schizotypy and depression were measured in patients with a recent history of SUD, patients with a recent history of SUD co-occurring with mental disorders (SUD + CMD), and non-clinical healthy control subjects. Group differences in ratings of criticism and praise were tested. The ratings were correlated against schizotypy and depression. Prediction of sensitivity to criticisms by a history of substance use was explored in the SUD groups. Compared to control subjects, individuals with a history of SUD rated criticism as less arousing and those with SUD + CMD rated criticism as more self-relevant. The rating of criticism was positively correlated with schizotypy and depression in the SUD group. Age of onset of substance use was a significant predictor of the arousal of criticism. History of SUD may affect perception of negative audio comments depicting family stress. This effect may be enhanced by high schizotypy traits and negative mental health status, and early age of onset of substance use.

## Introduction

Substance use disorder (SUD) is one of the costliest and most challenging public health issues. Its complexity is characterised by an interaction of biological (e.g., genetic and biochemical), psychological (e.g., mood and personality), social (e.g. adhering to social norms and less peer support), and chemical factors (e.g., the toxicity of the psychoactive substance; Buckner et al., 2013; Griffiths, 2008). The role of family relationships in the creation and maintenance of SUD has been the focus of considerable research. Family has been defined either based on biological or emotional connections (i.e., through the ties of marriage). A strong connection has been found between disrupted biologically

defined family relationships and SUD, such as family conflict and domestic violence, social isolation of family, heightened family stress, family drug use and mental health problem (Pomini et al., 2014; Sinha, 2008).

The family systems theory suggests that relationships and interactions among family members are important for family members to understand social norms and develop social and cognitive skills (Vakalahi, 2001). When there are disruptions in family relationship and interactions, including reciprocal extremes of behaviour between family members, lack of a model of normalcy, and power imbalances in family organisation, opportunities for self-development become limited. Moreover, emotional distress caused by family disruptions affect individuals' emotional wellbeing, leading to increased risks for substance use and mental disorders (Vakalahi, 2001). For example, individuals may resort to substance use to tide over high negative mood (Clark et al., 2011) and lack of social reward in close relationships (Coombs & Landsverk, 1988).

Furthermore, family conflict and criticism appear to be powerful precipitants of relapse of substance use (Fals-Stewart et al., 2001). High perceived criticism within the family at treatment intake are associated with a greater risk of relapse among cohabiting and married male substance users irrespective of the severity of substance use and other sociodemographic variables (Fals-Stewart et al., 2001). Conversely, higher rates of participation and compliance in SUD treatment are achieved with increased perceived family support (Lin et al., 2011). It has been suggested that individuals with SUDs cannot be understood and treated effectively without considering the impact on the whole family (Lander et al., 2013).

Expressed emotion (EE) is a rating of the level of criticism, hostility, and/or emotional over-involvement from a carer towards a family member diagnosed with mental illness (Barrowclough & Hooley, 2003). EE has widely been used to assess the emotional atmosphere of the home environment and the quality of the relationship between patients and their key relatives in psychiatry research. High EE has been associated with poorer clinical course and treatment outcome for many psychiatric disorders, such as schizophrenia, eating disorder and mood disorders (Amaresha & Venkatasubramanian, 2012; Peris & Miklowitz, 2015).

However, very little is known about the level of EE in people with SUD. One of the few pieces of research in this area found that caregivers of patients with only SUD

showed higher levels of burden and EE than those caring for patients with SUD and a co-occurring autism spectrum disorder (ASD) (Kronenberg et al., 2016). One of the possible reasons for these findings is the social basis of SUD. In contrast to many psychiatric disorders, e.g., attention deficit/hyperactivity disorder (ADHD) or autism spectrum disorder (ASD), which are considered illness with biological causes, SUD is often presumed to be the result of weak-will rather than an illness, thus resulting in families engaging with people with SUD with less compassion (Kronenberg et al., 2016). Furthermore, SUD patients may have persistently greater demand for caregivers' attention than those people with SUD and a co-morbid ASD (Kronenberg et al., 2016). It should be noted that EE rated by caregivers does not always reflect patients' perceived EE as perceived EE is mediated by patients' own characteristics, such as their sensitivity to criticism (Cutting et al., 2006), personality traits, mood and depression (Premkumar et al., 2019). Elevated sensitivity to standard criticism and perceived EE has been strongly associated with higher disorganised schizotypy and depression (Premkumar et al., 2019).

The aim of the present research was to acquire an 'insider's view' of EE from the perspective of individuals with a history of substance use and determine the association between sensitivity to criticisms and individuals' characteristics, including comorbid mental disorder (CMD), mood, schizotypal traits and depression, and history of substance use. More specifically, it was hypothesised that:

1. Both individuals with a history of SUD and those with a history of co-morbid SUD and mental disorders (SUD+CMD) would respond to the standard criticisms differently from non-drug using controls;
2. Subjective evaluation of standard criticism would be positively correlated with schizotypal traits and depression in both SUD and SUD+CMD groups as previously reported in healthy populations;
3. Rating of standard criticism would be predicted by length of drug abstinence and age of onset of substance use in the SUD group.

## Methods

### *Participants*

Ethical approval was granted by the research team's University's Ethics Committee and informed consent was provided by all participants. Data collection was carried out from June 2019 to February 2020 utilizing convenience sampling. Participants in the SUD group and those in SUD+CMD group both were recruited from the Auckland Wings Trust drug rehabilitation community by advertisement or by word-of-mouth. To be included in these groups, participants were required to have had a history of SUD, as evidenced by their current or historical treatment status, and their total score for either Alcohol Use Disorder Identification Test (AUDIT total score $\geq$8) (Babor et al., 2001) or the Drug Abuse Screening Test (DAST total score $\geq$6) (Skinner, 1982) prior to their current abstinence. Participants in the SUD+CMD group were also required to have a history of clinically diagnosed mental disorders. Participants with more than three years drug abstinence were excluded, so that the sample represented individuals in early to mid-stage of recovery. The SUD group comprised 17 males and 6 females with a mean age of 35.65 years (SD=7.33). The SUD+CMD group comprised 11 males and 5 females with a mean age of 33.38 years (SD=6.06).

A group of 30 age- and sex-matched control participants were recruited by advertisements distributed in a range of local community centres such as the universities, public library, shopping mall, cafés, and word-of-mouth. Their history of substance use was also assessed for eligibility using AUDIT (Babor et al., 2001) and the DAST (Skinner, 1982) to ensure not to accidentally include participants with the potential problem of substance use in the control group. The control group comprised 15 males and 15 females, with a mean age of 30.73 years (SD=6.06).

All participants were required to have a close relative (e.g., a parent, sibling, or partner), with whom they were in contact either in-person or by speaking on the telephone for more than 10 hours a week. This criterion ensured that participants were eligible to perform the task of rating the affect of emotional comments by referring to their close relative.

### *Measures*

*Affective evaluation of standard criticism and standard praise:* The participants were asked to listen to 60 comments in total, with 20 each for criticism, praise, and neutral comments and to rate how arousing and relevant the comments would be if the

comments were passed by a close relative. These comments were adapted from and validated in Premkumar et al. (2019). Considering that substance users may experience difficulties for a task requiring a long period of sustained attention, only half of the comments from the original package were included, which were selected based on the evaluation of a pool of 10 volunteers to ensure the sufficient variation in the valence of comments (i.e., positive vs negative). The criticism statements expressed an unfavourable comment upon the behaviour or personality of the person to whom it refers (e.g., *"you are lazy and never finish anything you start. You've had chances, but didn't go through with it"*). The praise comments expressed approval or appreciation of the behaviour or personality of the person to whom it refers (e.g., *"I thoroughly enjoy spending time with you. You are a lot of fun. It means a lot to me"*). Neutral statements were factual statements about science or comments on the weather (e.g., *"most places will be dry and bright, with a few light showers across northern parts during the morning"*). Comments were spoken by a male and female native English speakers respectively, who were trained to emphasise criticism, praise, and neutral reactions in tones and pitch.

*Addiction Severity Index (ASI, drug use section only):* The ASI was used to collate information about the history of drug use over the past 30 days and lifetime (McLellan & Carise, 1992). Questions include the number of days of substance use in the past month, and total years of drug use in a lifetime.

*Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE):* The O-LIFE is a 104-item self-report scale that has been commonly used to assess schizotypy traits based on self-reported behaviours (Mason et al., 1995). Each item is scored on a dichotomous two-point scale (yes/no). The subscales comprise 30 items for the unusual experiences (positive schizotypy), 27 items for introvertive anhedonia (lack of pleasure and withdrawal), 24 items for cognition disorganisation (moodiness, social anxiety, and concentration difficulty), and 23 items for impulsive nonconformity (lack of self-control and aggression). Cronbach's alpha reliabilities for each of subscales in the present study were 0.90 (Unusual Experiences), 0.93 (Cognitive Disorganisation), 0.82 (Introvertive Anhedonia), and 0.84 (Impulsive Nonconformity) respectively.

*Perceived Criticism Measure (PCM):* This one-item question asks participants, "How critical is your spouse/relative of you?" with scores ranging from 0 ("not at all critical") to 10 ("very critical indeed"). The higher the rating of PCS, the more EE-criticism individuals perceive from their relatives (Premkumar et al., 2019). This scale is used to provide validity and sensitivity of perceived criticism from the audio task.

*Depression, Anxiety and Stress Scale (DASS-21):* The 21-item DASS-21 assesses three domains (seven items each) over the past week: depression, anxiety, and stress (Lovibond & Lovibond, 1995). Good convergent and discriminant validity, and reliability of DASS-21 and its subscales have been reported (Henry & Crawford, 2005). The Cronbach's alpha for the subscales in the present study were 0.83 for anxiety, 0.91 for depression, and 0.90 for stress.

*Positive and Negative Affect Scale (PANAS):* The 20-item PANAS comprises 10 descriptors for positive mood (high energy, pleasure, and full concentration), and 10 descriptors for negative mood. Both negative and positive scores ranged from 10 to 50. The internal reliability, convergent correlations and discriminant correlations of this scale have been found to be excellent (Premkumar et al., 2019; Watson et al., 1988). Cronbach's alphas in the present study were 0.92 for positive mood and 0.87 for negative mood.

***Procedure***

Participants were asked to complete the psychometric measures and listen to auditory remarks which took approximately 50 minutes to complete in total. On hearing each comment in the audio recording, participants were asked to rate the level of arousal and relevance of the comment in terms of their own close relationships on an 11-point Likert scale. The task was delivered via the *OpenSesame* software (Mathôt et al., 2012) on a laptop. The participants rated their current mood before performing the evaluation of auditory comments. Participants were given a $20 shopping voucher to acknowledge their participation.

***Statistical analysis***

Initial group comparisons for demographic measures were performed using the Kruskal-Wallis test. Group comparisons for substance use-related measures (e.g., age of substance use onset) were performed using Mann–Whitney test. The median arousal and median relevance of the 20 comments in each condition (criticism, praise, and neutral comments) were used in the analysis to minimise the potential confounding effect associated with the skewed data distribution. The single-item PCS was significantly and positively correlated with arousal (r [69] =0.25, $p$=0.04) and relevance of criticism (r [69] =0.47, $p$<0.001), and indicated the validity and sensitivity of perceived criticism from the audio task. Group differences on the affective evaluation of audio comments were analysed using repeated-measures analysis of variance (ANOVA), including group as a between-group factor (SUD, SUD+CMD, Control) and emotion (criticisms, praise, and neutral) and type of rating (arousal, relevance) as the within-participants factor. The degrees of freedom were adjusted with a Greenhouse-Geisser correction where necessary. Significant main effects were follow-up with *post hoc* pairwise comparisons adjusted using a Sidak correction. The ANOVA was repeated as an analysis of covariance using negative mood as an additional covariate since there was a significant group difference in negative mood prior to testing ($t$ [67] =2.40, $p$=0.02).

The association between affective evaluation of audio comments (criticism and praise) and individual characteristic was explored in each group respectively using Pearson correlations. Logistic regressions were performed to determine the relative effects of age of onset of substance use and days of abstinence on predicting response to criticism (arousal, relevance) in the SUD group. Statistical analyses were performed via IBM SPSS Statistics (version 26).

## Results

### *Sociodemographic and clinical characteristics of the sample*

The demographic and clinical characteristics of the SUD group, SUD+CMD group and non-drug using control group are shown in Table 1. Results of the group comparisons showed no difference in age and gender. Comparisons of the SUD group to the SUD+CMD group also showed no significant difference in the mean age of onset of

substance use, the mean duration of drug abstinence, and type of substance use. Among the SUD+CMD group, depression (n=12) was the most common condition and five participants reported to have two or more mental disorders. In terms of lifetime history of substance use, the significant difference between the SUD and the SUD+CMD group was only observed in cannabis use (Mann-Whitney U=114.5, $p$=0.05). The year of cannabis use in a lifetime was significantly greater in the individuals in the SUD group.

### *Group comparisons on the affective evaluation of audio comments*

There were significant effects of Emotion*Type-of-Rating*Group (F [4, 66] =5.36, $p$=0.001) and Type-of-Rating*Group (F [2, 66] =4.21, $p$=0.02), which suggests group respond differently to audio comments. *Post hoc* tests showed that individuals with SUD rated criticism as less arousing (t=-2.18, $p$=0.03) than non-drug using controls, while individuals with SUD+CMD rated criticism more relevant (t=2.97, $p$=0.003) than non-drug using controls (t=2.97, $p$=0.003). However, there were no significant group differences in subjective evaluations of praise and neutral comments (Table 3). Results remained unchanged with the control of negative mood prior to rating of the audio comments.

Inspection of the group profile plots (Figure 1) showed different patterns of the interactions between arousal of criticism and the relevance of criticism between groups. In the SUD group, the level of arousal of criticisms was consistent with the self-relevance of criticisms. Individuals with SUD and CMD showed the moderate level of arousal to criticisms, but the level of self-relevance far exceeded the level of arousal. In contrast, the control group showed the greatest level of arousal but with minimum self-relevance.

### *Correlation of evaluation of criticism and schizotypy, depression and age of onset of substance use*

Table 4 presents correlations between the evaluation of criticism and individual characteristics, including schizotypal personality traits, depression, anxiety, stress and age of onset of substance use. In the SUD group, the relevance of criticism was positively associated with several schizotypal subscales, including unusual experience

(r=0.42, *p*=0.04), cognitive disorganisation (r=0.43, *p*=0.04) and introvertive anhedonia (r=0.45, *p*=0.03), and with depression (r=0.42, *p*=0.04), while the arousal of criticism was negatively associated with the age of onset of substance use (r=-0.45, *p*=0.03). In the SUD+CMD group, a significant association was only found between the relevance of criticism and schizotypal impulsive non-conformity (r=0.52, *p*=0.04).

In the control group, the relevance of criticism was positively associated with schizotypal unusual experience (r=0.62, *p*<0.001), cognitive disorganisation (r=0.55, *p*<0.001), and impulsive non-conformity (r=0.52, *p*=0.003), and with anxiety (r=0.42, *p*=0.02), depression (r=0.57, *p*=0.001), and stress (r=0.56, *p*=0.001). Furthermore, the arousal of criticism was positively associated with schizotypal-unusual experiences (r=0.40, *p*=0.03), depression (r=0.50, *p*=0.005) and stress (r=0.39, *p*=0.03).

### *Prediction of sensitivity to criticisms by the age of onset of substance use and days of substance abstinence in the SUD group*

Logistic regression analyses showed that age of onset of substance use was the significant solo predictor, which explained a significant amount of the variance in the arousal of criticism, $F(1, 21)=3.47$, $p=0.05$, $R^2=0.51$, $R^2_{Adjusted}=0.26$. However, neither age of onset of substance use nor days of substance abstinence were significant predictors of the relevance of criticism.

## Discussion

### *Summary of the key findings*

The critical role of the impact of the family environment on substance use and treatment outcome is well established. Family-based adverse childhood experiences are strong and robust predictors of substance use behaviours among both children and older adult populations (Forster et al., 2018). Higher criticism by family members is associated with shorter duration in drug treatment and greater depression (Lee et al., 2015). Evidence shows that family members of individuals with SUD are often strongly affected by the disorder and face high levels of stress, financial burden, and self-stigma, which may exacerbate likelihood of higher criticism expressed by them (Ellis et al., 2020). Furthermore, individuals with SUD tend to experience significantly more emotion regulation difficulties than non-drug use subjects, showing higher levels of

negative self-evaluation and social expectancies not to feel or show negative emotions (i.e., depression and anxiety; Dingle et al., 2018). However, it is unclear whether (and how) sensitivity to EE, a rating of family stress towards a person experiencing mental distress, is modulated by the history of SUD and individual characteristics.

The present study investigated the association between SUD and perceived EE through the comparison of personal response to emotional comments among individuals with a history of SUD, those with history of SUD co-occurring with mental disorders, and non-drug using controls. As hypothesised, individuals with a history of SUD rated criticism differently compared to non-drug using controls. Specifically, individuals with a history of only SUD showed reduced arousal of criticism while those with a history of SUD and CMD rated criticisms with greater personal relevance relative to non-drug using controls.

Recent cognitive neuroscience research suggests that both top-down and bottom-up attention contributes to the perception of sensory stimuli. Arousal or salience reflects bottom-up control and evaluates the emotional intensity of the stimulus for attentional resource allocation, whereas self-relevance is driven by top-down mechanism and involves stimulus appraisal and interaction (Schmitz & Johnson, 2007). Self-relevance could be affected by either pre-attentive bias for anticipatory or explicitly self-relevant stimuli, or by one's own mental state (e.g., self-evaluation, recollection) (Schmitz & Johnson, 2007). Research shows that blunted sensitivity to negative feedback during adolescence increases in risk-taking (McCormick & Telzer, 2017), while the attribution of negative affects to the self is likely to contribute to a heightened instability of self-image, triggering depression and undesirable behavioural outcomes such as impulsive and maladaptive behaviour (Kjærstad et al., 2016; Sarkheil et al., 2019).

Taken together, the findings here raise the possibility that a history of SUD affects one's ability to judge affective comments differently from co-occurring SUD and mental disorders. More specifically, SUD may reduce sensitivity to basic affective features of vocal emotion expressions while a history of SUD and CMD may enhance affective response to certain aversive emotions. These changes would negatively affect individuals in broader aspects of their social lives. For example, failing to fully appreciate negative characteristics of vocal stimuli in certain contexts; enhancing the disapproving view of oneself due to increased negative biases in information processing.

Nevertheless, it should also be noted that social stigma, bias, and marginalization associated with SUD can influence an individual's understanding of negative vocal stimuli. Evidence shows that family members who perceive they are marginalised often experience chronic stress associated with their position in the family and struggle to manage stigmatized identities in family interactions, although they likely need more support than other family members (Dorrance Hall, 2018). Unfortunately, the stigma surrounding individuals with SUD is a pervasive phenomenon (Zwick et al., 2020).

Furthermore, consistent with the previous EE research among the general population (Kwapil et al., 2020; Premkumar et al., 2019) as well as individuals with high-risk psychosis (O'Brien et al., 2015), the present study found that the relevance of critical comments was significantly correlated with measures of schizotypy and negative emotional states (i.e., depression) in both the SUD and control groups, implicating the role of individual personality characteristics and mental wellbeing in social perception. Schizotypy is a latent personality organisation that reflects a putative liability for these schizophrenia-spectrum disorders and psychoses (Fonseca-Pedrero et al., 2018; Grant et al., 2018). Elevated sensitivity to standard criticism and perceived EE have been strongly associated with higher disorganised schizotypy, positive schizotypy, and depression, while diminished sensitivity to praise is associated with disorganised schizotypy (Premkumar et al., 2019). Consistent with this, the present study found that high disorganised and negative schizotypal traits, and negative emotional status enhance the relevance of criticism regardless of history of substance use, suggesting the possible communication-related bias associated with specific personality traits. Research shows that negative schizotypal traits are largely overlapping with the social-communicative impairment of autistic traits (Zhou et al., 2019), and individuals high in negative schizotypal traits, including cognitive disorganisation and introvertive anhedonia, show stress-dependent increases in psychotic-like experiences without added effects of positive schizotypy (Grant & Hennig, 2020). Such overlaps and patterns could lead to the misinterpretation of other people's social behaviour. Furthermore, age of onset of substance use was a significant predictor of the arousal of criticism in the SUD group, suggesting that long-term substance use may be linked to heightened emotional arousal from criticism, or vice versa.

In contrast, few correlations were observed in the SUD+CMD group, and one of the main reasons for this might be due to small sample size. Nevertheless, it should be noted that the relevance of criticism was positively correlated with schizotypal impulsive nonconformity. Evidence shows that greater impulsive nonconformity is associated with higher self-certainty, and high confidence in one's thoughts could make one react in an impulsive manner due to an unwillingness to consider alternatives prior to arriving at a conclusion (Aldebot Sacks et al., 2012). Impulsive nonconformity is closely related to aggression which in turn relates to sensitivity to criticism (Premkumar et al., 2020). Accordingly, patients scoring higher on the impulsive nonconformity scale appear prone to a variety of psychopathologies (e.g., affective disorders, antisocial personality disorder) and report more problem-ridden relationships with others (Chapman et al., 1984). In the context of SUD treatment, individuals with co-occurring SUD and mental disorders tend to have a more severe course of illness, more severe psychosocial problems, more difficulties in treatment, and poorer treatment outcomes compared to a single disorder (Morisano et al., 2014). Thus, our findings highlight the complexity of perception of EE in the SUD+CMD group and suggest an important role of impulsive nonconformity on perceived EE in this group.

*Study limitations*

Interpretations suggested by the present findings need to be read with caution given the small sample size (although arguably large for an experimental study), the self-report and cross-sectional nature of the data and the complexity of substance users, such as type of drug use (Burdzovic Andreas et al., 2015), dysfunctional affiliations in childhood (Connor & Birchwood, 2012), and motivation and engagement at the time of testing. Also, the participants for both groups were collected simultaneously so the control group did not match the experimental groups in terms of numbers of males and females in each group. Furthermore, the SUD group was not specified based on the type of drug use and the possible effect of the type of drugs on perceived EE was not controlled for. The effect of social bias and stigma on perceived EE was also not assessed. Therefore these limitations restrict the strength and the generalisability of our results, and some of the present findings probably are not well represented in the populations experiencing problems with substance use. Nevertheless, substance users are a considered hard-to-reach study population and the present findings contribute to improved understanding of perceived EE associated with SUD and CMD.

*Conclusion and future research direction*

A history of SUD could affect sensitivity to criticism and this effect could be enhanced by high schizotypy traits and negative mental status, and age of onset of substance use. Given the important association between EE and treatment outcome, the findings of the present study highlight the importance of identifying and treating mental illness and improving family relationships in SUD treatment. Given that family environment dynamics and personality traits are not a state or trait phenomenon which can be modified with individual recovery and treatment, future studies with larger sample sizes should explore the dynamic change of perceived EE among treatment seekers with SUD.

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Table 1. Participants' demographic and clinical data

| | **SUD (n=23)** | **SUD+CMD (n=16)** | **Control (n=30)** | **Statistics** |
|---|---|---|---|---|
| | Mean (SD) or % (n) | Mean (SD) or % (n) | Mean (SD) or % (n) | |
| Age (years) | 35.65(7.33) | 33.38(6.06) | 30.73 (6.06) | H=0.62, *p*=0.43 |
| Male (%) | 73.9(17) | 61(11) | 50(15) | H=3.51, *p*=0.17 |
| Ethnicity (%) | | | | H=4.50, *p*=0.11 |
| New Zealand European | 43.5 (10) | 62.5(10) | 43.3 (13) | - |
| Maori | 43.5 (10) | 18.8(3) | 10.0 (3) | - |
| Pacific Islander | 8.7 (2) | 18.8(3) | 13.3 (4) | - |
| Asian | 4.3 (1) | | 23.3 (7) | - |
| Others | 0 | | 10.0 (3) | |
| Age of onset of substance use (years) | 14.06 (2.59) | 13.96 (4.83) | n/a | U=167.5, *p*=0.64 |
| Length of drug abstinence (days) | 226.8 (265.8) | 204.9(215.4) | n/a | U=137.5, *p*=0.18 |
| Comorbid mental disorder* | n/a | | n/a | |
| Depression only | | 43.5 (7) | | |
| Anxiety only | | 6.3 (1) | | |
| Depression and Anxiety | | 18.8 (3) | | |
| Depression and bipolar disorder | | 6.3 (1) | | |
| Bipolar disorder only | | 6.3 (1) | | |
| ADHD only | | 6.3 (1) | | |
| Anxiety, depression and ADHD | | 6.3 (1) | | |
| Paranoid schizophrenia | | 6.3 (1) | | |
| Major substance of use | | | n/a | U=184.0, *p*=1.00 |
| Alcohol | 17.4 (4) | 43.8 (7) | | |
| Cannabis | 4.3 (1) | 0 | | |
| Methamphetamine | 52.2 (12) | 37.8(6) | | |
| Opiates | 4.3 (1) | 6.3 (1) | | |
| Methamphetamine & alcohol | 4.3 (1) | 6.3 (1) | | |
| Methamphetamine & cannabis | 13 (3) | 6.3 (1) | | |
| Alcohol, cannabis & Robitussin Forte | 4.3 (1) | 0 | | |

Note: *some participants have more than one condition of mental disorder; ADHD: Attention deficit hyperactivity disorder

Table 2. Lifetime history of substance use measured with ASI

| **Lifetime regular use (years)** | **SUD group** | **SUD+CMD** | **Mann-Whitney U** |
|---|---|---|---|
| | Mean(SD) | Mean(SD) | |
| Alcohol to intoxication | 11.43(10.17) | 16.28 (11.35) | U=131.5, *p*=0.13 |
| Heroin | 1.13 (3.24) | 0.38(1.50) | U=171.0, *p*=0.48 |
| Other opiates | 1.85 (4.69) | 1.38(3.01) | U=182.0, *p*=0.94 |
| Barbiturate | 0.17 (0.83) | 0 (0) | U=176.0, *p*=0.41 |
| Other sedative use | 1.41 (3.65) | 2.19(4.81) | U=182.5, *p*=0.95 |
| Cocaine | 0.74(1.57) | 1.16 (2.89) | U=178.0, *p*=0.81 |
| Amphetamines | 11.39 (7.63) | 6.97(6.52) | U=118.5, *p*=0.06 |
| Ecstasy | 3.17 (4.48) | 4.56 (6.27) | U=166.5, *p*=0.59 |
| Cannabis | 15.30 (11.03) | 8.62(9.74) | **U=114.5, *p*=0.05** |
| Hallucinogens | 0.61 (2.15) | 1.96 (5.30) | U=158.5, *p*=0.41 |
| Inhalants | 1.74 (6.56) | 3.38 (9.88) | U=170.5, *p*=0.54 |
| Methadone | 0.39 (1.50) | 0.50 (1.75) | U=177.5, *p*=0.42 |
| Nicotine | 17.91 (8.83) | 19.56 (9.65) | U=175.5, *p*=0.81 |
| More than one substance | 18.94 (9.60) | 19.70 (7.81) | U=166.5, *p*=0.62 |
| Money spent on Nicotine for the past 30 days (New Zealand Dollars) | 155.89 (144.90) | 176.56 (151.78) | U=173.5, *p*=0.76 |

Table 3. Mean and standard deviation of evaluations of criticism and praise in groups

| Type of comments | Rating | SUD | SUD+CMD | Control | Group comparisons |
|---|---|---|---|---|---|
| | | Mean (SD) | Mean (SD) | Mean (SD) | |
| criticism | Arousal | 4.28(2.47) | 4.59(2.84) | 5.88 (2.67) | SUD<Control; SUD=SUD+CMD; SUD+CMD=Control |
| | Relevance | 4.28 (2.34) | 6.06 (2.26) | 3.72 (2.83) | SUD=Control; SUD+CMD>SUD; SUD+CMD>Control |
| Neutral | Arousal | 2.09 (2.78) | 1.56 (2.00) | 1.57 (2.14) | ns |
| | Relevance | 1.65 (2.68) | 1.06 (1.84) | 1.08 (1.86) | ns |
| Praise | Arousal | 6.89(2.82) | 6.13(3.39) | 7.21 (2.38) | ns |
| | Relevance | 6.48 (2.44) | 5.59 (2.88) | 6.79 (2.29) | ns |

Note: SUD: group with substance use disorder only; SUD+CMD: group with co-occurring substance use and mental disorders; Control: healthy control group; ns: No significant group difference.

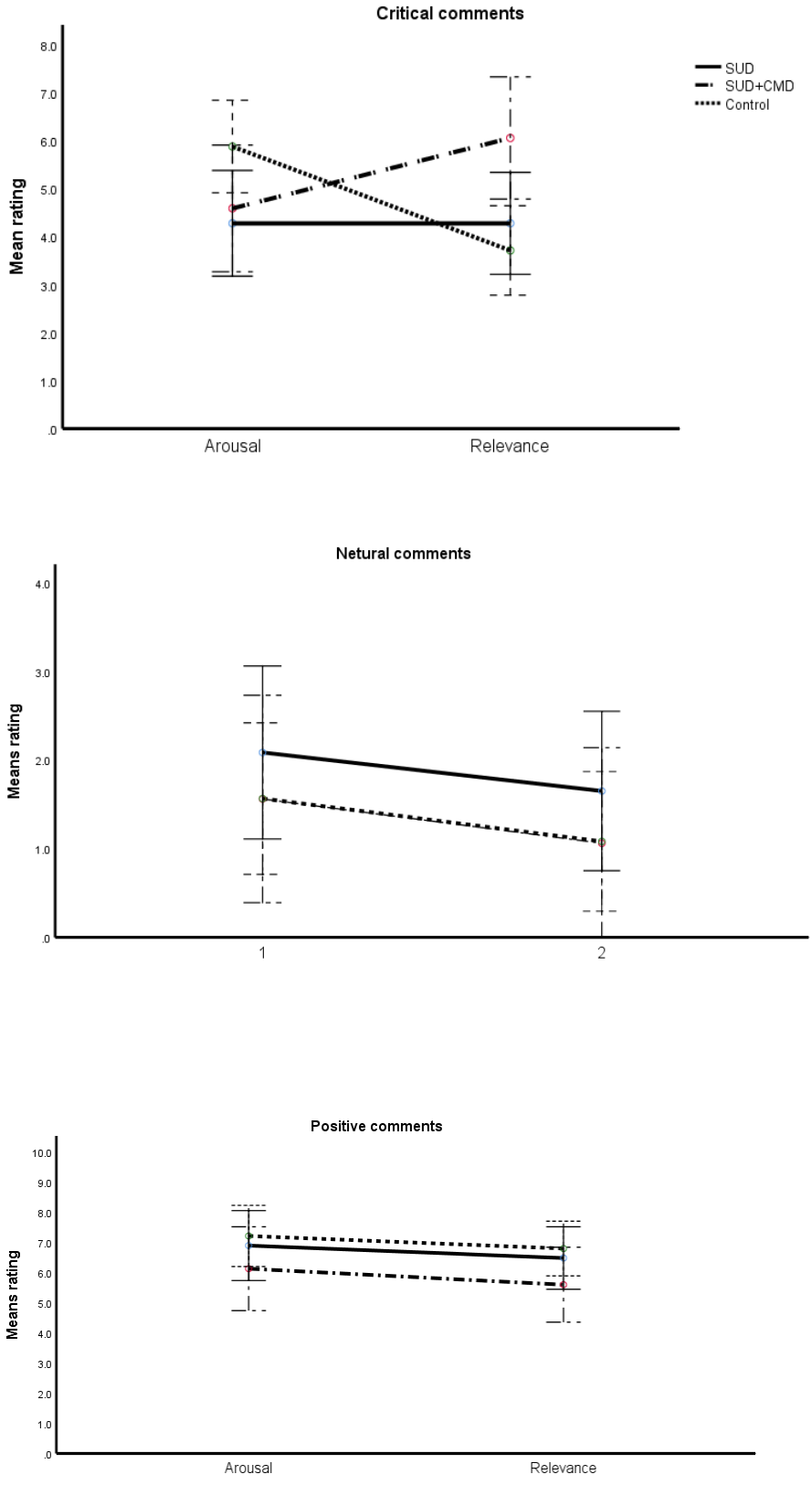


Figure 1. Interaction profile plots for groups.

Table 4. Correlations between arousal and relevance of criticism and schizotypy, depression, and history of substance use

| | Group | Mean (SD) | Relevance | | Arousal | |
|---|---|---|---|---|---|---|
| | | | r | *p* | r | *p* |
| O-LIFE UE | SUD | 10.61(5.70) | **0.42** | **0.04** | 0.06 | 0.80 |
| | SUD+CMD | 14.31(6.80) | -0.05 | 0.87 | -0.20 | 0.45 |
| | Control | 7.17(6.67) | **0.62** | **<0.001** | **0.40** | **0.03** |
| O-LIFE CD | SUD | 13.39(7.13) | **0.43** | **0.04** | 0.20 | 0.37 |
| | SUD+CMD | 18.38(4.86) | 0.37 | 0.16 | 0.44 | 0.09 |
| | Control | 9.97(6.91) | **0.55** | **0.002** | 0.25 | 0.19 |
| O-LIFE IA | SUD | 7.91(4.59) | **0.45** | **0.03** | 0.33 | 0.13 |
| | SUD+CMD | 11.88(4.84) | -0.02 | 0.95 | 0.21 | 0.43 |
| | Control | 7.10(4.91) | 0.21 | 0.28 | 0.05 | 0.81 |
| O-LIFE IN | SUD | 11.22(4.35) | 0.14 | 0.52 | 0.04 | 0.86 |
| | SUD+CMD | 13.50(3.03) | **0.52** | **0.04** | 0.64 | 0.82 |
| | Control | 6.13(3.95) | **0.52** | **0.003** | 0.02 | 0.91 |
| Anxiety | SUD | 5.13(4.25) | **0.41** | **0.05** | 0.42 | 0.04 |
| | SUD+CMD | 7.13(5.90) | 0.11 | 0.69 | 0.08 | 0.76 |
| | Control | 2.63(2.04) | **0.42** | **0.02** | 0.19 | 0.33 |
| Depression | SUD | 5.87(5.45) | **0.42** | **0.04** | 0.36 | 0.08 |
| | SUD+CMD | 9.38(5.80) | 0.25 | 0.35 | 0.26 | 0.33 |
| | Control | 2.60(2.66) | **0.56** | **0.001** | **0.50** | **0.005** |
| Stress | SUD | 7.09 (5.53) | 0.36 | 0.09 | 0.07 | 0.72 |
| | SUD+CMD | 10.19(4.74) | 0.30 | 0.26 | 0.07 | 0.81 |
| | Control | 4.70 (3.06) | **0.56** | **0.001** | **0.39** | **0.03** |
| Days of abstinence | SUD | 204.94 (215.36) | -0.31 | 0.16 | -0.15 | 0.51 |
| | SUD+CMD | 226.80(265.83) | -0.26 | 0.33 | 0.09 | 0.75 |
| Age of onset of use | SUD | 13.96(4.83) | -0.26 | 0.22 | **-0.45** | **0.03** |
| | SUD+CMD | 14.06(2.59) | -0.36 | 0.22 | 0.22 | 0.41 |

Note: Correlation that is significant at *$p \leq 0.05$ (2-tailed) is in bold. SD: Standard deviation, O-LIFE: Oxford and Liverpool Inventory of Feelings and Experiences, UE: unusual experiences (positive schizotypy), CD: cognitive disorganisation, IA: introvertive anhedonia (negative schizotypy), IN: Impulsive nonconformity.