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Acute subjective effects of psychedelics in naturalistic group settings prospectively predict longitudinal improvements in trauma symptoms, trait shame, and connectedness among adults with childhood maltreatment histories

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ABSTRACT

Studies of psychedelic use in naturalistic and clinical settings have suggested safety and mental health benefits for adults with histories of childhood maltreatment. Acute psychological mechanisms that predict therapeutic benefits in this population, however, have yet to be determined. Two common group settings of naturalistic psychedelic use – organized ceremonies and raves or other electronic dance music events – might facilitate therapeutic psychedelic effects because of the unique psychosocial environments they comprise. This prospective, longitudinal study sought to investigate 2 primary questions: first, whether adults with maltreatment histories planning to use psychedelic drugs with therapeutic intent at ceremonies or raves would see enduring psychological benefits after their experiences; and second, whether subjective dimensions of the acute psychedelic experience would be associated with lasting psychological benefits. Eighty-five participants completed self-report measures in the month before, within 2 days after, and approximately 2 months after a planned psychedelic experience with therapeutic intent at a ceremony or rave assessing childhood maltreatment history; trauma symptoms, internalized (trait) shame, and connectedness at baseline and follow-up; and various dimensions of the acute subjective psychedelic experience. Mean scores in posttraumatic stress disorder (PTSD) symptoms, complex PTSD symptoms, trait shame, social connectedness, and general connectedness significantly improved from baseline to 2-month follow-up (*ds* = 0.73–1.12). Longitudinal changes in outcomes significantly correlated with acute subjective effects of the psychedelic experience. These findings have implications regarding both the potential clinical benefit of psychedelic use among adults with childhood maltreatment histories as well as the psychological mechanisms of therapeutic action of psychedelics.

List of abbreviations

2C-B	2,5-dimethoxy-4-bromophenethylamine
5-MeO-DMT	5-methoxy-*N*,*N*-dimethyltryptamine
5D-ASC	5 Dimensions of Altered States of Consciousness Scale
ASAB	assigned sex at birth
COMS	Communitas Scale
CPTSD	complex posttraumatic stress disorder
CTO	WCS Connectedness to Others Subscale
CTQ	Childhood Trauma Questionnaire
CTS	WCS Connectedness to Self Subscale
CTW	WCS Connectedness to World Subscale
DMT	*N*,*N*-dimethyltryptamine
DSM	Diagnostic and Statistical Manual of Mental Disorders
DSO	ITQ Disturbances in Self-Organization (CPTSD) Subscale
EBI	Emotional Breakthrough Inventory
EDI	Ego Dissolution Inventory
GED	General Education Development
ICD-11	11th revision of the International Classification of Diseases

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IOS	Inclusion of Other in Self Scale
ISS	Internalized Shame Scale
ITPU	intentional therapeutic psychedelic use
ITQ	International Trauma Questionnaire
LSD	lysergic acid diethylamide
MDMA	3,4-methylenedioxy-methamphetamine
MEQ	Mystical Experiences Questionnaire
OBN	5D-ASC Oceanic Boundlessness Subscale
PIQ	Psychological Insight Questionnaire
PLUR	peace, love, unity, and respect
PTSD	posttraumatic stress disorder / ITQ PTSD Subscale
SCS	Social Connectedness Scale
SEM	structural equation modeling
T1	time 1
T2	time 2
T3	time 3
WCS	Watts Connectedness Scale

1. Introduction

Childhood maltreatment, including physical abuse and neglect, emotional abuse and neglect, and sexual abuse, is highly common globally, and it is implicated in the etiology of numerous mental and physical disorders (Jaffee, 2017; McCrory et al., 2012; Strathearn et al., 2020; Daníelsdóttir et al., 2024). Prospective and cross-sectional studies of naturalistic use of psychedelic drugs as well as clinical trials of psychedelic therapy have suggested safety and mental health benefits of psychedelic use for adults with histories of childhood maltreatment, including lower trauma symptoms, trait shame, depression, and psychological distress (Healy et al., 2021; Card et al., 2023; Nayak et al., 2023; Mathai et al., 2024; Oehen and Gasser, 2022; van der Kolk et al., 2024; Cassidy et al., 2024; Mehmood et al., 2025). Acute psychological mechanisms that predict persisting therapeutic benefits of psychedelic use in this population, however, have yet to be robustly examined. Two salient and common group settings of naturalistic psychedelic use – organized group ceremonies and raves or other electronic dance music events – because of the unique psychosocial environments they comprise and opportunities for social learning they afford, might facilitate psychedelics' capacity to occasion therapeutic adaptations in maladaptive cognitive, behavioral, and neural schemata of self-experience, emotional functioning, and interpersonal relationships associated with childhood maltreatment (Cannon and Greasley, 2021; Little et al., 2018; Newson et al., 2021; Nardou et al., 2023; Hutson, 1999; Olaveson, 2025; Kettner et al., 2021; Perkins and Sarris, 2021; Bathje et al., 2021; Ruffell et al., 2021).

1.1. Childhood maltreatment and complex trauma: Dysregulation of self, emotions, and relationships

Maltreatment in childhood and other forms of early life complex trauma are often referred to as "developmental trauma" in order to highlight the unique, lasting, and global effects of prolonged exposure to trauma on the child's cognitive, affective, social, and biological development (D'Andrea et al., 2012; De Bellis and Zisk, 2014; Spinazzola et al., 2018). The psychobiological effects of traumatic experiences that occur during childhood might be more profound and robust than those that occur during adulthood because they take place during critical periods of neurobiological and psychological development in which the brain and mind are particularly sensitive to environmental input (Andersen et al., 2008; Knudsen, 2004).

One of the primary outcomes of child maltreatment is maladaptive alterations to the development and experience of the self. Multiple longitudinal and cross-sectional studies have shown that childhood maltreatment is associated with high levels of trait (internalized) shame as well as abnormally low self-esteem, self-efficacy, and self-worth in adulthood (Berber Çelik and Odacı, 2020; Kim and Cicchetti, 2004; Pereira et al., 2021; Fowke et al., 2012; Rudy et al., 2022). Another salient outcome of childhood maltreatment is emotional dysregulation, including increased negative affect, heightened emotional reactivity, difficulty tempering emotional responses, inappropriate emotional responses, dissociation (the compartmentalization of painful memories and feelings or the detachment from awareness of emotions and self), and impairments in identifying, understanding, and expressing emotions (Dvir et al., 2014; Lavi et al., 2019; Aust et al., 2013; Hepp et al., 2021; Zlotnick et al., 2001; Reisch et al., 2023). Childhood maltreatment is also associated with impairments in interpersonal functioning and relationships, including difficulties with trust and intimacy, deficient social skills, impaired social cognition, and poor boundaries; these impairments often lead to interpersonal conflict, unstable and dysfunctional relationships, and social anxiety and isolation (Kim et al., 2009; Bolger et al., 1998; Paradis and Boucher, 2010; Shahab et al., 2021; Bruce et al., 2012; Elliott et al., 2005). These three domains – dysregulation of self, emotions, and relationships – are also the three core symptom clusters that distinguish complex posttraumatic stress disorder (CPTSD), a syndrome commonly associated with childhood maltreatment (Cloitre et al., 2018; McElroy et al., 2019).

1.2. Basic psychological effects of psychedelics: Altered sense of self, emotional processing, and social processing

Psychedelic drugs, including classic serotonergic psychedelics such as lysergic acid diethylamide (LSD), psilocybin, mescaline, and *N*,*N*-dimethyltryptamine (DMT)/ayahuasca, as well as non-classic psychedelics such as ketamine and 3,4-methylenedioxy-methamphetamine (MDMA), produce a number of acute and post-acute effects that are especially relevant to their potential utility as therapeutic agents in the treatment of the psychopathological sequelae of child maltreatment. These relevant effects fall across three broad domains – altered sense of self, altered emotional processing, and altered social cognition and behavior – which map to the domains of dysregulation of self, emotions, and relationships associated with childhood maltreatment described above (Vollenweider and Preller, 2020; Vollenweider and Smallridge, 2022).

Psychedelics have robustly been shown to profoundly compromise the normal subjective sense of self and, in high doses, occasion unitive or "mystical" states of selflessness, self-transcendence, or "ego dissolution," frequently leading to enduring positive changes in mood, personality, and self-concept (Griffiths et al., 2018; Letheby and Gerrans, 2017; MacLean et al., 2011; Millière et al., 2018; Vollenweider and Kometer, 2010; Amada et al., 2020). Furthermore, in many studies of psychedelics with both psychiatric and healthy samples, the degree or strength of loss of self directly correlated with beneficial outcomes (Garcia-Romeu et al., 2015; Griffiths et al., 2008; Johnson et al., 2017; Lebedev et al., 2016; Roseman et al., 2018). Psychedelics also acutely and post-acutely alter emotional processing (Weiss et al., 2024; Roseman et al., 2019). In clinical trials, participants have reported acutely experiencing emotions, both positive and negative, more intensely and vividly during psychedelic experiences (Wolff et al., 2020; Zeifman et al., 2023; Kometer et al., 2012; Kraehenmann et al., 2015; Rocha et al., 2019; Orłowski et al., 2024). These emotions are sometimes related to the spontaneous recall and immersive reliving of personal memories laden with intense affect and a subjective experience of emotional catharsis (Wolff et al., 2020). Participants have also reported an improved capacity to accept (rather than avoid) painful or distressing emotions as well as post-acutely being more open to emotions, more willing to engage with negative affect, and more capable of experiencing positive affect (Healy, 2021; Watts et al., 2017; Belser et al., 2017; Godes et al., 2023; Wolff et al., 2020; Zeifman et al., 2023). Furthermore, psychedelics have been found to acutely and post-acutely reduce brain reactivity to negative faces and other emotional stimuli, with a number of studies finding associations between acute and post-acute attenuations of amygdala reactivity to negative emotional stimuli and post-acute increases in positive mood

and well-being (Kometer et al., 2012; Kraehenmann et al., 2015; Rocha et al., 2019; Orłowski et al., 2024; Barrett et al., 2020; Pagni et al., 2024). Finally, psychedelics show a number of acute and post-acute effects on social cognition and behavior. Specifically, psychedelics have been shown to acutely modulate self-other processing and to produce acute and enduring prosocial attitudes and behaviors (Duerler et al., 2022; Preller and Vollenweider, 2019; Schmid and Bershad, 2024; Preller et al., 2018). Psychedelics acutely decrease the differentiation between self and other; increase emotional empathy, altruistic behavior, feelings of closeness and trust, and positive affective responses to social feedback; and decrease sensitivity and reactivity to social rejection, social exclusion, and social pain (Bershad et al., 2024; Dolder et al., 2016; Hysek et al., 2014; Kuypers et al., 2014; Pokorny et al., 2017; Schmid et al., 2014; Kamilar-Britt and Bedi, 2015; Preller et al., 2016; Dolder et al., 2018; Schmid et al., 2015; Frye et al., 2014). Participants in a number of studies have also reported enduring improvements in social functioning following psychedelic experiences, including improved relationships and communication and increased empathy, feelings of closeness to others, desire to interact with others and engage in social activities, and altruistic and other prosocial behavior (Griffiths et al., 2018; Griffiths et al., 2008; Griffiths et al., 2006; Griffiths et al., 2011; Noorani et al., 2018; Schmid and Liechti, 2018; Lyubomirsky, 2022; Barone et al., 2019; Kirkpatrick et al., 2014; Elmer et al., 2024).

Psychedelics also pose some acute and post-acute mental health risks, including acute psychological and physiological distress and post-acute anxious or dissociative symptoms: acute challenging experiences include feelings of panic, confusion, or paranoia, and post-acute challenging experiences, which are predicted by acute challenging experiences, include social disconnection, existential difficulties, or persisting derealization or depersonalization (Barrett et al., 2016; Evans et al., 2023; Simonsson et al., 2023). Four recent studies independently found that childhood trauma exposure was not significantly associated with challenging experiences during the acute effects of psychedelics, suggesting that a history of childhood trauma does not confer higher likelihood of having adverse psychedelic experiences (Nayak et al., 2023; Mathai et al., 2024; Cassidy et al., 2024; Mehmood et al., 2025).

1.3. Naturalistic use of psychedelics in group settings: Ceremonies and raves

Outside the formal clinical use of psychedelics, facilitated group ceremonies are unique naturalistic settings of psychedelic use with a long history that predates Western use of psychedelics (Ruffell et al., 2021; Carod-Artal, 2015; Guzmán, 2008; James et al., 2022; Weiss et al., 2021a). Psilocybin mushroom and ayahuasca ceremonies, which originate among indigenous and mestizo peoples in Central and South America, both typically involve various elements of ritual such as rhythmic music (potentially including drums, rattles, singing, or chanting), a group format, and a leader of the ceremony (the shaman, guide, or facilitator) (Ruffell et al., 2021; Carod-Artal, 2015; Guzmán, 2008; James et al., 2022; Weiss et al., 2021a; Winkelman, 2005; Manuel-Navarrete et al., 2024). Prospective and cross-sectional observational and survey-based studies from across the world have found a wide variety of immediate and long-term mental health and other psychosocial benefits associated with the ceremonial use of psychedelics, including decreased symptoms of depression and anxiety; decreased negative mood and increased positive mood; decreased posttraumatic stress disorder (PTSD) symptoms; changes in personality such as decreased neuroticism and increased extraversion, openness, agreeableness, and conscientiousness; increased social connectedness; and increased quality of life, satisfaction with life, and psychological well-being (Kettner et al., 2021; Ruffell et al., 2021; Weiss et al., 2021a; Weiss et al., 2023; Davis et al., 2019; Jiménez-Garrido et al., 2020; Sarris et al., 2021; Uthaug et al., 2021; Davis et al., 2020a; Netzband et al., 2020; Perkins et al., 2022; Gonzalez et al., 2021; Barbosa et al., 2009; Kiraga et al., 2022). Notably, a placebo-controlled trial of ayahuasca ceremonies found significant reductions in depression, anxiety, and stress after placebo ceremonies, suggesting the group setting itself might confer psychological benefits independent of the psychedelic effects (Gonzalez et al., 2021).

In addition to facilitated group ceremonies, another salient naturalistic setting where many people use psychedelics globally is raves or other electronic dance music events, such as music festivals or nightclubs, which share a number of social, cultural, environmental, structural, formal, ethical, and phenomenological features with traditional psychedelic group ceremonies, such as taking place at night, the use of music designed to occasion altered states of consciousness, the presence of a musical "guide" or "facilitator" of the group experience (such as an ayahuasquero/curandero or a DJ), a communal ethos that intentionally promotes bonding and connectedness, and elements of ritual (Tramacchi, 2003). Rave culture is a global phenomenon, mostly comprising youth who are focused not just on the music but also more broadly on sharing intersubjective "communitas" experiences (sacred experiences of bonding and connectedness), building community, and experimenting with and realizing new forms of the social, with experiences of communitas and connectedness being said to facilitate healing at raves (Cannon and Greasley, 2021; Little et al., 2018; Olaveson, 2025; Weir, 2000; Wagner, 2014; Wark, 2023; St John, 2003). Psychedelics are often consumed to enhance the aesthetic/sensory, spiritual, therapeutic, ecstatic, immersive, and communitas experiences that people seek at raves (Little et al., 2018; Hutson, 1999; Weir, 2000; Wark, 2023; St John, 2003; Taheri et al., 2017). In qualitative interview studies, ravers consistently report a number of personal and communal values associated with rave, such as self-expression, interpersonal tolerance and acceptance, the promotion of self-development, and "PLUR" (peace, love, unity, and respect), all of which create a prosocial atmosphere of radical acceptance, openness, vulnerability, authenticity, and connectedness (Little et al., 2018; Hutson, 1999; Wagner, 2014; Lynch and Badger, 2006). Ravers report that this loving, accepting, open, and authentic social environment promotes feelings of solidarity, bonding, and communitas, and they report increased autonomy, tolerance, capacity for self-expression, sense of belonging, social connectedness, and intimacy in relationships as enduring results of their participation in the culture (Cannon and Greasley, 2021; Lynch and Badger, 2006; Riley et al., 2010). The values and practices of self-expression, tolerance, acceptance, love, and communal bonding might be reinforced by the use of psychedelic drugs, which dissolve boundaries between self and other, enhance emotional experience, lower inhibitions, and promote prosocial attitudes and behaviors (Cannon and Greasley, 2021; Little et al., 2018; Hutson, 1999; Parrott, 2004; Reynolds, 1999).

A small number of studies to date have specifically examined the role of psychedelic experiences in the psychological outcomes of raves. Field studies conducted at multiday music festivals found that, after controlling for demographic variables and the use of other drugs, psychedelic use predicted positive mood, and this effect was mediated by transformative experiences and social connectedness (Forstmann et al., 2020). A recent prospective study similarly found that psychedelic use at multiday festivals predicted transformative experiences and that the relationship might have been mediated by changes to perceptions of reality and oneself (Yudkin et al., 2022). Another retrospective online study found that rave experiences led to personally transformative experiences, an association mediated by experiences of awe; among all drugs, psychedelics were associated with greater awe and subsequent transformative experiences, which in turn were associated with greater bonding to other ravers and increased prosocial behavior (Newson et al., 2021). Finally, 2 recent qualitative studies of psychedelic use at raves reported beneficial effects on emotional experience, sense of self, and interpersonal relationships, including intensification of positive emotions, increases in feelings of love and empathy, processing of difficult emotions and traumatic memories, freedom from social constraints and expanded self-expression, increased self-acceptance, feelings of connectedness to community, and enduring increases in happiness,

compassion, awe, trust, and emotional balance (Milshteyn and Bensimon, 2023; Mosina and Michael, 2024).

1.4. Psychological mechanisms predicting post-acute benefits of psychedelic use

An increasing number of studies have examined acute predictors of post-acute outcomes of psychedelic use in clinical and naturalistic settings. One of the most robust and consistent findings in both clinical and naturalistic settings regarding psychological mechanisms has been the role of ego dissolution or mystical experiences during the psychedelic experience in predicting beneficial psychological, biological, and social outcomes (Griffiths et al., 2018; Garcia-Romeu et al., 2015; Griffiths et al., 2008; Johnson et al., 2017; Lebedev et al., 2016; Roseman et al., 2018; Weiss et al., 2024; Weiss et al., 2021a; Davis et al., 2019; Sarris et al., 2021; Netzband et al., 2020; Perkins et al., 2022; Kiraga et al., 2022; Daldegan-Bueno et al., 2022; Perkins et al., 2021; van Oorsouw et al., 2022; van Oorsouw et al., 2021; Kałużna et al., 2022; Aday et al., 2024). Other acute experiential factors that have been found to predict beneficial outcomes of psychedelic use include psychological insight, emotional breakthrough or catharsis, cognitive reappraisal (e.g., of prior maladaptive beliefs about oneself or one's experiences), psychological flexibility and decentering, reduced experiential avoidance, and the reliving and processing of traumatic or other emotional memories (Roseman et al., 2019; Zeifman et al., 2023; Sarris et al., 2021; Perkins et al., 2021; Feduccia and Mithoefer, 2018; Healy, 2021; Davis et al., 2021; Agin-Liebes et al., 2022; Weiss et al., 2021b; Davis et al., 2020b; González et al., 2020; Zeifman et al., 2020). Interpersonal experiences during psychedelic experiences in group settings such as feeling a close sense of community, feeling a bond and sense of belonging with others in the group, and feeling connected to others in the group, all of which may be described as experiences of "communitas," have also been found to predict beneficial outcomes (Kettner et al., 2021; Perkins et al., 2021; Kałużna et al., 2022). Many studies have also found that a person's intention for psychedelic use, such as having therapeutic or recreational intentions, is an important factor predicting outcomes, with a number of studies reporting that therapeutic, healing, or medicinal intentions uniquely predict mental health benefits (Healy et al., 2021; Bathje et al., 2021; Elmer et al., 2024; Mosina and Michael, 2024; Perkins et al., 2021; Haijen et al., 2018; St Arnaud and Sharpe, 2022; St. Arnaud and Sharpe, 2023; Nygart et al., 2022; Soares et al., 2023; Carhart-Harris et al., 2018; Hartogsohn, 2016; Acevedo et al., 2024; Wolff et al., 2022; Wolff et al., 2024).

1.5. The present study

The present study is a prospective investigation of psychedelic use with therapeutic intent in naturalistic group environments among people with histories of childhood maltreatment and acute psychological mechanisms that predict post-acute outcomes. The study aims to determine: 1) whether psychedelic use with therapeutic intent in two different naturalistic group settings, facilitated group ceremonies/retreats ("ceremonies" hereafter) or electronic dance music events (such as raves, nightclubs, or electronic music festivals; "raves" hereafter), is associated with beneficial outcomes among people with histories of childhood maltreatment; and 2) the acute internal/intrapsychic and social/interpersonal factors during the psychedelic experience that predict post-acute outcomes.

Of the many studies that have examined the mental health and other psychological benefits of psychedelic use in clinical or naturalistic settings, few have specifically investigated the potential benefits or harms of psychedelic use for people with histories of complex trauma in childhood; the present study is significant, therefore, for prospectively investigating whether naturalistic psychedelic use with therapeutic intent might have therapeutic effects in this understudied population. This study builds on an earlier cross-sectional study that found lower self-reported CPTSD symptoms and levels of trait shame among people with childhood maltreatment histories who reported having used psychedelics with therapeutic intent compared to people with comparable histories of maltreatment but who had never used psychedelics with therapeutic intent (Healy et al., 2021). The prospective, longitudinal design of the present study allows for causation to be assessed more directly. The present study also builds on the expanding body of literature reviewed above regarding acute psychological mechanisms of psychedelic experiences that predict post-acute outcomes. Most of these existing studies have investigated factors such as ego dissolution, mystical experiences, psychological insight, emotional breakthrough, or communitas in isolation, while some have compared the relative predictive strength of two or more of these factors. The present study is innovative for examining the relative predictive strength of both personal and interpersonal acute factors, with the potential to expand and deepen the current understanding of the therapeutic mechanisms of action of psychedelics.

1.5.1. Hypotheses

Based on the rationale and aims of the present study described above, the primary hypotheses are:

H1. Following psychedelic use with therapeutic intent in naturalistic group settings (ceremonies and raves), compared to baseline, a) PTSD symptoms will be lower, b) CPTSD symptoms will be lower, c) trait shame will be lower, d) social connectedness will be higher, and e) general connectedness will be higher.

H2. Acute psychological factors during psychedelic experiences at ceremonies and raves, including personal experiences (ego dissolution, oceanic boundlessness, emotional breakthrough, and psychological insight) and interpersonal experiences (interpersonal closeness and communitas/group bonding), will be associated with the changes in outcome variables from baseline to follow-up hypothesized in H1.

2. Method

2.1. Participants

2.1.1. Recruitment

Participants were recruited via multiple streams: a number of psychedelic retreat centers and several other organizations involved in psychedelics and/or electronic dance music (e.g., harm reduction organizations, drug policy reform activist groups, local psychedelic societies, etc.) distributed information about the study to their member networks; advertisements were posted on various social media websites (e.g., Reddit, Facebook, and Instagram); and information about the study was disseminated by word of mouth.

2.1.2. Compensation

Participants were compensated at each time point, with a total compensation of $30: $5 for completing the first (T1) questionnaire, $10 for completing the second (T2) questionnaire, and $15 for completing the third (T3) questionnaire.

2.1.3. Inclusion and exclusion criteria

Inclusion criteria were that participants be 18 years or older, be fluent in English, be planning to attend a facilitated group psychedelic ceremony or to take a psychedelic at an electronic dance music event, endorse therapeutic intentions for their planned psychedelic use, and endorse a history of childhood maltreatment. To reduce the likelihood of medical emergencies during the study, a history of non-substance-induced psychosis or a diagnosis of schizophrenia or bipolar disorder were exclusion criteria, which were assessed in the pre-screening questionnaire.

2.2. Measures/materials

2.2.1. Demographics questionnaire

Age, identification with sex assigned at birth, gender, race, sexual orientation, marital status, socioeconomic status of childhood home, education, psychiatric diagnoses, current use of psychiatric medication, substance use history, and prior history of intentional therapeutic psychedelic use (ITPU), including substances used, number of occasions of use, timeframe of most recent occasion of use, and subjective impact of use).

2.2.2. Childhood trauma questionnaire (CTQ)

A 28-item retrospective self-report scale assessing exposure to and severity of childhood maltreatment across 5 subscales: physical abuse, sexual abuse, emotional abuse, physical neglect, and emotional neglect (Bernstein et al., 2003).

2.2.3. International trauma questionnaire (ITQ)

An 18-item measure assessing PTSD (PTSD subscale) and CPTSD ("Disturbances in Self-Organization" [DSO] subscale) symptomatology as described in the *International Classification of Diseases, 11th revision* (Cloitre et al., *2018*).

2.2.4. Internalized shame scale (ISS)

A 30-item self-report measure comprising 24 negatively worded items assessing internalized (trait) shame and 6 positively worded items to counteract a negative response set (Cook, 2001).

2.2.5. Social connectedness scale (SCS)

An 8-item self-report measure of negatively worded items assessing feelings of general belongingness and connectedness to others, reverse scored with higher scores indicating greater social connectedness and belongingness (Lee and Robbins, 1995).

2.2.6. Watts connectedness scale (WCS)

A 19-item self-report measure assessing feelings of general connectedness (WCS) as well as 3 subscales representing connectedness to self (CTS), others (CTO), and world (CTW) during the past 2 weeks (Watts et al., 2022).

2.2.7. Ego dissolution inventory (EDI)

An 8-item self-report measure assessing ego-dissolution experiences and the associated feeling of increased union with one's surroundings (Nour et al., 2016).

2.2.8. 5 dimensions of altered states of consciousness (5D-ASC)-oceanic boundlessness scale (OBN)

A 27-item measure assessing emotionally positive experiences of derealization/depersonalization, experiences of psychical and physical boundary dissolution, and spiritual experiences of unity and bliss that correspond to mystical experiences described in psychological and religious literature (Dittrich, 1998).

2.2.9. Emotional breakthrough inventory (EBI)

A 6-item self-report measure assessing experiences of emotional breakthrough or catharsis, especially during a psychedelic experience (Roseman et al., 2019).

2.2.10. Psychological lnsight questionnaire (PIQ)

A 23-item self-report measure assessing the intensity and range of psychologically insightful experiences during a psychedelic experience (Davis et al., 2021).

2.2.11. Inclusion of other in self scale (IOS)

A single-item, pictorial measure assessing interpersonal closeness (Aron et al., 1992).

2.2.12. Communitas scale (COMS)

An 8-item measure assessing acute relational experiences of togetherness and shared humanity during a group psychedelic experience, adapted for ceremonies and raves (Kettner et al., 2021).

2.3. Procedure

Applicants interested in participating in the study first completed an online pre-screening questionnaire to determine eligibility; preliminarily eligible respondents were invited to a screening video call with the primary investigator (C. J. H.) to confirm eligibility, after successful completion of which they were enrolled in the study as participants. Data were collected across 3 time points (Fig. 1).

All self-report measures were completed online via Qualtrics without time constraints. The first round of measures (T1) was sent 30 days prior to the date of the participant's planned psychedelic experience (in the case of participants attending multiday retreats or festivals, the date of the first day of the retreat/festival), and participants were instructed to complete those measures within the month before the date of their planned experience (or the start of the retreat/festival). After granting informed consent, participants completed a demographics questionnaire, the CTQ to assess childhood maltreatment exposure and severity, the ITQ to assess baseline PTSD symptoms (PTSD) and CPTSD symptoms (DSO), the ISS to assess baseline trait shame, the SCS to assess baseline social connectedness, and the WCS to assess baseline general connectedness. The second round of measures (T2) was sent before the planned experience, and participants were instructed to complete those measures within 2 days (48 h) after the experience (in the case of participants attending multiday retreats or festivals, within 2 days after the last day of the retreat/festival). Participants completed the EDI, OBN, EBI, PIQ, IOS, and COMS to assess various internal/intrapsychic and social/interpersonal factors of their psychedelic experience. Participants also completed a questionnaire regarding variables related to the experience, such as the physical setting (indoor/outdoor), the type of psychedelic drug used and the dose, and the number of other people present. Participants attending multiday retreats or festivals during which they had multiple psychedelic experiences were instructed to answer to the T2 measures based on the single psychedelic experience during the retreat or festival that they found the most therapeutic. The third round of measures (T3) was sent 45 days after the psychedelic experience (or after the date of the last day of a multiday retreat/festival), and participants were instructed to complete those measures approximately 2 months after the experience. Participants again completed the ITQ, ISS, SCS, and WCS. The final page of each survey thanked participants for taking part in the study and provided the contact information of the principal investigator and their supervisor as well as information for referrals to mental health providers. The study was granted ethical approval by BRANY SBER IRB (protocol #22–132-1244).

2.4. Data analysis

Statistical analyses were conducted using IBM SPSS v25.0 unless otherwise indicated (IBM Corp, 2017). Descriptive statistics were calculated for all variables. Data were inspected for skewness and outliers. Data were also inspected for duplicate responses and invalid responding and removed or corrected as necessary and appropriate.

Fig. 1. Study protocol.

Only the data of those participants who completed at least part of all 3 surveys were included in analyses. For H1, paired-samples *t*-tests were used to assess differences between baseline (T1) and follow-up (T3) PTSD scores (H1a), DSO scores (H1b), ISS scores (H1c), SCS scores (H1d), and WCS scores (H1e). For H2, bivariate correlation tests were used to assess the relationships between scores in acute subjective measures (OBN, EDI, PIQ, EBI, IOS, and COMS) and residualized change scores from baseline to follow-up on outcome measures (PTSD, DSO, ISS, SCS, and WCS). A Monte Carlo simulation of 100,000 trials was conducted using the R package MASS to assess the significance of the observed correlations (Venables and Ripley, 2002). The H2 bivariate correlation tests were exploratory in that they were designed not to test specific IV-DV pairings but rather to assess whether an overall pattern of significant relationships existed as hypothesized, with the primary interest being in evaluating whether the number of significant correlations would exceed what would be expected by chance. Bonferroni correction, a conventional and conservative method for controlling multiple comparisons, assumes that variables being tested are independent and can thereby reduce statistical power and inflate Type II error, and so it is not an appropriate approach to apply when assessing an overall pattern of effects in a correlation matrix of highly interrelated variables. Monte Carlo simulation, by contrast, directly estimates the likelihood of observing the specific pattern of significance (number of significant correlations) under the null hypothesis, making it a more accurate and empirically justified approach for controlling Type I error in this context. Because our analysis sought to assess the overall likelihood of any observed pattern, rather than the significance of individual tests; our variables were interrelated and not independent; and Monte Carlo simulation provides a direct, empirical estimation of the probability of obtaining the observed number of significant correlations by chance, we determined that Monte Carlo was the more appropriate method. This approach ensures rigorous Type I error control while maintaining robust sensitivity to true relationships in the data. Additional multiple regression tests with scores in acute subjective measures as covariates and residualized change scores in outcome measures as the dependent variable were used to assess whether any acute subjective measures emerged as independent predictors of change in outcome measures. Composite variables were also calculated for overall change in outcomes (comprising the sum of the standardized residualized change scores from T1 to T3 in each outcome variable, with SCS and WCS reverse coded such that the composite variable was unidirectional with negative scores representing improvement) and overall acute subjective effects of the psychedelic experience (comprising the sum of the standardized scores in each acute effects variable) for use in bivariate correlation tests and multiple regression tests. Exploratory path analyses were conducted with structural equation modeling using SmartPLS v4.0.9.6 (Ringle et al., 2025).

3. Results

3.1. Participant characteristics

Recruitment took place from January 25 to December 31, 2023, and data collection with enrolled participants took place from January 27, 2023 to February 28, 2024. During that time, 3527 people registered through the recruitment website and received the link to the pre-screening questionnaire; of those, 2374 started and/or completed the pre-screening questionnaire; of those, 596 were preliminarily eligible and invited for a screening video call; of those, 181 completed the screening video call; of those, 104 were eligible and enrolled in the study. Of the 104 enrolled participants, 11 completed no questionnaires, 7 completed only T1, 1 completed only T1 and T2, and the final sample of 85 participants completed all three questionnaires (T1, T2, and T3; 1 participant who did not complete the ISS, SCS, or WCS at T3 and 1 participant who did not complete the SCS or WCS at T3 were included in final analyses). A figure that graphically presents the details of the stepwise process of arriving at the final sample of 85 participants from the initial 3527 applicants has been added to the Supplementary Material (Fig. S1). Median completion times for T1, T2, and T3 were, respectively: 18 min 41 s (interquartile range [IQR]: 12 min 56 s to 30 min 42 s), 11 min 6 s (IQR: 8 min 31 s to 19 min 38 s), and 10 min 10 s (IQR: 7 min 36 s to 19 min 25 s). Median submission times for T1, T2, and T3 with respect to participants' index psychedelic experiences were, respectively: 7.37 days before the start of the experience (IQR: 1.85 to 22.24), 0.73 days after the end of the experience (IQR: 0.49 to 1.52), and 60.79 days after the end of the experience (IQR: 55.19 to 65.82).

3.1.1. Demographics and baseline variables

The mean age of participants was 36.01 ($SD = 13.81$) years, and the majority of participants identified as White (72.9 %), cisgender (90.6 %), woman (58.8 %), and heterosexual (57.6 %). A large proportion of the sample was LGBTQ, with 8.2 % identifying as transgender and 42.4 % identifying as non-heterosexual. The majority of participants endorsed at least one self-reported psychiatric condition, most commonly depression (61.2 %) and/or anxiety (55.3 %), and 17.6 % endorsed no psychiatric condition. All participants endorsed some lifetime history of substance use, most commonly cannabis (98.8 %), alcohol (97.6 %), and caffeine (97.6 %). Full demographics information is reported in Table 1.

Across the entire sample, 82.4 % of participants scored in the severe range on at least one of the CTQ maltreatment type subscales. CTQ scores and baseline (T1) PTSD scores, DSO scores, ISS scores, SCS scores, and WCS scores showed no significant differences by setting (i.e., between ceremony and rave participants).

3.1.2. Prior history of intentional therapeutic psychedelic use

The majority of participants (87.1 %) endorsed a prior history of intentional therapeutic psychedelic use (ITPU). Full information on prior history of ITPU is reported in Table S1 in the Supplementary Material. Demographic variables and CTQ scores were not significantly different between participants with and without a prior history of ITPU. At baseline (T1), the ITPU group reported significantly lower DSO scores ($t(82) = 2.045$, $M_{Diff} = -3.44$, 95 % CI[−6.78, −0.09], $p = .044$, $d = 0.64$) and ISS scores ($t(82) = 2.164$, $M_{Diff} = -12.87$, 95 % CI[−24.70, −1.04], $p = .033$, $d = 0.72$) and significantly higher WCS scores ($t(82) = 2.620$, $M_{Diff} = 13.20$, 95 % CI[3.18, 23.22], $p = .010$, $d = 0.92$) than the non-ITPU group with moderate-to-large effect sizes; baseline PTSD and SCS scores were not significantly different between the ITPU and non-ITPU groups.

3.1.3. Study index psychedelic experience

The sample comprised 31 (36.5 %) ceremony participants and 54 (63.5 %) rave participants. The drugs most commonly reported having been used were psilocybin mushrooms/truffles (38.8 %), ayahuasca/yagé (24.7 %), MDMA (20.0 %), and LSD (18.8 %), and the majority of participants reported taking a moderate dose (52.9 %). The majority of participants reported that there was music during their experience (96.5 %) and that they danced during their experience (70.6 %). Full information on participants' study index psychedelic experience is reported in Table 2.

There were no significant differences in scores in any of the measures of acute subjective effects (COMS, IOS, PIQ, EDI, EBI, or OBN) by setting. Various CTQ scores (total and subscale scores) and baseline (T1) scores in outcome variables showed significant correlations with various variables of acute subjective effects (Tables S2 and S3 in the Supplementary Material).

3.2. Hypotheses

Hypothesis 1 was confirmed. Compared to baseline (T1), at follow-up (T3) participants reported significantly lower PTSD scores ($t(84) = 9.514$, $M_{Diff} = -6.19$, 95 % CI[−7.48, −4.89], $p < .001$, $d = 1.03$), DSO

Table 1
Demographic characteristics.

Variable	Whole sample ($N = 85$) n (%)	Ceremony participants ($N = 31$) n (%)	Rave participants ($N = 54$) n (%)	p (t or X^2)
Age in years, Mean (SD)	36.01 (13.81)	43.81 (18.40)	31.54 (7.39)	**<.001**
Identifies with sex assigned at birth				.195
Yes	77 (90.6 %)	30 (96.8 %)	47 (87.0 %)	
No	7 (8.2 %)	1 (3.2 %)	6 (11.1 %)	
Gender identity				.196
Woman	50 (58.8 %)	21 (67.7 %)	29 (53.7 %)	
Man	28 (32.9 %)	10 (32.3 %)	18 (33.3 %)	
Non-binary/Genderqueer	5 (5.9 %)	0 (0.0 %)	5 (9.3 %)	
Other	2 (2.4 %)	0 (0.0 %)	2 (3.7 %)	
Racial, ethnic, or cultural background				.428
American Indian	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
Black	2 (2.4 %)	0 (0.0 %)	2 (3.7 %)	
Asian/Asian American	7 (8.2 %)	1 (3.2 %)	6 (11.1 %)	
Latinx/Hispanic	10 (11.8 %)	3 (9.7 %)	7 (13.0 %)	
Pacific Islander	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
South Asian	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
Arab/Middle Eastern/North African	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
White	62 (72.9 %)	26 (83.9 %)	36 (66.7 %)	
Mixed race/Multiracial	4 (4.7 %)	1 (3.2 %)	3 (5.6 %)	
Sexual orientation				**.039**
Heterosexual	49 (57.6 %)	24 (77.4 %)	25 (46.3 %)	
Gay	2 (2.4 %)	1 (3.2 %)	1 (1.9 %)	
Lesbian	2 (2.4 %)	1 (3.2 %)	1 (1.9 %)	
Bisexual	18 (21.2 %)	2 (6.5 %)	16 (29.6 %)	
Pansexual	10 (11.8 %)	2 (6.5 %)	8 (14.8 %)	
Asexual	1 (1.2 %)	1 (3.2 %)	0 (0.0 %)	
Other	3 (3.5 %)	0 (0.0 %)	3 (5.6 %)	
Marital status				**.009**
Single, never married	26 (30.6 %)	10 (32.3 %)	16 (29.6 %)	
Married	17 (20.0 %)	12 (38.7 %)	5 (9.3 %)	
Committed partner	25 (29.4 %)	6 (19.4 %)	19 (35.2 %)	
Separated	3 (3.5 %)	0 (0.0 %)	3 (5.6 %)	
Divorced	7 (8.2 %)	3 (9.7 %)	4 (7.4 %)	
Widowed	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
Living together	6 (7.1 %)	0 (0.0 %)	6 (11.1 %)	
Socioeconomic status of childhood home				.198
Lower ($24,999 or less)	10 (11.8 %)	2 (6.5 %)	8 (14.8 %)	
Lower Middle ($25,000–$49,999)	17 (20.0 %)	5 (16.1 %)	12 (22.2 %)	
Middle ($50,000–$74,999)	23 (27.1 %)	7 (22.6 %)	16 (29.6 %)	
Upper Middle ($75,000–$149,999)	25 (29.4 %)	11 (35.5 %)	14 (25.9 %)	
Upper ($150,000 or greater)	9 (10.6 %)	6 (19.4 %)	3 (5.6 %)	
Highest level of education completed				**.021**
Less than High School/GED	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	
High School/GED	1 (1.2 %)	1 (3.2 %)	0 (0.0 %)	
Some College	9 (10.6 %)	4 (12.9 %)	5 (9.3 %)	
Associate's Degree	8 (9.4 %)	1 (3.2 %)	7 (13.0 %)	
Bachelor's Degree	37 (43.5 %)	10 (32.3 %)	27 (50.0 %)	
Master's Degree	22 (25.9 %)	14 (45.2 %)	8 (14.8 %)	
Doctorate Degree	4 (4.7 %)	1 (3.2 %)	3 (5.6 %)	
Other	4 (4.7 %)	0 (0.0 %)	4 (7.4 %)	
Psychiatric diagnoses[†]				
Depression	52 (61.2 %)	16 (51.6 %)	36 (66.7 %)	.170
Bipolar/Manic Depressive Illness	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	–
Anxiety	47 (55.3 %)	11 (35.5 %)	36 (66.7 %)	**.005**
Schizophrenia	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	–
Substance abuse	26 (30.6 %)	7 (22.6 %)	19 (35.2 %)	.225
Eating disorder	12 (14.1 %)	5 (16.1 %)	7 (13.0 %)	.687
Attention Deficit Disorder	26 (30.6 %)	6 (19.4 %)	20 (37.0 %)	.089
Anger problems	12 (14.1 %)	5 (16.1 %)	7 (13.0 %)	.687
Other mental illness	8 (9.4 %)	2 (6.5 %)	6 (11.1 %)	.479
None	15 (17.6 %)	7 (22.6 %)	8 (14.8 %)	.366
Current use of psychiatric medication				**.049**
Yes	18 (21.2 %)	3 (9.7 %)	15 (27.8 %)	
No	67 (78.8 %)	28 (90.3 %)	39 (72.2 %)	
Lifetime substance use history[†]				
Alcohol	83 (97.6 %)	31 (100.0 %)	52 (96.3 %)	.278
Tobacco	63 (74.1 %)	18 (58.1 %)	45 (83.3 %)	**.010**
Caffeine	83 (97.6 %)	30 (96.8 %)	53 (98.1 %)	.687
Cannabis	84 (98.8 %)	30 (96.8 %)	54 (100.0 %)	.184
Hallucinogens	81 (95.3 %)	28 (90.3 %)	53 (98.1 %)	.101
Inhalants	33 (38.8 %)	7 (22.6 %)	26 (48.1 %)	**.020**

(*continued on next page*)

Table 1 (*continued*)

Variable	Whole sample (*N* = *85*) n (%)	Ceremony participants (*N* = 31) n (%)	Rave participants (*N* = 54) n (%)	*p* (*t* or X^2)
Opioids	27 (31.8 %)	7 (22.6 %)	20 (37.0 %)	.168
Sedatives, hypnotics, or anxiolytics	28 (32.9 %)	8 (25.8 %)	20 (37.0 %)	.289
None of the above	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	–
History of intentional therapeutic psychedelic use (ITPU)				**.003**
Yes	74 (87.1 %)	23 (74.2 %)	51 (94.4 %)	
No	10 (11.8 %)	8 (25.8 %)	2 (3.7 %)	

GED: General Education Development (equivalent to U.S. high school diploma).
Significant relationships with setting (ceremony or rave) are indicated in bold font.
† Participants could select multiple responses for this question.

scores ($t(84) = 9.413$, $M_{Diff} = -4.88$, 95 % CI[−5.91, −3.85], $p < .001$, $d = 1.02$), and ISS scores ($t(83) = 10.271$, $M_{Diff} = -17.56$, 95 % CI [−20.96, −14.16], $p < .001$, $d = 1.12$) and significantly higher SCS scores ($t(82) = 6.656$, $M_{Diff} = 8.11$, 95 % CI[5.69, 10.53], $p < .001$, $d = 0.73$) and WCS scores ($t(82) = 8.274$, $M_{Diff} = 15.10$, 95 % CI[11.47, 18.74], $p < .001$, $d = 0.91$), all with large effect sizes (Fig. 2a). These results remained statistically significant after post-hoc Bonferroni correction for multiple comparisons. There were no significant differences between ceremony and rave participants in T3 scores or magnitude of change in scores from T1 to T3 in any outcome (Fig. 2b).

Hypothesis 2 was also confirmed. Scores in 5 out of 6 acute subjective psychedelic effects variables (COMS, PIQ, EDI, EBI, and OBN, but not IOS) significantly correlated with a composite outcome change variable representing overall change in outcomes (Fig. 3a), and a composite acute effects variable representing overall acute subjective effects significantly correlated with residualized change scores from T1 to T3 in all 5 outcome variables as well as with the composite outcome change variable (Fig. 3b).

Every acute effects variable significantly correlated with residualized change from T1 to T3 in at least 1 outcome variable, and residualized change in every outcome variable significantly correlated with at least 1 acute effects variable. Out of 30 total correlation values, 16 were statistically significant. All correlations between acute effects variables and residualized change in outcome variables from T1 to T3 are reported in

Table 2
Characteristics of the index psychedelic experience of the study.

Variable	Whole sample (*N* = 85) n (%)	Ceremony participants (*N* = 31) n (%)	Rave participants (*N* = 54) n (%)	*p* (X^2)
Setting				–
Ceremony/retreat	31 (36.5 %)	–	–	
Rave/festival/nightclub/dance music event	54 (63.5 %)	–	–	
Physical setting				.332
Indoors (inside a building)	49 (57.6 %)	20 (64.5 %)	29 (53.7 %)	
Outdoors (in nature or open space)	36 (42.4 %)	11 (35.5 %)	25 (46.3 %)	
Drug type†				
Psilocybin mushrooms/truffles	33 (38.8 %)	8 (25.8 %)	25 (46.3 %)	.062
Ayahuasca/yagé	21 (24.7 %)	21 (67.7 %)	0 (0.0 %)	**<.001**
LSD/"acid"	16 (18.8 %)	1 (3.2 %)	15 (27.8 %)	**.005**
Mescaline/peyote/San Pedro	1 (1.2 %)	1 (3.2 %)	0 (0.0 %)	.184
DMT (extracted)	1 (1.2 %)	0 (0.0 %)	1 (1.9 %)	.446
MDMA/"ecstasy"	17 (20.0 %)	2 (6.5 %)	15 (27.8 %)	**.018**
Ketamine	9 (10.6 %)	0 (0.0 %)	9 (16.7 %)	**.016**
5-MeO-DMT/"bufo"	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	–
2C-B	2 (2.4 %)	0 (0.0 %)	2 (3.7 %)	.278
Other	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	–
Approximate dose				**.031**
Microdose (i.e., a dose with effects that could not be perceived)	2 (2.4 %)	0 (0.0 %)	2 (3.7 %)	
Small dose	11 (12.9 %)	0 (0.0 %)	11 (20.4 %)	
Moderate dose	45 (52.9 %)	20 (64.5 %)	25 (46.3 %)	
Large dose	27 (31.8 %)	11 (35.5 %)	16 (29.6 %)	
Approximate number of other people present				**<.001**
1–10	16 (18.8 %)	13 (41.9 %)	3 (5.6 %)	
11–20	15 (17.6 %)	15 (48.4 %)	0 (0.0 %)	
21–50	7 (8.2 %)	3 (9.7 %)	4 (7.4 %)	
51–200	8 (9.4 %)	0 (0.0 %)	8 (14.8 %)	
201–1000	22 (25.9 %)	0 (0.0 %)	22 (40.7 %)	
1000+	17 (20.0 %)	0 (0.0 %)	17 (31.5 %)	**.020**
Music during the experience				
Yes	82 (96.5 %)	28 (90.3 %)	54 (100.0 %)	
No	3 (3.5 %)	3 (9.7 %)	0 (0.0 %)	**<.001**
Dancing during the experience				
Yes	60 (70.6 %)	7 (22.6 %)	53 (98.1 %)	
No	25 (29.4 %)	24 (77.4 %)	1 (1.9 %)	

LSD: lysergic acid diethylamide; DMT: *N*,*N*-dimethyltryptamine; MDMA: 3,4-methylenedioxy-methamphetamine; 5-MeO-DMT: 5-methoxy-*N*,*N*-dimethyltryptamine; 2C-B: 2,5-dimethoxy-4-bromophenethylamine.
Significant relationships with setting (ceremony or rave) are indicated in bold font.
† Multiple responses could be selected for this question.

Table 3.

In a Monte Carlo simulation of 100,000 trials, examining correlations between 6 independent and 5 dependent variables with a sample size of 85, a range of 0 to 9 significant correlations were observed by chance ($M = 1.50$, $SD = 1.20$); the present finding of 16 significant correlations, therefore, is highly unlikely to have occurred due to random chance ($p < .00001$).

Multiple regression tests with all 6 variables of acute subjective effects as covariates and each of the 5 residualized change scores from T1 to T3 in outcome variables as well as the composite outcome change variable described above as dependent variables found no significant independent predictors of outcomes among acute subjective effects variables. An additional multiple regression test with the composite outcome change variable described above as the dependent variable and all demographic variables as covariates in the first step of the model; setting, dose, and drug type of the study index psychedelic experience added in the second step of the model; and all 6 variables of acute subjective effects added in the third step of the model found that the acute subjective effects of the psychedelic experience significantly accounted for 21.1 % of additional variance in the third step of the model ($\Delta R^2 = 0.211$, $F(6,52) = 3.014$, $p = .013$); full regression test results are reported in Table S4 in the Supplementary Material.

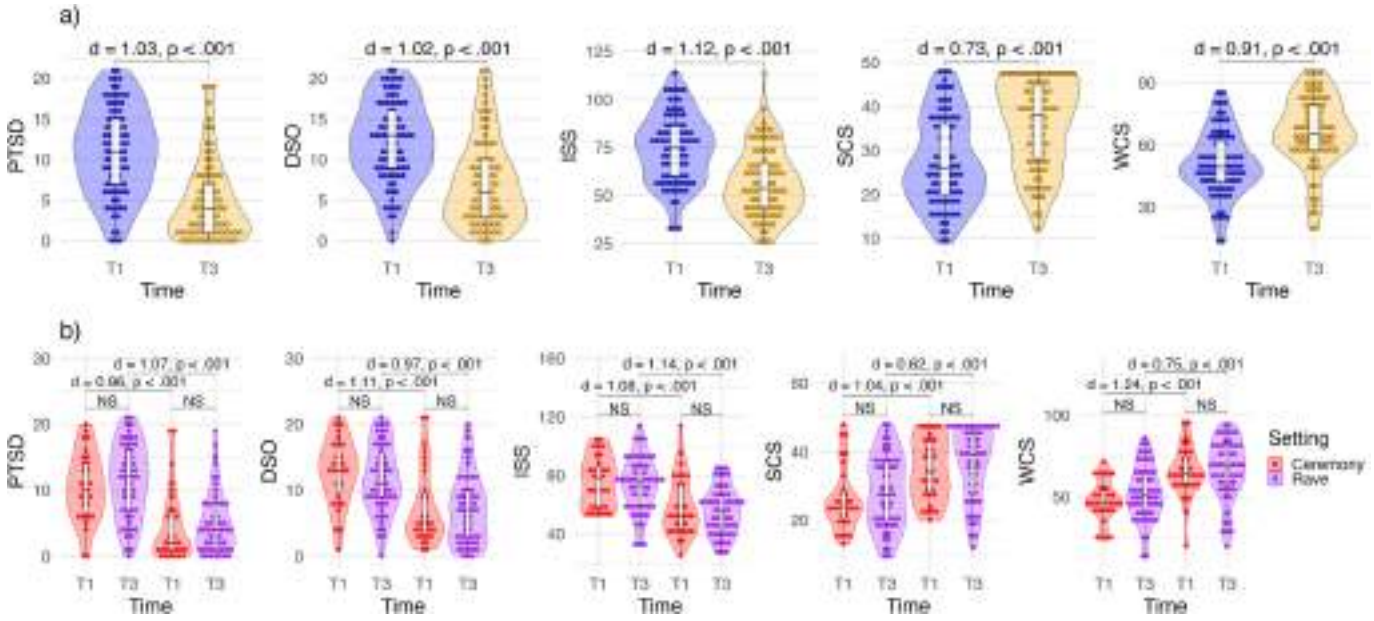

Fig. 2. Changes in PTSD, DSO, ISS, SCS, and WCS scores from T1 to T3 a) across the whole group and b) by setting.
PTSD: International Trauma Questionnaire Posttraumatic Stress Disorder Subscale; DSO: International Trauma Questionnaire Disturbances in Self-Organization Subscale; ISS: Internalized Shame Scale; SCS: Social Connectedness Scale; WCS: Watts Connectedness Scale (General Connectedness).

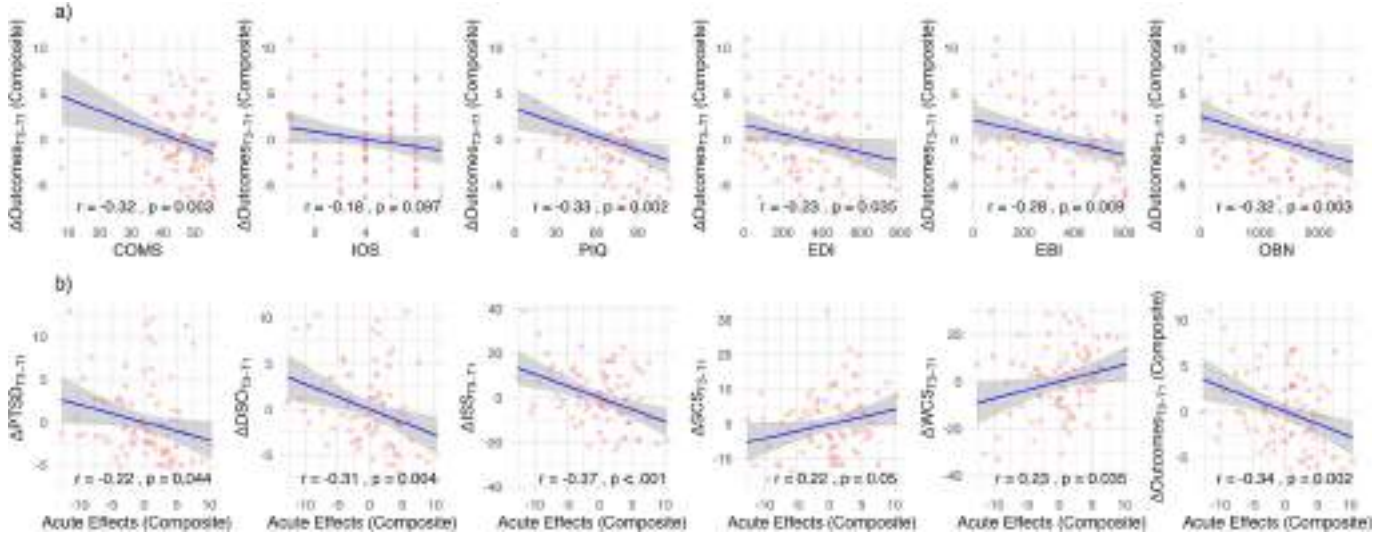

Fig. 3. Correlations between a) composite residualized change scores from T1 to T3 in all outcome variables and COMS, IOS, PIQ, EDI, EBI, and OBN scores and b) composite acute subjective effects scores and residualized change scores from T1 to T3 in PTSD, DSO, ISS, SCS, and WCS; gray bands around the regression lines represent 95 % confidence intervals.
COMS: Communitas Scale; IOS: Inclusion of Other in Self Scale; PIQ: Psychological Insight Scale; EDI: Ego Dissolution Inventory; EBI: Emotional Breakthrough Inventory; OBN: 5 Dimensions of Altered States of Consciousness (5D-ASC)-Oceanic Boundlessness Scale; PTSD: International Trauma Questionnaire Posttraumatic Stress Disorder Subscale; DSO: International Trauma Questionnaire Disturbances in Self-Organization Subscale; ISS: Internalized Shame Scale; SCS: Social Connectedness Scale; WCS: Watts Connectedness Scale (General Connectedness).

Table 3
Correlations among scores in acute effects variables and residualized change scores in outcomes variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. COMS	–												
2. IOS	.62***	–											
3. PIQ	.65***	.42***	–										
4. EDI	.56***	.46***	.62***	–									
5. EBI	.54***	.30**	.82***	.58***	–								
6. OBN	.66***	.47***	.72***	.83***	.73***	–							
7. Acute Effects (Composite)	.82***	.67***	.87***	.83***	.81***	.90***	–						
8. $\Delta PTSD_{T3\text{-}T1}$	−.23*	−.05	−.24*	−.11	−.23*	−.21	−.22*	–					
9. $\Delta DSO_{T3\text{-}T1}$	−.32**	−.16	−.24*	−.29**	−.18	−.33**	−.31**	.50***	–				
10. $\Delta ISS_{T3\text{-}T1}$	−.30**	−.23*	−.33**	−.31**	−.29**	−.37**	−.37***	.49***	.68***	–			
11. $\Delta SCS_{T3\text{-}T1}$	.24*	.14	.20	.09	.20	.19	.22*	−.40***	−.58***	−.54***	–		
12. $\Delta WCS_{T3\text{-}T1}$	.19	.13	.30**	.11	.23*	.18	.23*	−.48***	−.52***	−.57***	.56***	–	
13. $\Delta Outcomes_{T3\text{-}T1}$ (Composite)	−.33**	−.18	−.33**	−.23*	−.29**	−.32**	−.34**	.73***	.83***	.83***	−.78***	−.79***	–

Statistical significance: *$p < .05$; **$p < .01$; ***$p < .001$.
COMS: Communitas Scale; IOS: Inclusion of Other in Self Scale; PIQ: Psychological Insight Scale; EDI: Ego Dissolution Inventory; EBI: Emotional Breakthrough Inventory; OBN: 5 Dimensions of Altered States of Consciousness (5D-ASC)-Oceanic Boundlessness Scale; PTSD: International Trauma Questionnaire Posttraumatic Stress Disorder Subscale; DSO: International Trauma Questionnaire Disturbances in Self-Organization Subscale; ISS: Internalized Shame Scale; SCS: Social Connectedness Scale; WCS: Watts Connectedness Scale (General Connectedness).

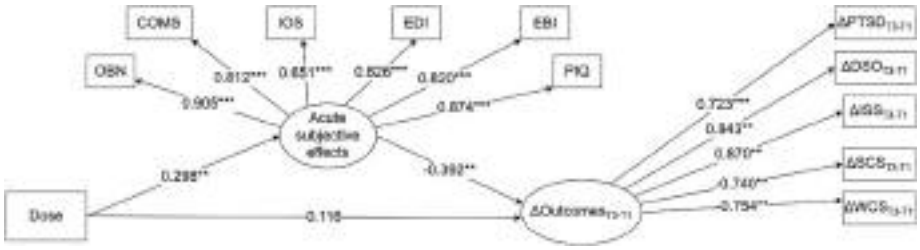

Fig. 4. Structural equation model of the relationships between drug dose of the study index psychedelic experience, acute subjective effects, and residualized change in outcomes from T1 to T3.
Statistical significance: *$p < .05$; **$p < .01$; ***$p < .001$.
COMS: Communitas Scale; IOS: Inclusion of Other in Self Scale; PIQ: Psychological Insight Scale; EDI: Ego Dissolution Inventory; EBI: Emotional Breakthrough Inventory; OBN: 5 Dimensions of Altered States of Consciousness (5D-ASC)-Oceanic Boundlessness Scale; PTSD: International Trauma Questionnaire Posttraumatic Stress Disorder Subscale; DSO: International Trauma Questionnaire Disturbances in Self-Organization Subscale; ISS: Internalized Shame Scale; SCS: Social Connectedness Scale; WCS: Watts Connectedness Scale (General Connectedness).

Finally, an exploratory path analysis was conducted using structural equation modeling in order to determine the relationships between drug dose of the study index psychedelic experience, acute subjective effects, and residualized change in outcomes from T1 to T3. In a model that showed good fit (*SRMR* = 0.077), dose significantly predicted acute subjective effects ($\beta = 0.298$, $p = .005$), and acute subjective effects significantly predicted outcomes ($\beta = -0.392$, $p = .007$), but dose did not significantly predict outcomes after accounting for acute subjective effects ($\beta = 0.116$, $p = .347$; Fig. 4).

4. Discussion

This prospective, longitudinal study sought to investigate 2 primary questions: first, whether adults with histories of childhood maltreatment who were planning to use psychedelic drugs with therapeutic intent in naturalistic group settings – specifically, at facilitated group ceremonies or at raves or other electronic dance music events – would see enduring psychological benefits 2 months after their experiences, namely reductions in symptoms of PTSD and CPTSD, reductions in trait (internalized) shame, and increases in connectedness to themselves, other people, and the world; and second, whether the intensity and quality of the subjective dimensions of the acute psychedelic experience would be associated with the magnitude of any observed post-acute psychological benefits. Our first hypothesis was confirmed: from the month before to 2 months after psychedelic experiences, participants reported significant improvements with large effect sizes in PTSD and CPTSD symptoms, trait shame, social connectedness, and general connectedness. Our second hypothesis was also confirmed: every dimension of the acute subjective effects of the psychedelic experience significantly correlated with improvements from baseline to follow-up in at least 1 outcome, improvements in every outcome significantly correlated with at least 1 dimension of the acute subjective psychedelic effects, and overall acute subjective psychedelic effects significantly correlated with overall improvements in outcomes.

The findings of this study have both clinical and theoretical implications. Clinically, this study is the first to find prospective, longitudinal improvements in trauma symptoms, shame, and connectedness among adults with childhood maltreatment histories following psychedelic experiences with therapeutic intent in naturalistic settings. These results provide strong rationale for proposing that clinical use of psychedelics in the model of psychedelic-assisted psychotherapy might be well suited for treating adults with maltreatment histories who present with PTSD or CPTSD as well as other sequelae like trait shame or general feelings of disconnection from themselves, other people, and the world. In addition to the main longitudinal results, this study also replicated the findings of Healy et al., 2021 that, at baseline, participants with prior histories of using psychedelics with therapeutic intent reported significantly lower levels of CPTSD symptoms and trait shame (as well as significantly higher levels of general connectedness, which was not assessed in the prior study) than participants who had never used psychedelics with therapeutic intent. This replication provides robust evidence that intentional therapeutic psychedelic use might confer durable benefits for complex trauma symptoms and shame among people with histories of childhood maltreatment. Given that most participants endorsed prior

intentional therapeutic psychedelic use and yet saw further benefit in the present study, the durability of such benefit might be questioned; one proposal is that early therapeutic experiences with psychedelics do in fact produce lasting mental health improvements, after which both the trajectory of symptom remission and the phenomenology and subjective interpretation of trauma symptoms and other psychological sequalae of maltreatment might be nonlinear or otherwise more complex.

The results of the present study also contribute to preliminary but accumulating evidence that a history of childhood maltreatment or other forms of childhood trauma might in fact prove a favorable prognostic baseline factor for predicting the attainment of therapeutic benefits from psychedelic experiences (Perkins and Sarris, 2021). A significant limitation of this study is the lack of assessment of acute challenging experiences or post-acute harms associated with psychedelic use in this population, which is an important avenue for further research. Four recent studies, however, independently reported that histories of maltreatment or other childhood trauma did not significantly correlate with acute challenging experiences during naturalistic psychedelic experiences, and 2 of these studies further found that childhood trauma histories significantly predicted greater prospective mental health improvements and other psychological benefits following naturalistic psychedelic use (Nayak et al., 2023; Mathai et al., 2024; Cassidy et al., 2024; Mehmood et al., 2025). In the present study, both levels of maltreatment history and levels of baseline trauma symptoms and trait shame showed significant positive correlations with various acute subjective effects of the psychedelic experience, including emotional abuse, physical neglect, and overall childhood maltreatment with acute interpersonal closeness; emotional abuse with acute communitas; PTSD symptoms, CPTSD symptoms, and trait shame with acute psychological insight; and PTSD symptoms additionally with acute oceanic boundlessness, emotional breakthrough, and interpersonal closeness. Although preliminary, these findings suggest that rather than conferring higher risk of harm or adverse experiences as a result of psychedelic use, having a history of maltreatment in childhood might lead to a greater likelihood of therapeutic benefits from psychedelic experiences.

The findings of hypothesis 2 indicate that the strength and quality of the acute psychedelic experience predict post-acute outcomes. Surprisingly, however, no single dimension of the acute subjective experience emerged as a unique predictor. With the exception of the IOS, a single-item measure of interpersonal closeness, every other measure of the acute subjective effects of the psychedelic experience – ego dissolution (EDI), oceanic boundlessness (OBN), psychological insight (PIQ), emotional breakthrough (EBI), and communitas (COMS) – significantly correlated with a composite variable representing overall change in outcomes from baseline to follow-up (the correlation with IOS was trending toward significance). The dose of the drug that participants used, furthermore, significantly predicted the strength of the acute subjective effects but not change in outcomes in a structural equation model. These results suggest that the strictly neurobiological effects of psychedelics are necessary for inducing the acute subjective experience but might not directly cause post-acute psychological benefits and that the subjective experience plays a critical mechanistic role in producing long-lasting therapeutic effects (Yaden and Griffiths, 2021).

Although this study investigated psychedelic use in naturalistic settings, these findings regarding the mechanisms of therapeutic action of psychedelics have implications for clinical treatments using psychedelics. The psychological mechanisms of therapeutic action observed in this study – experiences of changes in sense of self, emotional catharsis, mutative insight, and interpersonal closeness and bonding – are all also empirically established mechanisms of therapeutic action of psychotherapy (Jennissen et al., 2018; Baier et al., 2020; Lane et al., 2022). Clinical treatments with psychedelics, then, might maximize effectiveness by formally incorporating rigorous programs of psychotherapy in order to mobilize these psychological mechanisms of therapeutic action (Gründer et al., 2024). Additionally, elements of group dynamics such as comunitas were associated with therapeutic outcomes, providing a rationale for group-based psychedelic therapies as potentially beneficial and appropriate for individuals with history of childhood maltreatment.

A number of distinct but conceptually overlapping theories and empirical findings regarding the neurobiological and psychological effects of psychedelics and mechanisms of psychical change more broadly considered might together provide models for understanding the present findings. As noted above, the psychological and neurobiological impacts of childhood maltreatment might be especially profound, widespread, and enduring (as compared, for example, to other forms of trauma) because maltreatment takes place during developmental critical periods in which the brain and mind are particularly sensitive to environmental input (Andersen et al., 2008; Knudsen, 2004). Carhart-Harris and Friston (Carhart-Harris and Friston, 2019) proposed that psychedelics "relax" reified cognitive and neural schemata, increasing their pliability and allowing for their adaptive revision; in principle, this theory might also apply to psychically fundamental schemata such as those related to sense of self, affective experience and regulation, and interpersonal functioning that are consolidated during early development and maladaptively impacted by maltreatment. In a series of studies whose findings complement that theoretical model, Nardou et al. (Nardou et al., 2023; Nardou et al., 2019) discovered a critical period of social reward learning and found that psychedelics reopen that critical period in mice, producing a window of neural metaplasticity (i.e., plasticity of synaptic plasticity) in which neural circuits and cognitive schemata of social behavior become subject to new learning, or "re-imprinting," from social experiences. Finally, recent theoretical interventions have posited memory reconsolidation as a core mechanism of therapeutic action of psychotherapy, including psychedelic-assisted psychotherapy, proposing that the activation of memory-based implicit (or unconscious) schemata – including (or even especially) psychically fundamental schemata of self, other, and affective functioning – in the context of emotional arousal temporarily destabilizes and increases the lability and malleability of the memories (including procedural, semantic, and episodic memories) underlying those schemata, rendering them available for enduring adaptive revision or "retranscription" by the incorporation of new information from the environment as they are reconsolidated (Feduccia and Mithoefer, 2018; Ecker et al., 2012; Lane et al., 2015).

Together, these models suggest that implicit or unconscious schemata related to sense of self, affective experience, and interpersonal functioning, which consolidate during critical periods of early development in childhood and are critically and maladaptively impacted by maltreatment, might become particularly plastic and sensitive to new learning or relearning from the environment during the acute effects of psychedelics and therefore vulnerable to adaptive and lasting revision by processes of "re-imprinting" (as critical periods are reopened) or "retranscription" (as infantile memories are reconsolidated with new information). Such psychedelic-facilitated transformations in experiences of the self, emotions, and relationships by way of relearning might be especially marked – both quantitatively, in terms of the degree of change, and qualitatively, in terms of the nature of change (e.g., how beneficial/adaptive) – when they take place in settings that are distinguished by not only the salience of interpersonal interaction, intense and acute affective arousal, and potential changes in identity and self-experience but also unique social norms, practices, values, and aims that are highly distinct from those of everyday life and deliberately designed to promote relationally mediated transformative experiences: settings such as psychotherapy, facilitated group psychedelic ceremonies, and raves. Additional research informing optimal environmental and interpersonal parameters for facilitating such transformative and therapeutic experiences with psychedelics is necessary.

Conceptualizing the psychedelic experience as the result of a four-way interaction between baseline mindset ("set," centrally including intent), the acute psychological drug effects (i.e., the subjective

experience), the acute neurobiological drug effects, and the environment ("setting") might provide the most comprehensive account of the nature of the acute experience and any persisting post-acute outcomes it causes (Carhart-Harris et al., 2018; Hartogsohn, 2016; Meling and Scheidegger, 2023). In the present study, endorsing therapeutic intent for the study index occasion of psychedelic use was an inclusion criterion for participation, which likely significantly contributed to psychologically priming participants toward an openness to therapeutically mutative experiences during their psychedelic experiences, such as intense or potentially difficult emotional experiences, experiences of shifts in identity or ego dissolution, the generation or discovery of meaningful insights, or experiences of closeness and bonding with other members of the group present during the experience. These psychological drug effects – experiences of profound changes in the sense of self, powerful emotions, important insights, or interpersonal communion – in themselves have the potential to lead to lasting psychological transformation. The durability of such transformation, however, is likely augmented by the acute neural changes effected by psychedelics, including decreased modularity of functional networks, increased global connectivity, and increased metaplasticity associated with the reopening of critical periods, which might promote the consolidation or "cementing" of enduring post-acute changes (Nardou et al., 2023; Lebedev et al., 2016; Barrett et al., 2020; Daws et al., 2022; Mortaheb et al., 2024). Finally, these acute psychedelic effects critically interact with and are modulated by the environment in which they take place; the unique environmental factors that characterize raves and ceremonies – explicit or implicit elements of ritual; trance-inducing music; prolonged group experiences of altered states of consciousness; and psychosocial cultures that encourage and facilitate the experience and expression of intense emotions, spontaneous and authentic self-expression and vulnerability, and interpersonal openness and nonjudgmental acceptance – likely both enhance and produce many of the acute subjective effects of the psychedelic experience that can lead to lasting therapeutic changes in the sense of self, emotional experience, and interpersonal relationships.

4.1. Limitations and future directions

This study has a number of limitations. Without an experimental control group, the causal influence of the psychedelic experience cannot be conclusively determined, and the impact of potentially confounding factors, such as regression to the mean or demand characteristics among participants, cannot be examined or controlled for. The relative effects of therapeutic intent (versus other intentions for psychedelic use) and of the group setting (versus alone) also remain uncontrolled. Future longitudinal studies of naturalistic psychedelic use might aim to recruit a control group that is equivalent to the group of psychedelic users in demographics and other baseline variables and that will not be using psychedelics but will be participating in similar events (e.g., people planning to attend a rave but not to use psychedelics or people planning to attend a facilitated group ceremony that is structured similarly to psychedelic ceremonies but does not include the use of psychedelics). Also introducing the potential problem of demand characteristics is the study's reliance on self-report measures; although the measures in the study are widely used and well validated, future naturalistic studies might aim to incorporate behavioral tasks or biological measures in addition to questionnaires in order to decrease the potentially confounding influence of participant bias. Other factors that were not assessed, such as additional psychedelic use, ceremony or rave attendance, or initiation of new therapies or medications between the index experience and the final follow-up assessment, might have impacted observed outcomes. The study also neglected to measure baseline expectancy and so could not account for the possibility that expectancy or placebo effects might have influenced the observed results; a recent trial of psilocybin therapy, however, found that treatment expectancy did not predict clinical outcomes, suggesting that expectancy or placebo effects might not considerably contribute to the therapeutic effects of psychedelics (Szigeti et al., 2024). Finally, drug type and dose also relied on participant self-report and so could have been liable to inaccuracies, and whether participants might have used non-psychedelic drugs or other intoxicating substances concurrently during their study index psychedelic experiences was not assessed; future naturalistic studies might aim to incorporate anonymous drug testing measures in order to determine the type and dose of psychedelics used by participants with greater accuracy.

Despite these limitations, the study has several important strengths. The prospective, longitudinal design of the study entails significant improvements over similar studies with retrospective, cross-sectional designs in terms of the ability to determine the causal impact of naturalistic psychedelic experiences on long-term psychological outcomes. The study also had very high ecological validity and likely also good generalizability regarding the enduring psychological benefits of naturalistic psychedelic use with therapeutic intent in group settings for people with childhood maltreatment histories. The diversity of referral sources for participants (including multiple retreat centers, harm reduction organizations, dance music community newsletters, and psychedelic activist organizations in addition to public online recruitment advertisements across multiple forums and social media websites) contributed to the diversity of types and locations of ceremonies and raves that participants attended, bolstering the generalizability and ecological validity of the study. Although the final sample comprised predominantly White participants, the overall racial makeup of the sample was proportionally comparable to a recent U.S. population cohort study of psychedelic use, further suggesting good generalizability of the findings; lack of robust representation of non-White participants remains a notable problem in psychedelic research, however, and future research might continue to attempt to recruit participants of color and take further steps to redress historical harms and inequities (George et al., 2020; Jahn et al., 2021; Neitzke-Spruill, 2020; Hughes and Garcia-Romeu, 2024). Similar to the sample in Healy et al., 2021, furthermore, nearly half of the participants in the present sample were non-heterosexual, strengthening the representation of participants of non-dominant identities and indicating that psychedelic use might have similar potential for LGBT people as for heterosexual and cisgender people (Carlisle et al., 2023). Finally, childhood maltreatment and its sequelae have rarely been specifically examined as clinical targets in trials of psychedelic therapy, and so the broad etiological influence of maltreatment across psychiatric conditions indicates that the present findings might translate to transdiagnostic clinical efficacy across disorders in which maltreatment is etiologically implicated (Perkins and Sarris, 2021).

5. Conclusion

This prospective, longitudinal study found that adults with histories of childhood maltreatment reported significantly lower levels of PTSD and CPTSD symptoms and internalized (trait) shame and significantly higher levels of social connectedness and general connectedness 2 months after using psychedelic drugs with therapeutic intent in naturalistic group settings – specifically, facilitated group ceremonies or raves, electronic music festivals, or other electronic dance music events – compared to the month before the psychedelic use. Furthermore, these lasting improvements significantly correlated with various intrapsychic and interpersonal dimensions of the acute subjective psychedelic experience. These findings have implications regarding both the potential clinical benefit of psychedelic use for adults with maltreatment histories as well as the therapeutic mechanisms of action of psychedelics.

CRediT authorship contribution statement

C.J. Healy: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration,

Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Aaron Frazier:** Writing – review & editing, Project administration, Investigation, Data curation. **Stephen Kirsch:** Writing – review & editing, Project administration, Investigation, Data curation. **Anna Sanford:** Writing – review & editing, Project administration, Investigation, Data curation. **Albert Garcia-Romeu:** Writing – review & editing, Supervision. **McWelling Todman:** Writing – review & editing, Supervision. **Jeremy Varon:** Writing – review & editing, Supervision. **Wendy D'Andrea:** Writing – review & editing, Supervision.

Ethical statement

The work complied with APA and Declaration of Helsinki ethical standards. The study was granted ethical approval by BRANY SBER IRB (protocol #22–132-1244).

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

C.J. Healy reports financial support was provided by Source Research Foundation. Albert Garcia-Romeu reports a relationship with InnerWell that includes: consulting or advisory. Wendy D'Andrea reports a relationship with Trauma Research Foundation that includes: employment. Albert Garcia-Romeu reports a relationship with Johns Hopkins Center for Psychedelic and Consciousness Research with funding provided by Tim Ferriss, Matt Mullenweg, Craig Nerenberg, Blake Mycoskie, and the Steven and Alexandra Cohen Foundation that includes: employment. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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