Recreational Psychedelic Users Frequently Encounter Complete Mystical Experiences:
Trip Content and Implications for Wellbeing

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Abstract

A growing proportion of the population is engaging in recreational psychedelic use. Psychedelics are uniquely capable of reliably occasioning mystical experiences in ordinary humans without contemplative or religious backgrounds. While clinical research has made efforts to characterize psychedelic experiences, comparably little is understood about how humans naturalistically engage with psychedelics. The present study employs a mixed-methods approach to examine the content and implications of psychedelic and mystical experiences, occurring outside of laboratory settings. We use text mining analyses to arrive at a qualitative description of psychedelic experiential content by abstracting from over two-thousand written reports of first-person psychedelic experiences. Following up, we conducted quantitative analyses on psychometric data from a large survey ($N = 1424$) to reveal associations between psychedelic use practices, complete mystical experiences, and psychological wellbeing. Topic-modelling and sentiment analyses present a bottom-up description of human interactions with psychedelic compounds and the content of such experiences. Psychometric results suggest psychedelic users encounter complete mystical experiences in high proportions, dependent on factors such as drug type and dose-response effects. Furthermore, a salient association was established between diverse metrics of wellbeing and those with complete mystical experiences. Our results paint a new picture of the growing relationships between humans and psychedelic experiences in the real-world use context. Ordinary humans appear to encounter complete mystical experiences via recreational psychedelic use, and such experiences are strongly associated with improved psychological wellbeing.

1. Introduction

1.1 Background on Naturalistic Psychedelic Use

Psychedelic drugs have long been consumed by humans throughout history in various locations and cultures (Nichols, 2016). In the 1970s, due to government legal intervention particularly in the United States, much of psychedelic culture in the Western hemisphere either disappeared or escaped underground.

Recently there has been a re-emergence of psychedelic use in society, particularly in Western societies. The culture of psychedelics is steadily growing and breaking into mainstream culture (Sessa, 2012). Increasing proportions of individuals are reporting recreational psychedelic use (Winstock et al., 2021). Once constrained to the fringes of society, now more than ever ordinary humans are accessing psychedelics and more importantly, accessing the experiences these drugs have on offer. Arguably, the compelling feature of psychedelic drugs lie not in its pharmacology but rather in the unique subjective experiences these drugs can occasion.

Classical psychedelics refer to a category of tryptamines, phenylethylamines, and lysergamides that exhibit 5-HT_{2a} agonist activity and occur in nature (Glennon et al., 1984). These are psilocybin, mescaline, N,N-dimethyltryptamine (DMT), and lysergic acid diethylamide (LSD), though LSD does not exist naturally, it is derived from a natural precursor (Carhart-Harris et al., 2014; Nichols, 2016). In addition, though 3,4-Methylenedioxy methamphetamine (MDMA) is not a classical psychedelic—it differs in neuropharmacology—it does act as a 5-HT_{2a} agonist and more importantly, psychometric evidence suggests MDMA experiences exhibit significant phenomenological overlap with classical psychedelics (Holze et

al., 2020; Liechti et al., 2017; Schmid et al., 2021). The present study is centered on describing the experiential aspect of naturalistic or recreational psychedelic use, thus MDMA is a relevant subject of study. Henceforth the classical psychedelics and MDMA will be referred to as simply “psychedelics” for brevity.

1.2 Psychedelics and Mystical Experiences

Subjectively, psychedelic drug experiences range from mild perceptual distortions to utter departures from any recognizable landmark of ordinary consciousness; the intensity of experiences are related to dosage (Griffiths et al., 2006; Nichols, 2016). A certain subset of these experiences has been operationally defined as a mystical-type experience, which converges with non-drug related experience reports from mystics and contemplatives across cultures, religions, and history (Barrett et al., 2015; Davidson, 1976; Stace, 1960). Mystical experiences are defined as having four distinct subjective qualities: deeply felt positive mood, experience of transcending time and space, ineffability, and mysticism. Operationally, a ‘complete mystical experience’ must qualify all four subjective qualities with sufficient intensity by self-report (Barrett et al., 2015). Mysticism refers to experiences of noetic quality including unity consciousness, ultimate reality, ego dissolution, sacredness, and reverence (Barrett et al., 2015; Johnson et al., 2019).

When taken under the right prescription of set and setting—referring to the user’s mindset and ensemble of environmental conditions—psychedelics are capable of reliably eliciting mystical experiences in the user (Barrett et al., 2015; Griffiths et al., 2011; Holze et al., 2020; Liechti et al., 2017). Comparisons against active placebos such as modafinil or methylphenidate suggests this property of invoking mystical experiences is somewhat unique

though not strictly limited to the psychedelic drug class (Carbonaro et al., 2020; Griffiths et al., 2011; Liechti et al., 2017; Schmid et al., 2021; Strassman, 1994).

Considering recreational psychedelic use has been growing, and that these compounds reliably occasion mystical experiences, it stands to reason that a growing proportion of the human population are encountering these mystical states. For decades in which psychedelics were suppressed, most humans would unlikely chance upon a mystical experience (Thomas & Cooper, 1978; Yaden et al., 2017). Though mystical states have been reported to spontaneously occur in contemplative, near-death, and religious contexts, such non-drug related experiences were almost wholly unpredictable and could not be reliably induced—neither recreationally nor in a laboratory (Griffiths et al., 2019; Hood, 1975; Peinkhofer et al., 2019; Yaden et al., 2017). Generally, mystical experiences were uncommonly documented in modern human societies, and within any one individual’s lifetime.

While psychedelic and mystical experiences have been characterized in clinics, there are few studies on experiences of recreational psychedelic users. Humans are increasingly engaging with psychedelic drugs in real-world contexts, but little is known about what is occurring experientially. What is happening to these people? Psychedelic and possibly mystical experiences are manifesting within the consciousness of ordinary people, outside of any laboratory (Griffiths et al., 2019; Lyvers & Meester, 2012; Qiu & Minda, 2021; Sweat et al., 2016). Little is known beyond anecdotal reports by so-called “psychonauts”; individuals who recreationally explore altered states of consciousness via compounds such as psychedelics (Móro et al., 2011). Clinical data may offer us some weak inferences on how psychedelic experiences play out in the real world. However, knowing that psychedelic effects are dependent on set and setting, recreational psychedelic experiences may exhibit high divergence from the experiences

recorded in controlled clinical settings (Forstmann et al., 2020; Hartogsohn, 2017; Johnson et al., 2008). Though we may make weak inferences from existing clinical data, the experiential content of recreational psychedelic trips remains an open question.

1.3 Questions and Objective

The present study aims to answer the following questions: what is the nature of psychedelic experiences in a naturalistic use context? Can recreational psychedelic use reliably occasion mystical experiences, and do these experiences hold a relationship with drug type or dosage? Finally, we ascertain whether complete mystical experiences have implications for psychological wellbeing in recreational users. We aim to describe and understand the experience and subsequent psychological effects of recreational psychedelic use. Explicit hypotheses and predictions were pre-registered to Open Science Framework (Table 1.) and available at osf.io/kpfbm/. Based on our findings, we propose a basic descriptive model of how recreational psychedelic use relates to naturalistic mystical experiences and psychological wellbeing (Fig 3).

Table 1. Open Science Pre-Registered Hypotheses. All hypotheses were pre-registered on Open Science Framework prior to conducting analyses. Pre-registration can be found at osf.io/kpfbm/. Each hypothesis is explicitly tagged (eg. **H4a**) and referenced as such in the present report.

Tag	Explicit Hypotheses with Prediction
H1	Trip reports of LSD, MDMA, DMT, mushrooms will significantly differ from each other in AFINN sentiment scores
H2	Psychedelic users will have higher proportion of complete mystical experiences when compared to naïve controls
H3	Higher number of lifetime doses will be associated with an increased odds ratio for occurrence of complete mystical experiences
H4	Engaging in psychedelic drugs is associated with odds ratio significantly greater than one for complete mystical experiences

H4a	Using LSD is associated with significantly higher OR
H5b	Using Mushrooms is associated with significantly higher OR
H4c	Using DMT is associated with significantly higher OR
H4d	Using MDMA is associated with significantly higher OR
H5	Higher psychedelic drug dosages will be associated with increased odds ratio of complete mystical experiences
H5a	High LSD dose (ug) is associated with significantly higher OR
H5b	High mushrooms dose (g) is associated with significantly higher OR
H5c	High DMT dose (mg) is associated with significantly higher OR.
H5d	High MDMA dose (mg) is associated with significantly higher OR.
H6	Individuals who experienced a complete mystical experience will score more positively on all metrics of wellbeing
H6a	Higher mean on Brief Wisdom Screening Scale (BWSS)
H6b	Higher mean on Satisfaction with Life Scale (SWLS)
H6c	Higher mean on Five Facet Mindfulness Questionnaire (FFMQ)
H6d	Higher mean on Meaning in Life (MLQ)–presence subscale
H6e	Higher mean on Meaning in Life (MLQ)–search subscale
H6f	Lower mean on Depression, Anxiety, Stress (DASS)–depression subscale.
H6g	Lower mean on Depression, Anxiety, Stress (DASS)–anxiety subscale.
H6h	Lower mean on Depression, Anxiety, Stress (DASS)–stress subscale.
H6i	Higher mean on Positive Negative Affect Schedule (PANAS)–positive subscale.
H6j	Lower mean on Positive Negative Affect Schedule (PANAS)–negative subscale.

2. Methods

2.1 Data Sources

We acquired the data of the present study from two existing sources. The first dataset is a corpus of written reports of first-person experiences under influence of psychoactive drugs. The second dataset is taken from an existing study which examined the intersection of psychedelic experiences, and wellbeing (Qiu and Minda, 2021).

2.2 Erowid Dataset

The first source of data comes from erowid.org. Erowid is the oldest and most comprehensive public-access database documenting the relationship between humans and psychoactive drugs (Erowid, 2002). Erowid Experience Vaults is a subsection of the database containing what are called trip reports, written text accounts of one's experience under the influence of a single or combination of psychoactive substances. User submitted trip reports are filtered for spam and manually curated by Erowid staff for writing quality, descriptive detail, and holistic depictions of drug experiences.

In 2016, Matti Vuorre published a web scraped dataset of Erowid experience reports in an R package: "tmasc" as part of a project on Text Mining Altered States of Consciousness. In the present study we analyze the "erowid" dataset from the "tmasc" R package (Vuorre, 2016). The full "erowid" dataset contained 24788 unique trip reports of drug experiences with dates ranging 2000-2016 (Vuorre, 2016). For the analyses we picked the three most common classical psychedelics; psilocybin containing mushrooms, LSD, and DMT. Though not considered a classical psychedelic, we included MDMA due to its potential to elicit mystical-type experiences and strong phenomenological overlap with the classical psychedelics (Holze et al., 2020; Liechti et al., 2017; Schmid et al., 2021). Trip reports may document more than one substance consumed in a single session, however we analyzed reports detailing only one of either mushrooms, LSD, DMT or MDMA to mitigate confounds of mixing drugs. Subsetting by single drug resulted in impendent corpora of trip reports for each drug; mushrooms ($n = 651$), LSD ($n = 690$), DMT ($n = 227$), MDMA ($n = 435$). A total of ($N = 2003$) unique written trip reports were used in the subsequent text mining analyses. Trip report average word count ($M = 1249$, $SD = 1115$).

2.2.1 Sentiment Analysis

We conducted a sentiment analysis on the corpora of trip reports for each of the four substances by referencing AFINN sentiment lexicon which contains 2477 unique English words accompanied by affect valence scores ranging -5 (*very negative*) to +5 (*very positive*) and a minor bias towards negative words; 65% of the lexicon is negative (Nielsen, 2011).

All corpora of trip reports were preprocessed identically. We tokenized all documents into individual words, removed punctuation, numbers, and converted all words to lowercase. English stopwords (e.g. ‘to’, ‘in’, ‘here’, ‘off’) were removed by referencing “SMART” lexicon of stopwords (Lewis et al., 2004; Rocchio, 1971). Whitespaces were stripped.

Tokenized words for each trip report were reference matched to AFINN lexicon for assigning sentiment scores to emotionally valanced words. We computed the sum of all sentiments for each trip report document and the mean of all trip report scores for each psychedelic. Differences between sentiment scores for each of the drugs were tested using ANOVA and Tukey’s HSD; p -values are reported with $\alpha < .05$ denoting statistical significance.

2.2.2 Topic Modelling

We trained Latent Dirichlet Allocation (LDA) topic models for each of the respective drugs corpora. David Blei’s original paper contains a complete description of LDA (Blei, 2012). LDA treats each document as a mix of k number of latent topics where each topic is a mix of words and word order is irrelevant. LDA generates documents based on Dirichlet distributions; it models the probability of documents occurring within a Dirichlet distribution of topics, and the probability of topics occurring within a Dirichlet distribution of words. Thus, latent topics bridge the probabilities of words occurring within a document. From these tunable parameters of document-per-topic and topic-per-word probabilities, LDA generates novel sets of documents

and evaluates their match to the original corpus and retrains parameters until the match is optimized (Blei, 2012).

Of relevance to the present study are two parameters: (β) describing the probability of a word contributing to a given topic and (γ) which describes the probability that documents are composed of a given topic. We use LDA to automatically extract topics from our corpus of trip report documents. Extracted topics are composed of words, each with their own β probability and in turn, topics contribute to documents ranked by their γ probability.

Number of topics k is somewhat arbitrary and left as an *a priori* assumption. Several metrics have been developed to optimize k for topic coherence. We evaluate convergence of three metrics: “Griffiths2004”, “CaoJuan2009”, and “Arun2010” to find optimal topic numbers (Arun et al., 2010; Cao et al., 2009; Griffiths & Steyvers, 2004). Final optimal topic numbers for mushrooms, LSD, DMT, and MDMA corpora were $k = 23; 20; 18; 22$, respectively.

Text data was preprocessed in the same way as sentiment analysis. However, topic models may contain uninformative stopwords specific to the subject matter (e.g. LSD stopwords may include: ‘acid’, ‘lsd’, ‘trip’). Thus, topic models were rerun iteratively, removing uninformative stopwords in each iteration until no subject-specific stopwords remained in the final topic models.

2.3 Mystical Experiences Dataset

The second source of data comes from a previous survey-based observational study on psychedelics, mindfulness, and self-reported wellbeing of recreational users and meditators (Qiu & Minda., 2021). In the original study, 1219 participants were used in the analyses. Since the

publication of the previous study, we collected additional data from 205 new participants bringing the total to ($N = 1424$) participants for the present analyses (Table 2).

Table 2. Participant characteristics. Average age was ($M = 24$, $SD = 8$). Age of first psychedelic use ($M = 20$, $SD = 6$). Lifetime psychedelic doses ($M = 42$, $SD = 53$).

Variable	N	%
Gender		
Male	912	64
Female	488	34
Other	16	1
Ethnicity		
White	948	70
Asian	230	17
Latin American	50	4
Black	26	2
Native American	9	1
Other	99	7
Education		
Lower secondary	34	2
Upper secondary	330	23
Post-secondary non-tertiary	216	15
Short-cycle tertiary	78	6
Bachelor's	658	47
Master's	71	5
Doctorate	23	2
Psychedelic Use History		
Yes	991	70
No	419	30
Specific Substances* (users only $n = 991$)		
Mushrooms	818	83
LSD	791	80
MDMA	578	58
DMT	507	51
Mescaline	85	9
Frequency of Dosing (regular users $n = 946$)		
Daily	10	1
Multiple times a week	43	5
Once per week	56	6
Once every two weeks	117	12
Once per month	201	21
Once every 3 months	238	25
Once every 6 months	123	13
Once every year	77	8
Once every couple of years	58	6
Once a decade	23	2

***Note:** Proportions sum $>100\%$ because there is considerable overlap. The same participant may report engaging in more than one substance.

Online survey was administered through Qualtrics XM and participants were recruited from two sources: Reddit communities related to psychedelic drugs, and Western University's internal subject recruitment pool. Survey had three sections. First section asked standard demographic questions such as age, gender, ethnicity, and education. Second section asked specific questions relevant to psychedelic practices including lifetime doses, type of drug, and their respective estimates of average dosage. Last section included a diverse array of wellbeing metrics and a measure for mystical experiences.

2.3.1 Psychometrics

We measured mystical experience using the MEQ, a 30-item scale derived and normed through clinical studies of psilocybin-induced mystical experiences (Barrett et al., 2015). The MEQ has a stable four-factor structure corresponding to the unique aspects of a mystical experience: mysticism, positive mood, transcendence of time and space, and ineffability. The score is taken as the mean of all items which are rated on a Likert scale from 0 (*none; not at all*) to 5 (*extreme, more than any other time in my life*); higher scores correspond to higher intensity of mystical experience. Included in the MEQ30 is the metric for scoring a 'complete mystical experience' which is defined as scoring over or equal to 60% of the maximum score on all four subscales.

A battery of wellbeing psychometrics was included in the survey, all scored using Likert scales. The Five Facet Mindfulness Questionnaire (FFMQ) contains 39-items scored by mean for items ranging 1-5; 5 represents higher frequency of mindful experience (Baer et al., 2006). Depression Anxiety and Stress Scale (DASS) is a 21-item questionnaire with three subscales measuring frequency of the mood disorder symptoms for depression, anxiety, and stress (Henry

& Crawford., 2006). The DASS is scored as sum of each subscale with items spanning 0-3; 3 represents more frequent symptoms of the respective mood disorders. Meaning in Life Questionnaire (MLQ) is a 10-item questionnaire measuring the presence and search for meaning as two subscales (Steger et al., 2006). It is scored as sum of each subscale with items ranging 1-7; 7 represents increased meaning in life. Positive And Negative Affect Schedule (PANAS) measures positive and negative affect on two separate subscales (Watson et al., 1988). It is scored by sum on items ranging 1-5; 5 corresponds to higher frequency of respective affect for the given item. Brief Wisdom Screening Scale (BWSS) is a 20-item scale scored by mean for items ranging 1-5; 5 representing higher self-perceived wisdom (Glück et al., 2013). Satisfaction with Life Scale is a 5-item scale scored by sum for items ranging 1-7; 7 represents higher satisfaction with life (Diener et al., 1985).

2.3.2 Statistical Analyses

Self-reported psychedelic users were compared by z-test for the proportions of individuals who have encountered a complete mystical experience. In addition, individuals with complete mystical experience were compared against individuals without complete mystical experiences for the following psychometrics: FFMQ, SWLS, BWSS, PANAS, DASS subscales, and MLQ subscales. Differences in mean score were computed by two-tailed Welch's t-tests. Family-wise error rates were corrected by Bonferroni method, only adjusted p-values are reported with $\alpha < .05$ denoting statistical significance. Effect sizes are reported as Cohen's d with Hedge's correction.

We ran logistic regression models to assess odds of encountering complete mystical experiences given the behaviours of recreational engagement in psychedelics. Only individuals

who've used psychedelics were included in logistic regression ($n = 991$). All models controlled for age, gender, ethnicity, and education level as covariates. Total number of lifetime psychedelic doses were tested as a possible predictor. Another model tested if using each of the four drugs: mushrooms, LSD, DMT, and MDMA were uniquely associated with higher odds of encountering complete mystical experiences. Similarly, dosages of the four respective drugs were modelled to assess the presence of dose-dependence relationships. However, the four psychedelics differ drastically in dosing units. For example, 2.0 μg of LSD is not meaningfully more than 1.0 μg of LSD whereas 2.0 g of mushrooms is substantially more than 1.0 g of mushrooms. To improve interpretability, we derived a coarse estimate of "standard recreational dose" from Erowid's proprietary scales of common recreational drug dosages (Erowid, 2002). Estimated standard recreational dosages are 1.0 g for mushrooms, 100 μg for LSD, 30 mg for DMT, and 80 mg for MDMA. These standard doses were factored out from the dosage data before the regression so model coefficients are to be interpreted as scalars of the standard recreational dose.

3. Results

3.1 Text Mining Analyses

3.1.1 Psychedelic Trip Reports Vary in Sentiment and Captures Extreme Experiences.

Sentiment analysis was conducted on the corpora of trip reports for each of mushrooms, LSD, DMT and MDMA. Consistent with our hypothesis (**H1**), mean sentiment scores for each

drug type were significantly different from one another, $F(3, 1977) = 20.8, p < .001, \eta^2 = .031$, (Fig 1). Trip reports of LSD ($SD = 49.91$) and mushrooms ($SD = 42.68$) have higher variance than DMT ($SD = 36.07$) and MDMA ($SD = 33.15$). Visualization of sentiment score distributions in Fig 1 exhibits thicker tails and more extreme outliers in LSD and mushroom trip report corpora. Indeed, the most extreme sentiment score in the LSD dataset was -627, corresponding to z -score of -12.53. Similarly, the most extreme sentiment in the mushroom corpora was +330, a z -score of 7.64. Although these outliers do not represent the aggregate of reports, the existence of seven and twelve SD datapoints indicate that trip report sentiment does not follow a true normal distribution. LSD and mushroom trip reports characteristically allow for extremes in positive and negative sentiment. Finally, MDMA and DMT sentiment distributions are asymmetrical and do not exhibit an extreme long tail of negative sentiment.

Fig 1. Trip report sentiment scores for psychedelic drug experiences. Each point represents a unique trip report document of the respective drug type arranged in a sample distribution with width representing frequency of the given observation. Note that outliers beyond the range of (-200, 150) are not visualized in the figure. Boxplots indicate sample median, IQR, and 1.5x IQR. Positive sentiment scores represent net positive sentiment within the trip report document. Asterisks denote significance for pairwise comparisons; $p < .05^*$, $< .01^{**}$, $< .001^{***}$, $< .0001^{****}$, as computed by Tukey's HSD.

3.1.2 Topic Models Describe Similarities and Unique Characteristics of Various Psychedelics.

Topic modeling by LDA revealed an optimal number of latent topics for each drug described by top terms contributing to each topic (Fig 2). General trends may be abstracted from the topic models. The term “*life*” appeared with comparable frequency in all four topic models: occurring in 10 LSD topics, 9 mushroom topics, 10 DMT topics, and 8 MDMA topics. The term “*friend*” occurred frequently in LSD, mushrooms, and MDMA topics—10, 9, 13 topics respectively, but only in 2 DMT topics. Also unique to DMT, was a much higher prominence of terms related to the physical body and sensations such as: “*body*”, “*eyes*”, “*face*”, “*energy*”, which occurred in 9 DMT topics. Mushrooms, LSD, and MDMA had comparably lower frequency of somatic related terms at 4, 4, 3, topics respectively. The term “*love*” also featured in 5 MDMA topics, once in DMT and mushrooms, but never in LSD topics. Finally, LSD, mushrooms, and DMT were similar in prevalence of “*mind*” term at 9, 9, 7 topics respectively while MDMA model only had 2 topics containing “*mind*”.

We also identify interesting and especially coherent topics that may be related to the specific effects of the drug. From the LSD model, topic #1: “*life, mind, god, reality, thought, people, feel*”, may represent the mystical-type experience because the terms “*life*”, “*mind*”, “*god*” and “*reality*” coincide with normed items of the MEQ. Topic #9 of DMT: “*psychedelic,*

brain, visual, body, patterns, people, states, waves”, represents a coherent qualitative description of DMT drug experiences. Topic #3 of MDMA: *“people, life, night, day, love, experiences, beautiful”*, appears to report highly positive MDMA experiences. The MDMA topic model is the only one to include mention of family members; #7 mentions *“husband”*, and topic #11 mentions *“sister”*. Finally, all topic models included some aspect of environment or description of setting, these are *“day”, “night”, “room”, “house”, “tent”, “car”, “tree”, “water”, “music”*.

Fig 2. Psychedelic trip report topic modeling by LDA. Top twenty topics of all models are ordered by descending γ ; interpreted as the probability that the respective topic contributes to any given document of the corpus. The top seven words are labeled next to their respective topic number and ordered by descending β ; the probability that the word contributes to the given topic.

3.2 Statistical Analysis of Complete Mystical Experiences

3.2.1 *Psychedelic Users Encounter Complete Mystical Experiences in Higher Proportion.*

We compared psychedelic users against non-users for proportion of individuals who've encountered a complete mystical experience. We found that psychedelic users had a substantially higher proportion (63.5%) of individuals who encountered complete mystical experiences than non-users (11.7%), $z = 17.1$, $p < .001$, 95% CI [0.47, 0.56], in support of our hypothesis (**H2**).

We subsetting only participants who've self-identified as psychedelic users ($n = 991$) for logistic regression modeling. Total lifetime doses of psychedelic drugs were tested as a possible predictor. Lifetime doses were found to have significant though weak association with occurrence of complete mystical experience, $b = 0.008$, $OR = 1.008$, 95% CI [1.004, 1.012], $p < .001$. The lower bound of the confidence interval suggests the per-dose association may be spurious and therefore merely weak statistical evidence in support of our hypothesis (**H3**).

3.2.2 *LSD, DMT, and MDMA Use are Associated with Complete Mystical Experience.*

Recreational usage of four psychedelic drugs: mushrooms, LSD, DMT, and MDMA were entered into one model to assess if each compound had any unique associations with increased odds of encountering a complete mystical experience. In line with our hypotheses (**H4a**, **H4c**, **H4d**), three drugs: LSD use, $b = 1.15$, $OR = 3.16$, 95% CI [2.16, 4.64], $p < .001$; DMT use, $b = 0.78$, $OR = 2.18$, CI [1.59, 3.00] $p < .001$; and MDMA use, $b = 0.50$, $OR = 1.64$, CI [1.21, 2.24], $p = .002$, are significantly associated with higher odds of occasioning complete mystical experiences. However, contrary to our hypothesis (**H4b**), mushroom use is not uniquely

associated with higher odds of encountering complete mystical experiences, $b = 0.22$, $OR = 1.24$, $CI [0.84, 1.84]$, $p = .28$, when the variance by LSD, DMT, and MDMA use were also accounted in the model. That is to say, each of LSD, DMT and MDMA are uniquely associated with higher odds of complete mystical experiences even having engaged with other psychedelics. However, mushrooms have no unique association with complete mystical experiences if the individual has already engaged in using other psychedelics.

3.2.3 Mushrooms and LSD Exhibit Dose-dependence for Complete Mystical Experiences.

Dose-dependence for each of the four psychedelic drugs were individually modeled for association with occurrence of complete mystical experiences. Consistent with our hypotheses (**H5a**, **H5b**), higher doses of mushrooms and LSD were associated with higher odds of occasioning complete mystical-type experiences. Higher mushroom dosages per 1.0 g was significant, $b = 0.21$, $OR = 1.23$, 95% $CI [1.08, 1.41]$, $p = .002$. LSD dosages per 100 μg was significant, $b = 0.25$, $OR = 1.28$, 95% $CI [1.08, 1.53]$, $p = .006$. DMT dosages per 30 mg also appeared to be statistically significant, $b = 0.38$, $OR = 1.46$, $CI [1.02, 2.12]$, $p = .04$. However, both the threshold p-value and the lower confidence bound suggest the association of DMT dosage is worthy of suspicion. It is spurious or at best, weak support for our hypothesis (**H5c**). Also, conflicting with our hypothesis (**H5d**), higher MDMA dosages per 80 mg was not significantly associated with increased odds of complete mystical experience, $b = 0.19$, $OR = 1.21$, $CI [0.97, 1.52]$, $p = .09$.

3.2.4 Complete Mystical Experiences are Associated with Higher Subjective Wellbeing.

Individuals who've encountered complete mystical experiences were compared against individuals naïve to a complete mystical experience. A battery of wellbeing metrics was evaluated: FFMQ, BWSS, SWLS, DASS subscales, PANAS subscales, and MLQ subscales (Table 2). As predicted by our hypotheses (**H6a, H6b, H6c, H6d, H6f, H6h, H6i, H6j**), individuals with complete mystical experiences had significantly more positive scores on all metrics with two exceptions. DASS anxiety and MLQ search subscales did not differ significantly between groups, which ran contrary to our predictions (**H6e, H6g**). Mean differences ranged from small to medium effect sizes, though self-reported wisdom metric BWSS exhibited a large effect size.

Table 2. Psychometrics of self-reported wellbeing compared for completeness of mystical experiences. Complete mystical experiences are defined as scoring over or equal to 60% on all four subscales of the MEQ. All *p*-values are reported as adjusted for multiple comparisons by Bonferroni correction. Cohen's *d* includes Hedge's bias correction.

Variable	Complete		Incomplete		<i>df</i>	<i>t</i>	95% CI	<i>p</i>	<i>d</i>
	M	SD	M	SD					
FFMQ	3.47	0.50	3.22	0.47	1268	9.13	[0.19, 0.30]	<.001	0.51
Positive	33.02	7.89	29.94	7.48	1238	7.12	[2.23, 3.93]	<.001	0.40
Negative	20.79	8.45	22.87	8.42	1244	-4.38	[-3.02, -1.15]	<.001	-0.25
Presence	22.88	7.02	21.39	6.97	1251	3.79	[0.72, 2.26]	.002	0.21
Search	25.79	7.28	24.71	6.87	1234	2.70	[0.29, 1.86]	.070	0.15
Depression	5.38	5.12	6.50	5.21	1247	-3.83	[-1.69, -0.54]	.001	-0.22
Anxiety	4.69	4.30	5.23	4.33	1243	-2.24	[-1.03, -0.07]	.250	-0.13
Stress	5.93	4.51	6.86	4.47	1242	-3.65	[-1.42, -0.43]	.003	-0.21
BWSS	3.85	0.48	3.42	0.49	1258	15.76	[0.37, 0.48]	<.001	0.89
SWLS	22.32	7.48	20.95	7.26	1252	3.30	[0.55, 2.18]	.010	0.19

Note: FFMQ—Five Facet Mindfulness Questionnaire; BWSS—Brief Wisdom Screening Scale; SWLS—Satisfaction with Life Scale; Positive and Negative are subscales of PANAS—Positive And Negative Affect Schedule; Presence and Search are subscales of MLQ—Meaning in Life Questionnaire; Depression, Anxiety, and Stress are subscales of DASS—Depression Anxiety Stress Scale.

Fig 3. Schematic Representation of Human Recreational Engagement with Psychedelics and Mystical Experiences. The general population is depicted as composed of two subpopulations: a smaller group of recreational psychedelic users and a much larger group of non-users. Percentages represent the proportion of the respective population encountering a complete mystical experience. Psychedelic users encounter complete mystical experiences in much higher proportion than non-users. Regardless of psychedelic use, those with complete mystical experiences self-report higher wellbeing across multiple dimensions (see methods). Graph depicts mean z-score with 95% confidence interval for wellbeing metrics. Note that scores on: ‘negative’, ‘depression’, ‘stress’, ‘anxiety’, are inverted because the absence of such states is positive (i.e., scoring lower on ‘stress’ is desirable).

4. Discussion

4.1 Overview

The aim of our study was to make rigorous observations on the novel and growing phenomenon of recreational engagement with psychedelic experiences. We depicted such phenomenon through mixed methods of text mining and psychometric analyses. Our results paint a picture of the changing relationship between humans and psychedelic drugs in naturalistic

contexts outside of laboratory settings. Topic models provide a qualitative description of psychedelic experiences by abstracting over two thousand curated written reports in a replicable manner. Sentiment analysis suggests that emotional valence of psychedelic experiences differ by drug type, and certain psychedelics may allow for extreme deviations in positive and negative experience. Psychometric analysis of a large sample survey suggests psychedelic users are more likely to encounter complete mystical experiences, depending on drug type and dose-response effects. In turn, complete mystical experiences associate with higher self-reported wellbeing on a range of facets including affect, mood disorder, life meaning, life satisfaction, mindfulness, and wisdom.

From these findings, we derive a descriptive model of the current relationships between recreational psychedelic users, naturalistic mystical experiences, and psychological wellbeing (Fig 3). We assert the model is neither causal nor a mechanistic explanation. Rather the model is a depiction of the present associative relationships. Though one cannot make causal inferences from this model, it sets the context for further research in the field. We have statistically documented the claim that recreational psychedelic use leads to mystical experiences and such experiences are linked to improved wellbeing.

4.2 Mystical Experience and Wellbeing

Existing data of naturalistic psychedelic use suggests that MDMA exhibits no dose-dependent relationship with intensity of mystical experience (Lyvers & Meester, 2012). Our data agrees with such evidence, higher MDMA doses do not exhibit increased odds of invoking complete mystical experience, though simply using MDMA is associated with increased odds beyond the effects of using other psychedelics. DMT also exhibited dose-dependence, but the

evidence was weak and possibly spurious. Finally, mushrooms and LSD exhibit dose-dependence for invoking complete mystical experiences, agreeing with both clinical evidence (Barrett et al., 2015; Griffiths et al., 2006; Liechti et al., 2017; Schmid et al., 2021), and naturalistic data (Griffiths et al., 2019; Lyvers & Meester, 2012; Maclean et al., 2012).

Recreational psychedelic users with complete mystical experiences had substantially higher self-reported wellbeing than those without, echoing clinical studies of psychedelic positive psychology (Aday et al., 2020; Griffiths et al., 2011; Griffiths et al., 2006; Jungaberle et al., 2018). However, our data are novel in that they describe a recreational context and employ a broader array of metrics spanning nonparallel facets of psychological and human wellbeing. Participants who experienced complete mystical states scored higher on mindfulness, wisdom, satisfaction with life, positive affect, presence of meaning in life, while simultaneously scoring lower on negative affect, depression, and stress. These results are a strong signal that simply experiencing strong mystical states outside of controlled lab settings is closely related to holistic and multi-faceted psychological wellbeing. Though such conclusions are correlational and not causal, such consistent signal across many nonparallel domains of wellbeing is worthy of further investigation for the potential of recreational psychedelics as means to influence personal wellbeing.

In our sample, psychedelic users have higher proportions of encountering complete mystical experiences compared to non-users. These findings are unsurprising considering the clinical evidence which document the unique reliability of psychedelics for eliciting mystical states. Use of LSD, DMT, and MDMA are each uniquely associated with higher odds of occasioning mystical type experience which corroborates existing clinical evidence for all three substances (Holze et al., 2020; Liechti et al., 2017; Pallavicini et al., 2021; Schmid et al., 2021;

Timmermann et al., 2018). Our models reveal an interesting point, that recreational mystical experiences aren't limited to a single psychedelic drug, rather different substances can bring the user to a similar qualitative state. Findings of LSD and DMT eliciting mystical experience is congruent with existing clinical evidence (Griffiths et al., 2019; Lyvers & Meester, 2012). However, our results are the first to link recreational LSD and DMT use to higher odds of encountering complete mystical experiences.

4.3 Subjective Trip Content

Returning to the psychedelic experience, the text mining analyses provides some insight about the phenomenological content of such experiences. Topic modelling suggests trip reports of psychedelic experiences qualitatively differ from one another. Friends and other people appear less relevant to DMT experiences whereas LSD, mushrooms, and MDMA experiences prominently feature friends and even family members in the trip reports; likely due to the sheer intensity of altered states under DMT influence, which has been clinically well documented (Davis et al., 2020; Timmermann et al., 2018). Such drastic departures from ordinary consciousness would likely impede interactions with other humans under the influence. Indeed, DMT topics frequently presented “*body*” and related sensory terms indicating the unique salience and intensity of bodily sensations which coincide with existing literature (Griffiths et al., 2019; Pallavicini et al., 2021; Strassman, 1994). Three classical psychedelics showed higher prominence of the term “*mind*” when compared with MDMA, suggesting classical psychedelic experiences offer some altered state of mind that is consistently different than MDMA states. In addition, “*love*” is prominently featured in MDMA topics, likely referring to its empathogenic properties which may invoke feelings of compassion, love, and empathy as described by existing

research (Carlyle et al., 2019; Kamboj et al., 2015; Liechti et al., 2001). Though vague to interpret, it is interesting that “*life*” featured as a prominent term for all four substances, suggesting that somehow these psychedelic experiences are consistent in pertaining to the concept of “*life*”.

The sentiment of psychedelic experiences varies by drug, suggesting that despite the same categorization of classical psychedelics, they do not necessarily invoke the same degree of positive and negative emotional valence. Mushrooms and LSD exhibit high variance and allow for extreme outliers of positive and negative drug experiences. In clinical studies, negative experiences are intentionally minimized by careful screening and design of set and setting (Johnson et al., 2008). However, such deliberate selection for appropriate set and setting may not be observed by recreational users explaining the potential for extreme negative experiences.

4.4 Strengths and Limitations

A unique strength of the present study is the application of text mining analyses and especially topic modelling to effectively summarize a large dataset of written reports. Whereas traditional thematic or coding analyses are labour intensive and vulnerable to researcher bias, data-driven text mining analyses are comparably faster, trivially easy to replicate (scripts available at osf.io/kpfbm/), and less subject to researcher bias due to the minimal top-down assumptions. Regarding the psychometric data, the large sample size and diverse wellbeing metrics allows for interesting and stronger conclusions despite the observational design of the study. However, the observational design also limits inferences to associations and not causality. Another weakness of the survey design is that recruitment was largely by voluntary interest or

convenience. Thus, the sample does not faithfully represent the general population but is biased towards those with significant interest in psychedelic drugs and culture.

5. Conclusion

Our study presents an understanding of human experiences in relation to psychedelic use. The focus is of natural interactions between humans and psychedelics without top-down influence of clinical or laboratory interventions. By analyzing trip reports, we abstracted effective qualitative descriptions of recreational psychedelic experiences. Finally, psychometric results show that psychedelic users experience complete mystical states in substantial proportions and such states are associated with improved wellbeing across a wide range of psychological domains. We propose a novel descriptive model documenting the relationships between recreational psychedelic users, mystical experiences, and psychological wellbeing.

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