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# A quantitative exploration of the relationships between regular yoga practice, microdosing psychedelics, wellbeing and personality variables

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## Abstract

**Objective**: The current study aimed to explore whether the subjective effects of microdosing psychedelics are comparable to those of yoga in relation to psychological wellbeing, depression, anxiety and stress. It also aimed to explore the relationship between yoga, microdosing and personality variables including neuroticism, openness and absorption.

**Method**: The sample comprised 339 participants, yoga ($n$ = 131), microdose ($n$ = 69), microdose and yoga ($n$ = 54) and control ($n$ = 85). All completed an online survey concerning personality (M5-50 and Tellegen Absorption Scale), mood (Depression, Anxiety and Stress Scale-21) and wellbeing (Ryff Scales of Psychological Wellbeing).

**Results**: The yoga and microdosing groups scored significantly higher on psychological wellbeing and absorption than did control. The microdosing and yoga group had lower depression scores than the microdose only group, and lower anxiety scores than the yoga only group. Furthermore, the microdosing and yoga group had the highest absorption score. Openness was significantly lower in the control group than in all other groups.

**Conclusions**: While we cannot infer that yoga and microdosing leads to increased wellbeing, openness and absorption, or to decreased depression and anxiety,
the findings suggest that the subjective effects of microdosing psychedelics are comparable to those of yoga and that the combination of both might be beneficial.


**Key words:** hallucinogen, microdose, openness, psychedelic, wellbeing, yoga.

**Key points:**

**What is already known about this topic**

- Previous researchers have found yoga has improved psychological wellbeing, decreased depressive and anxiety symptoms, decreased neuroticism, and increased openness and absorption.
- A small number of recent studies have found that taking subthreshold doses of psychedelic substances, known as microdosing, has improved psychological wellbeing, reduced depressive, anxiety and stress symptoms and increased the personality traits of openness and absorption.
- However, most research concerning psychedelics, wellbeing and personality focuses on high doses of psychedelics. For example, 30 mg/70 kg of psilocybin has significantly increased openness.

**What this topic adds**

- We are the first researchers to compare the effects of yoga with psychedelic microdosing on wellbeing and personality.
- Our findings suggest the effects of microdosing psychedelic substances might be comparable to those of yoga.
- Our study implies the combination of both yoga and microdosing have complimentary effects on general wellbeing and absorption.

# A quantitative exploration of the relationships between regular yoga practice, microdosing psychedelics, wellbeing and personality variables

Yoga incorporates physical and mental practices with the aim of achieving self-realisation or union between body, mind and spirit (Ivtzan & Jegatheeswaran, 2015; Moliver, Mika, Chartrand, Haussmann, & Khalsa, 2013). Yoga has been related to improved physical and psychological health in a range of populations (Büssing, Khalsa, Michalsen, Sherman, & Telles, 2012; Jeter, Slutsky, Singh, & Khalsa, 2015). For example, Moliver et al. (2013) found that hours of yoga practice correlated with higher levels of psychological wellness. Similarly, Ivtzan and Jegatheeswaran (2015) found that psychological wellbeing increased with length of yoga practice. In a randomised controlled trial (RCT) by Hartfiel, Havenhand, Khalsa, Clarke, and Krayer (2011), yoga was found to significantly improve wellbeing and mood. Yoga has also been related to decreases in depressive and anxiety symptoms (Lin, Hu, Chang, Lin, & Tsauo, 2011).

There is some evidence that microdosing also improves psychological wellbeing (Fadiman, 2011). Microdosing involves taking 1/10 of a recreational dose of a psychedelic drug such that there is no apparent alterations in consciousness or feelings of intoxication that are generally associated with recreational doses of psychedelics (Fadiman, 2011). People typically microdose every third day to avoid the tachyphylaxis associated with psychedelic drugs, which reduces the drug's efficacy. Classic psychedelic drugs, including psilocybin, lysergic acid diethylamide (LSD), N,N-dimethyltryptamine (DMT) and mescaline, affect serotonin (or 5-Hydroxytryptamine [5-HT]) pathways in the brain as $5HT_{2A}$ receptor agonists (Nichols, 2016).

Lea, Amada, Jungaberle, Schecke, and Klein (2020) found that most participants who disclosed microdosing reported improved mood and anxiety on the days they microdosed. Participants in a qualitative study of microdosing reported that the practice led to decreased depressive and anxiety symptoms (Johnstad, 2018). Subsequently, Polito and Stevenson (2019) examined 63 people who self-reported microdosing and found that depressive and stress symptoms reduced after 6 weeks. Anderson et al. (2019) completed a cross-sectional study comparing 315 non-microdosers with 594 self-reported microdosers. They found that microdosers had lower scores on measures of dysfunctional attitudes and negative emotionality. Individuals low in dysfunctional attitudes are less likely to be vulnerable to stress (Jarrett et al., 2012) and depression (Adler, Strunk, & Fazio, 2015), while individuals high in negative emotionality, including anxiety and depression, have an increased likelihood of developing a mental health problem (Lahey, 2009).

To our knowledge there have been two clinical trials of microdosing. Bershad, Schepers, Bremmer, Lee, and de Wit (2019) randomly administered either a placebo, 6.5, 13, or 26 μg of LSD to 20 healthy adults. They observed dose-respondent subjective changes, including increased vigour. Vigour incorporates being cheerful, alert, active, lively, carefree and energetic (Bershad et al., 2019). Yanakieva, Family, Williams, Luke, and Terhune (2019) conducted a double-blind study in which 48 healthy older adults (*Mage* = 62.92, *SD* = 5.65) were administered either a placebo, 5, 10, or 20 μg of LSD and completed a cognitive task three hours after administration. While they found that participants administered LSD performed better in a cognitive task compared to controls, there was a general trend towards lower doses of LSD showing the greatest improvement in participants' performance on the task that was not statistically significant. This latter finding might have been due to low statistical power related to sample size.

Personality has typically been conceptualised to comprise a set of traits that are reasonably stable and consistent over time and across contexts with few interventions shown to change an individual's personality. However, both yoga and microdosing appear to lead to changes in personality. When high doses of psilocybin (30 mg/70 kg) have been administered, significant increases in openness have been observed that were sustained at a 16-month follow-up (MacLean, Johnson, & Griffiths, 2011). Openness is one of the Big Five personality factors, which refers to broad-minded tolerance of others' values and viewpoints, aesthetic appreciation, sensitivity, imagination, and fantasy (MacLean et al., 2011). Polito and Stevenson (2019) did not observe any change in openness among self-reported microdosers and found increases in neuroticism, which is another of the Big Five personality factors. Neuroticism comprises anxiety, hostility, depression, self-consciousness, impulsiveness and vulnerability (Yadav, Magan, Mehta, Mehta, & Mahapatra, 2012). Anderson et al. (2019) found that open-mindedness was higher among people who microdosed compared to controls.

In contrast, yoga practice has been consistently related with increased openness and decreased neuroticism. For example, research examining the effectiveness of yoga among 90 hospital outpatients with chronic disease found that following the 10-day yoga retreat, they had higher levels of openness, and lower levels of neuroticism, than at baseline (Yadav et al., 2012). This change in personality was not seen in the control condition. A two-year follow-up of one participant from Yadav et al's study who had been diagnosed with chronic fatigue syndrome showed he had experienced a marked improvement in symptoms, and that the changes in openness and neuroticism were maintained (Yadav, Sarvottam, Magan, & Yadav,

2015). A cross-sectional study by Misra, Gupta, Alreja, and Prakash (2013) found people who had practised yoga for 10 years or longer ($n$ = 26) had significantly lower levels of neuroticism compared with yoga practitioners who had less than two years ($n$ = 38) of practice.

Both microdosing and yoga practice have been associated with increased levels of absorption. Absorption influences how easy it is to enter altered states of consciousness (Menzies, Taylor, & Bourguignon, 2008). For example, Polito and Stevenson (2019) found self-reported absorption significantly increased after a microdosing period of six weeks. However, the relationship between absorption and yoga appears to be reciprocal, with absorption also predicting the degree to which people are able to engage in meditation during yoga. For example, Hölzel and Ott (2006) found that people who had practised meditation for a longer time were more absorptive and that absorption influenced meditation depth more than the amount of meditation practice.

The current study aimed to contribute to the growing body of knowledge about microdosing by exploring whether the relationship between microdosing and wellbeing is similar to that of regular yoga practice and wellbeing. It also aimed to enhance our understanding of the relationships between microdosing and personality and to explore whether these relationships are comparable to those associated with yoga. We explored whether or not there were differences in wellbeing, depression, anxiety and stress between people who microdose, practise yoga or do neither. Additionally, we explored whether there were differences in openness, neuroticism and absorption between people who microdose, practise yoga, or do neither. These psychological dimensions were selected since there is evidence that engaging in yoga and microdosing can affect these variables. As such, it was hypothesised that people who engage in yoga or microdosing would have increased levels of wellbeing, openness and absorption compared to the control group. However, since this is the first study to our knowledge to compare microdosing with yoga, there was no hypothesis regarding differences between these groups.

## Method

### Research design

The current study employed a quasi-experimental survey design, which was conducted online via Qualtrics between June and August 2018. The independent variable was activity, with three planned conditions: microdosing, yoga, or neither (control). However, during the recruitment process we identified participants who reported engaging in both

microdosing and yoga (MY), so this was included as a fourth condition. The dependent variables included measures of wellbeing, mood and personality. Specifically, Ryff Scales of Psychological Wellbeing was used to measure wellbeing, the Depression, Anxiety and Stress Scale-21 (DASS-21) was used to measure mood, and the M5-50 and the Tellegen Absorption Scale were used as personality measures. The survey was piloted with six people known to the researchers to assess face validity, formatting, clarity and duration of the task.

**Participants**

Yoga and microdosing participants were recruited via advertisements distributed on websites, social media and mailing lists of organisations dedicated to psychedelics or yoga. Organisations included Psychedelic Research in Science and Medicine, Entheogenesis Australis, the Australian Psychedelic Society, Kundalini Yoga Western Australia, Yoga Australia and yoga schools across Australia. The control participants were recruited via Turk Prime Panels, an international crowdsourcing platform. Participants were excluded if they were under 18 years of age, had a current diagnosed mental disorder, a history of psychosis and/or a current substance use disorder.

**Materials**

**Ryff Scales of Psychological Wellbeing**

Ryff Scales of Psychological Wellbeing was used as a measure of wellbeing. It consists of six subscales with seven items in each. These include autonomy, environmental mastery, personal growth, positive relations with others, purpose in life and self-acceptance. Factor analytic studies provide support for the six-factor structure (for review, see Ryff & Singer, 2008). Participants respond using a 6-point (1-6) Likert type scale ranging from *Strongly Disagree* to *Strongly Agree*. Internal consistencies have been reported as ranging from $\alpha$ = .69 to $\alpha$ = .85 (Morozink, Friedman, Coe, & Ryff, 2010). Test re-test reliability has ranged from .78 - .97 (Akin, 2008). Environmental mastery was not administered due to an error, which means the data were not captured.

**The Depression, Anxiety and Stress Scale-21 (DASS-21)**

The DASS-21 measures depression, anxiety and stress (Antony, Bieling, Cox, Enns, & Swinson, 1998). Participants are asked to rate how much different statements applied to them during the past week using a 4-point (0-3) Likert scale ranging from 0 = *Did not apply to me at all* to 3 = *Applied to me very much or most of the time*. There is evidence that the DASS-21 has convergent validity with a correlation of .81 found between the depression subscale of the DASS-21 and the Beck Depression Inventory and a correlation of .74 between

the DASS-21 and the Beck Anxiety Inventory (Lovibond & Lovibond, 1995). The scale is widely used and has reported internal consistencies of depression ($\alpha$ = .94), anxiety ($\alpha$ = .87) and stress ($\alpha$ = .91; Antony et al., 1998).

**M5-50**

Openness and neuroticism were measured using these two subscales of the M5-50 (Socha, Cooper, & McCord, 2010). Participants are asked to rate their level of agreement with 20 statements on a 5-point (1-5) Likert type scale (1 = *Inaccurate* to 5 = *Accurate)*. The M5-50 subscales of openness and neuroticism have good internal consistency with $\alpha$ = .78 and $\alpha$ = .86 respectively (Socha et al., 2010). The M5-50's construct validity has also been supported through the confirmatory factor analysis with the proposed five factor providing the best fit (Socha et al., 2010). Warlick, Ingram, Vuyk, and Multon (2019) demonstrated convergent validity of the M5-50 through moderate to strong correlations between the M5-50 neuroticism subscale and the neuroticism domains of the NEO-Personality Inventory-3 ($\alpha$ = .61 - .89).

**Tellegen Absorption Scale**

The Tellegen Absorption Scale was used to measure the personality trait of absorption. Participants are asked to state whether 34 statements were true or false for them. The scale's construct validity was developed following a series of factor-analytic examinations that revealed a six-factor structure that form one higher-order factor (Tellegen & Atkinson, 1974) that has excellent internal consistency, with $\alpha$ reported to range between .92 - .95 (Hölzel & Ott, 2006; Studerus, Gamma, Kometer, & Vollenweider, 2012).

**Procedure**

Following the receipt of ethics approval from the university [insert HREC reference number in final copy], potential participants were directed to a Qualtrics page containing information about the study. Rather than recording re-identifiable informed consent, participants had to check a box to indicate that they had read and understood this information before proceeding to the online survey, so they were able to remain anonymous since the research involved questions about illicit behaviour. Participants were first asked to respond to three separate items to confirm they met the inclusion criteria of being over 17 years of age and not having a current diagnosed mental disorder or a history of psychosis. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) was then completed by participants to identify people with a current substance use disorder. Developed for the World Health Organization (WHO; World Health Organization, 2010), the ASSIST has been subject

to stringent testing ensuring its reliability and validity. In accordance with the recommendations by the WHO, people who scored 27 or above for any of the eight drugs for which the ASSIST assesses were excluded from the study and provided with information about support services. Following basic demographic questions, and items concerning respondents' history of yoga and microdosing behaviour, all participants completed the aforementioned psychometric measures of wellbeing, mood, personality and drug use.

**Analysis**

The data from Qualtrics were exported to SPSS where they were screened to ensure that the assumptions for univariate and multivariate parametric analysis were met. Unless stated otherwise, all assumptions were met. To explore whether there were differences in psychological wellbeing between participants who microdosed, practised yoga or did neither, a Multivariate Analysis of Variance (MANOVA) was planned using Ryff Scales of Psychological Wellbeing as the dependent variables (DVs). A MANOVA using the three DASS-21 subscales as DVs was also planned. Separate Analysis of Variance (ANOVAs) were then conducted to explore whether there were differences in personality using the two M5-50 subscales and the Tellegen Absorption Scale. Alpha was set at .05 with Bonferroni adjustments for post-hoc analyses to reduce the likelihood of Type I error.

**Results**

From a total of 488 recorded responses, 59 people were excluded from participating in the study because their ASSIST scores indicated their substance use was harmful according to the World Health Organisation scoring criteria. Seventy-two participants did not complete all the measures. No imputation methods were performance and these cases were excluded from the analyses. An additional 18 cases were excluded due to being identified as multivariate outliers according to Mahalanobis and Cooks distance criteria described by Tabachnick and Fidell (2007). The final sample comprised 339 participants. Respondents' demographic characteristics are presented in Table 1.

(INSERT TABLE 1 HERE)

Pearson's Chi-square Tests of Independence indicated there were significant differences between the groups in the pattern of responses across gender $\chi^2$ (3, 324) = 101.282, $p$ = < .001, education, $\chi^2$ (6, 324) = 45.87, $p$ = < .001, and employment $\chi^2$ (9, 320) = 77.634, $p$ = < .001. Significant standardised residuals indicated people who reported engaging in yoga were more likely to be female, have a higher level of education and be self-

employed. A one-way analysis of variance (ANOVA) revealed a statistically significant main effect for age using Welch's F since Homogeneity of variance was not met, $F$ (3,300) = 19.720, $p$ = < .001. Games-Howell post-hoc analysis revealed the mean age of the yoga and control participants was significantly higher $p$ = <.001 than either the MY or the microdose participants.

Over half (50.6%) of the microdose participants reported they had been microdosing for 6 months or less, and 8.9% reported that they had been microdosing for two years or longer. Microdose participants reported a high level of uncertainty regarding dose. Almost half (48.1%) reported always carefully weighing dose, 29% reported eyeballing the dose, 19.1% reported sometimes measuring their dose and 3.8% didn't know what a microdose was. Many microdose participants (24.1%) microdosed every third day. See Table 2 for microdose substances reported by the participants.

(INSERT TABLE 2 HERE)

Yoga participants were mostly long-term practitioners with 10.7% having practised for two years, 9.8% having practised for 5-10 years and 35.9% for longer than 10 years. Almost a third (32.8%) of yoga participants practised daily, 22.1% practised 5 times per week, 17.6% practised 3 times per week and 4.6% practised weekly. All yoga participants practised meditation. Mantra (chanting, repeating phrase silently or aloud) was included in the practice of 50.4% yoga participants, 87.8% of yoga participants practised pranayama (breath control) and 70.2% practised drishti (specific point of focus). We were unable to extract information about the length of yoga practice for the MY group.

A MANOVA was performed using Ryff Scales of Psychological Wellbeing $F$(15, 999) = 7.989, $p$ = <.001, partial $\eta^2$ = .107. While Box's M was significant, indicating the variance-covariance matrices were not homogeneous, Tabachnick and Fidell (2007) state that MANOVA is robust against violations of this assumption. Subsequent ANOVAs showed there were significant differences for personal growth $F$(3, 335) = 23.77, $p$ = <.001, $\eta^2$ = .176 and self-acceptance $F$(3, 335) = 8.780, $p$ = <.001, $\eta^2$ = .73. Pairwise comparisons using the Games-Howell procedure showed that the control group had significantly lower scores for the psychological wellbeing component of personal growth than the yoga group $p$ = <.001, $d$ = .76, the microdose group $p$ = .001, $d$ = .62 and the MY group $p$ = <.001, $d$ = .75. Self-acceptance scores were significantly higher for the yoga group than the microdose group $p$ =

.001, $d$ = .43 and the control group $p$ = .001, $d$ = .44. Figure 1 shows mean subscale scores for each condition.

(INSERT FIGURE 1 HERE)

The control group had significantly lower overall psychological wellbeing scores than the yoga group $p$ = <.001, $d$ = .57 and the MY group $p$ = .001, $d$ = .42. The microdose group ($M$ = 30.76, $SD$ = 4.4) also scored higher in psychological wellbeing than the control ($M$ = 29.39, $SD$ = 3.9). See Table 3 for the mean scores for total psychological wellbeing by condition.

(INSERT TABLE 3 HERE)

To explore whether there were group differences in depression, anxiety or stress, a second MANOVA was conducted using the DASS-21, $F(9, 1011) = 13.98$, $p < .001$, partial $\eta^2 = .11$. Box's M was significant, indicating the assumption of homogeneity of variance-covariance matrices was violated. Post-hoc ANOVAs showed there were significant differences for depression $F(3, 335) = 11.47$, $p < .001$, partial $\eta^2 = .097$; anxiety $F(3, 335) = 9.18$, $p$ <.001, partial $\eta^2$= .076 and stress $F(3, 335) = 5.74$, $p < .001$, partial $\eta^2 = .049$. Pairwise comparisons using the Games-Howell procedure showed that the yoga group scored significantly higher in anxiety than the microdose group $p$ <.001, $d$ = .53 and the control group $p$ = .001, $d$ = .42. However, the yoga group scored significantly lower in stress than the microdose group $p$ <.001, $d$ = .58 and the MY group $p$ = .005, $d$ = .38. The microdose group scored significantly higher in depression than the yoga group, $p$ = .002, $d$ = .40. See Table 3 for descriptive statistics.

An ANOVA was performed using the M5-50 as the DV to assess whether there were group differences in openness. A statistically significant main effect was revealed for openness, $F(3, 335) = 23.165$, $p$ = < .001. The effect size $\eta^2 = .17$ was considered large, as outlined by Cohen (1988). Tukey's post-hoc procedure (using an a priori alpha of .05) revealed the control group was significantly lower in mean openness scores compared to the microdose group ($p$ = <.001), the yoga group ($p$ = <.001) and the MY group ($p$ = <.001). Effect sizes for the three comparisons were $d$ = 0.81, 0.73 and 0.64 respectively.

An additional ANOVA was conducted to assess whether there were group differences in neuroticism. The main effect for neuroticism was not significant $F(3, 335) = 1.99$, $p$ =

.115. Table 3 shows the mean scores and standard deviations for openness and neuroticism across the four conditions.

Finally, to explore whether there were statistically significant differences concerning absorption between the microdose group, yoga group, MY group and control, an ANOVA was conducted. A statistically significant main effect was revealed, Welch's $F(3, 335) = 10.45$, $p = < .001$, effect size $\eta^2 = 0.11$. As the assumption of homogeneity of variance was not met, the Games-Howell procedure was used for post-hoc analyses. The results showed that the control group had significantly lower absorption scores than the microdose group $p = <.001$, the yoga group $p = <.001$ and the MY group $p = <.001$. Effect sizes for the comparisons were $d = 0.43$, 0.57 and 0.53 respectively. Table 3 shows the total Tellegen Absorption Scale scores and standard deviations across the four groups.

## Discussion

In the present, exploratory study we aimed to investigate differences in mood and wellbeing between samples of people who either microdose, practise yoga, or engage in neither. We also aimed to investigate the personality traits of openness, neuroticism and absorption among those who microdose compared to those who practise yoga or do neither However, during the analysis process, a fourth group was identified who engaged in both yoga and microdosing (MY).

The yoga group reported better overall wellbeing compared to the control. In particular, the yoga group scored significantly higher in two of the four measured components of wellbeing, personal growth and self-acceptance, than the control group. This was consistent with the results of previous researchers who found that yoga significantly improved wellbeing (Hartfiel et al., 2011), that wellbeing was significantly related to length of yoga practice (Ivtzan & Jegatheeswaran, 2015) and that psychological wellness was significantly related to hours practising yoga (Moliver et al., 2013). The microdose group scored significantly higher than the control group in one of the four measured components of wellbeing, personal growth. To our knowledge, we were among the first researchers to generate empirical evidence that suggests microdosing might improve wellbeing. A study published after this manuscript was submitted for publication found that most participants who disclosed microdosing reported improved mood and anxiety on the days they microdosed (Lea et al., 2020).

However, the yoga group reported more symptoms of anxiety than the control, and the microdose group reported more symptoms of depression than the control. As our study was cross-sectional, it is possible that the relatively high anxiety among participants who

engaged in yoga and relatively high depression among participants who microdosed was due to sampling issues. This might be why our findings were not consistent with the findings of previous researchers who found that yoga reduced anxiety and depression (Khalsa, Shorter, Cope, Wyshak, & Sklar, 2009; Lin et al., 2011), and that self-reported microdosing decreased depressive symptoms (Polito & Stevenson, 2019).

Since previous researchers found that open-mindedness was higher among people who microdosed than people who did not (Anderson et al., 2019) and that yoga was significantly related to increased openness (Yadav et al., 2012; Yadav et al., 2015), to achieve our second aim, we sought to find out whether there were differences in openness between people who microdose, practise yoga or do neither. Consistent with previous findings, openness was significantly higher in the microdose group than the control group. Openness was also significantly higher in the yoga group than the control, and in the combined yoga and microdosing group (MY) than the control. Since past researchers have found that self-reported microdosing led to increased neuroticism at follow up (Polito & Stevenson, 2019), and that a yoga intervention significantly decreased neuroticism compared to a control group (Yadav et al., 2012), we sought to find out whether there were differences in neuroticism between people who microdose, practise yoga or do neither. However, we did not observe any statistically significant differences between the groups. Finally, consistent with previous research (Polito & Stevenson, 2019; Simpkins & Simpkins, 2010), the yoga and microdosing groups scored significantly higher in absorption than the control group.

The combination of microdosing and yoga (MY) appeared to have a complimentary effect. The microdosing and yoga group had lower depression scores than the microdose only group, and lower anxiety scores than yoga only group. Furthermore, the microdosing and yoga group had the highest absorption score. Consistent with our findings, psilocybin combined with meditation increased psychological wellbeing more than psilocybin alone (Griffiths et al., 2018). This resonates with the concept of set and setting in psychedelic-assisted psychotherapy (Hartogsohn, 2016). The context of microdosing might contribute significantly to microdosing effects.

Our cross-sectional design presents some limitations. While, our exploratory study found significant relationships between yoga, microdosing, wellbeing, openness and absorption, we cannot infer that yoga and microdosing leads to increased wellbeing, openness and absorption. Similarly, we cannot conclude that the combination of yoga and microdosing leads to decreased depression or lower anxiety. In addition, we found significant differences in age, gender, employment and education between the conditions, which could have

confounded our findings. Bias could also have impacted our results due to the use of self-reported measures.

It was impossible to know the precise dosages taken and whether all reported psychedelics consumed were psychedelics. This is because participants were using substances in an illegal context where the substances were unregulated. For example, less than half of microdose participants reported always carefully weighing their dose. In contrast, the substances and dosages used in published RCTs are known and consistent for all participants in each condition.

Participants who scored high on the ASSIST were excluded from the study. While these people were potentially vulnerable, they also potentially had more to gain in terms of improved wellbeing. It has also been suggested that psychedelics are means of treating substance use disorders (Bogenschutz et al., 2015). However, the relationship between people with substance use disorders and microdosing is an important, if ethically complex area of research, that was beyond the scope of our study.

Our study implies that both yoga and microdosing may be effective strategies for improving wellbeing. While microdosing was associated with significantly higher levels of one component of wellbeing (personal growth), yoga practitioners scored significantly higher in overall wellbeing and two specific components (personal growth and self-acceptance) compared to the control. Yoga and microdosing also appeared to have a strong relationship with levels of absorption. Yoga and microdosing participants both scored higher in absorption than the control. Participants that combined microdosing and yoga scored higher in absorption than the control and individual and yoga microdosing groups. Yoga, microdosing and their combination may be useful for improving emotional responsiveness (Tellegen, 1981) and the efficacy of mind-body interventions (Menzies et al., 2008), such as mindfulness (Hölzel & Ott, 2006), which have been shown to be significantly influenced by absorption.

Future research could explore reasons for the inconsistencies between the findings of the current study and previous research concerning the influence of yoga and microdosing on anxiety, depression and neuroticism. It will also be important to explain why microdosing was significantly related to some aspects of wellbeing and not others. A longitudinal study or RCT could help address this, and some of the aforementioned limitations of our cross-sectional design.

Future research could also investigate other psychological constructs impacted on by microdosing or yoga, such as attention, mindfulness and sense of agency, and the influence of

combined microdosing and yoga on these constructs. Additional interventions that may improve the efficacy of combined yoga and microdosing should be considered.

In conclusion, participants engaged in yoga and microdosing were found to have higher mean wellbeing scores compared to controls. Mean openness and absorption scores were significantly higher among the yoga and microdose participants. A novel finding was the complimentary effect of microdosing and yoga concerning depression, anxiety and absorption. It is hoped that the results of this study will form the basis for more rigorous research under controlled conditions.

## References


Adler, A. D., Strunk, D. R., & Fazio, R. H. (2015). What changes in cognitive therapy for depression? An examination of cognitive therapy skills and maladaptive beliefs. *Behavior therapy, 46*(1), 96-109.

Akin, A. (2008). The scales of psychological well-being: a study of validity and reliability. *Educational sciences: Theory and practice, 8*(3), 741-750.

Anderson, T., Petranker, R., Rosenbaum, D., Weissman, C. R., Dinh-Williams, L.-A., Hui, K., . . . Farb, N. A. (2019). Microdosing Psychedelics: Personality, mental health, and creativity differences in microdosers. *Psychopharmacology, 236*(2), 731-740.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological assessment, 10*(2), 176.

Bershad, A. K., Schepers, S. T., Bremmer, M. P., Lee, R., & de Wit, H. (2019). Acute subjective and behavioral effects of microdoses of LSD in healthy human volunteers. *Biological Psychiatry*.

Bogenschutz, M. P., Forcehimes, A. A., Pommy, J. A., Wilcox, C. E., Barbosa, P. C. R., & Strassman, R. J. (2015). Psilocybin-assisted treatment for alcohol dependence: a proof-of-concept study. *Journal of Psychopharmacology, 29*(3), 289-299.

Büssing, A., Khalsa, S. B. S., Michalsen, A., Sherman, K. J., & Telles, S. (2012). Yoga as a therapeutic intervention. *Evidence-Based Complementary and Alternative Medicine, 2012*.

Fadiman, J. (2011). *The psychedelic explorer's guide: Safe, therapeutic, and sacred journeys*: Simon and Schuster.

Griffiths, R. R., Johnson, M. W., Richards, W. A., Richards, B. D., Jesse, R., MacLean, K. A., . . . Klinedinst, M. A. (2018). Psilocybin-occasioned mystical-type experience in combination with meditation and other spiritual practices produces enduring positive changes in psychological functioning and in trait measures of prosocial attitudes and behaviors. *Journal of Psychopharmacology, 32*(1), 49-69.

Hartfiel, N., Havenhand, J., Khalsa, S. B., Clarke, G., & Krayer, A. (2011). The effectiveness of yoga for the improvement of well-being and resilience to stress in the workplace. *Scandinavian journal of work, environment & health*, 70-76.

Hartogsohn, I. (2016). Set and setting, psychedelics and the placebo response: An extra-pharmacological perspective on psychopharmacology. *Journal of Psychopharmacology, 30*(12), 1259-1267.

Hölzel, B., & Ott, U. (2006). Relationships between meditation depth, absorption, meditation practice, and mindfulness: A latent variable approach. *Journal of Transpersonal Psychology, 38*(2).

Ivtzan, I., & Jegatheeswaran, S. (2015). The yoga boom in western society: practitioners' spiritual vs. physical intentions and their impact on psychological wellbeing. *J Yoga Phys Ther, 5*(204), 2.

Jarrett, R. B., Minhajuddin, A., Borman, P. D., Dunlap, L., Segal, Z. V., Kidner, C. L., . . . Thase, M. E. (2012). Cognitive reactivity, dysfunctional attitudes, and depressive relapse and recurrence in cognitive therapy responders. *Behaviour research and therapy, 50*(5), 280-286.

Jeter, P. E., Slutsky, J., Singh, N., & Khalsa, S. B. S. (2015). Yoga as a therapeutic intervention: a bibliometric analysis of published research studies from 1967 to 2013. *The Journal of Alternative and Complementary Medicine, 21*(10), 586-592.

Johnstad, P. G. (2018). Powerful substances in tiny amounts: An interview study of psychedelic microdosing. *Nordic Studies on Alcohol and Drugs, 35*(1), 39-51.

Khalsa, S. B. S., Shorter, S. M., Cope, S., Wyshak, G., & Sklar, E. (2009). Yoga ameliorates performance anxiety and mood disturbance in young professional musicians. *Applied psychophysiology and biofeedback, 34*(4), 279.

Lahey, B. B. (2009). Public health significance of neuroticism. *American Psychologist, 64*(4), 241.

Lea, T., Amada, N., Jungaberle, H., Schecke, H., & Klein, M. (2020). Microdosing psychedelics: Motivations, subjective effects and harm reduction. *International Journal of Drug Policy, 75*, 102600.

Lin, K.-Y., Hu, Y.-T., Chang, K.-J., Lin, H.-F., & Tsauo, J.-Y. (2011). Effects of yoga on psychological health, quality of life, and physical health of patients with cancer: a meta-analysis. *Evidence-Based Complementary and Alternative Medicine, 2011*.

MacLean, K. A., Johnson, M. W., & Griffiths, R. R. (2011). Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *Journal of Psychopharmacology, 25*(11), 1453-1461.

Menzies, V., Taylor, A. G., & Bourguignon, C. (2008). Absorption: An individual difference to consider in mind–body interventions. *Journal of Holistic Nursing, 26*(4), 297-302.

Misra, N., Gupta, A., Alreja, S., & Prakash, O. (2013). Effect of Raj Yoga meditation on affective & cognitive functions. *International Journal of Heath Sciences and Research, 3*(2), 38-46.

Moliver, N., Mika, E., Chartrand, M., Haussmann, R., & Khalsa, S. (2013). Yoga experience as a predictor of psychological wellness in women over 45 years. *International journal of yoga, 6*(1), 11.

Morozink, J. A., Friedman, E. M., Coe, C. L., & Ryff, C. D. (2010). Socioeconomic and psychosocial predictors of interleukin-6 in the MIDUS national sample. *Health psychology, 29*(6), 626.

Nichols, D. E. (2016). Psychedelics. *Pharmacological Reviews, 68*(2), 264-355.

Polito, V., & Stevenson, R. J. (2019). A systematic study of microdosing psychedelics. *PloS one, 14*(2), e0211023.

Ryff, C. D., & Singer, B. H. (2008). Know Thyself and Become What You Are: A Eudaimonic Approach to Psychological Well-Being. *Journal of Happiness Studies, 9*(1), 13-39. doi:10.1007/s10902-006-9019-0

Simpkins, A. M., & Simpkins, C. A. (2010). *Meditation and Yoga in Psychotherapy: Techniques for Clinical Practice*. Hoboken, New Jersey.: John Wiley & Sons.

Socha, A., Cooper, C. A., & McCord, D. M. (2010). Confirmatory factor analysis of the M5-50: An implementation of the International Personality Item Pool item set. *Psychological assessment, 22*(1), 43.

Studerus, E., Gamma, A., Kometer, M., & Vollenweider, F. X. (2012). Prediction of psilocybin response in healthy volunteers. *PloS one, 7*(2), e30800.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson/Allyn & Bacon.

Tellegen, A. (1981). Practicing the two disciplines for relaxation and enlightenment: comment on" Role of the feedback signal in electromyograph biofeedback: the relevance of attention" by Qualls and Sheehan.

Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences (" absorption"), a trait related to hypnotic susceptibility. *Journal of abnormal psychology, 83*(3), 268.

Warlick, C., Ingram, P. B., Vuyk, M. A., & Multon, K. D. (2019). Concurrent validity and expanded interpretation of the M5–50. *Current Psychology*, 1-9.

World Health Organization. (2010). *The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): Manual for use in primary care*. Geneva, Switzerland: Author.

Yadav, R. K., Magan, D., Mehta, M., Mehta, N., & Mahapatra, S. C. (2012). A short-term, comprehensive, yoga-based lifestyle intervention is efficacious in reducing anxiety, improving subjective well-being and personality. *International journal of yoga, 5*(2), 134.

Yadav, R. K., Sarvottam, K., Magan, D., & Yadav, R. (2015). A two-year follow-up case of chronic fatigue syndrome: substantial improvement in personality following a yoga-based lifestyle intervention. *The Journal of Alternative and Complementary Medicine, 21*(4), 246-249.

Yanakieva, S., Family, N., Williams, L. T. J., Luke, D. P., & Terhune, D. B. (2019). The effects of microdose LSD on time perception: a randomised, double-blind, placebo-controlled trial. *Psychopharmacology, 236*(4), 1159-1170. doi:10.1007/s00213-018-5119-x

Table 1. Demographic Characteristics.

| | Microdose | Yoga | Control | MY |
|---|---|---|---|---|
| Mean Age (*SD*) | 34.37 (10.79) | 44.85 (12.25) | 47.8 (17.40) | 33.35 (9.70) |
| Gender (%) | | | | |
| Male | 51 (73.9) | 17 (12.3) | 40 (45.4) | 33 (61.1) |
| Female | 17 (24.6) | 121 (87.6) | 44 (50) | 20 (37) |
| Other | 1 (1.40) | __ | __ | 1 (1.9) |
| Highest level of education (%) | | | | |
| High school | 31 (44.9) | 12 (9.1) | 31 (36.4) | 16 (29.6) |
| Further education | 12 (17.3) | 33 (25.1) | 29 (34.1) | 14 (25.9) |
| Tertiary | 26 (37.6) | 84 (64.1) | 22 (16.7) | 21 (38.8) |
| Other | 4 (5.7) | 2 (1.5) | 3 (3.5) | 3 (5.6) |
| Employment status (%) | | | | |
| Fulltime | 25 (36.2) | 29 (22.1) | 26 (30.5) | 23 (42.5) |
| Part time | 22 (31.9) | 36 (27.4) | 13 (15.2) | 8 (14.8) |
| Unemployed | 5 (7.2) | 17 (12.9) | 40 (47) | 5 (9.2) |
| Self-employed | 16 (23.2) | 48 (36.6) | 4 (4.7) | 18 (33.3) |

*Note:* Missing data for employment = microdose 1, yoga 1, control 2. Missing data for age = yoga 15, microdose 1. Control 1 and MY 3. SD = standard deviation.

Table 2. Microdose Substances Reported by Microdose and MY Participants.

| | Microdose | MY | Total |
|---|---|---|---|
| Psilocybin | 44 | 32 | 76 |
| LSD | 43 | 32 | 75 |
| DMT | 4 | 9 | 13 |
| Mescaline | 1 | 1 | 2 |
| 251-NBome (2c-1-NBome) | 1 | 0 | 1 |
| 2C-B | 0 | 2 | 2 |
| Mescaline NBome | 1 | 0 | 1 |
| 1P-LSD | 3 | 5 | 8 |
| 4 – Acetoxy DMT | 1 | 0 | 1 |

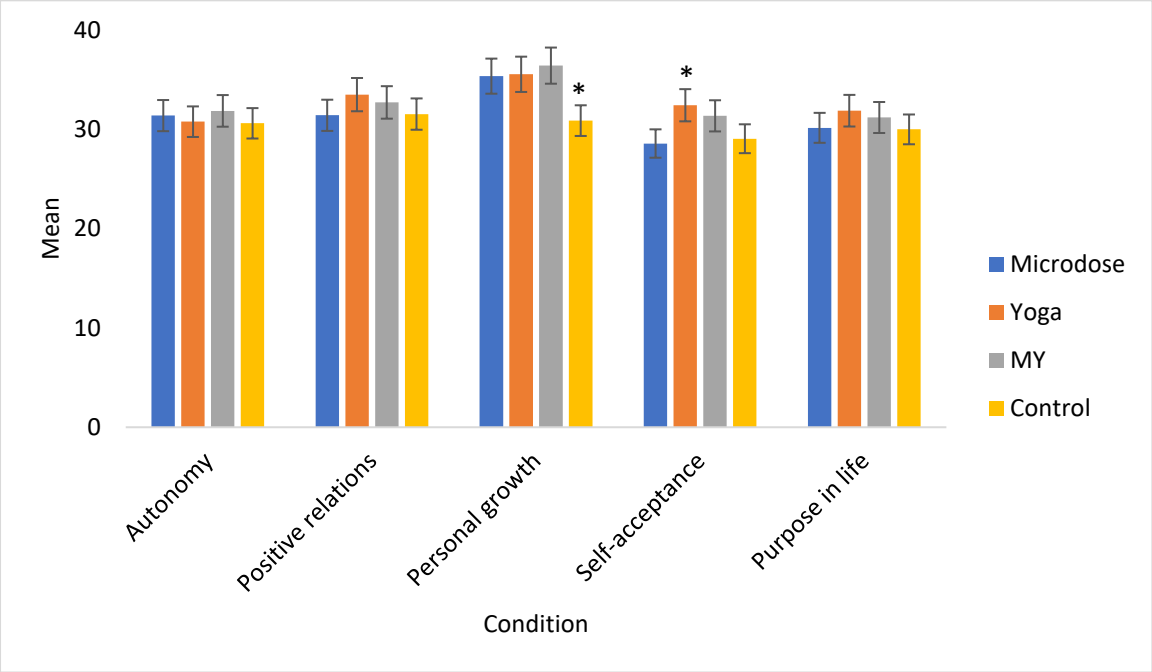
Table 3. Descriptive Statistics for Psychological Wellbeing, Depression, Anxiety, Stress, Neuroticism, Openness and Absorption.

| Variable | | N | Mean | SD | Lower (CI, 95%) | Upper (CI, 95%) |
|---|---|---|---|---|---|---|
| Psychological Wellbeing | Control | 85 | 29.39 | 3.9 | 28.55 | 30.24 |
| | Microdose | 69 | 30.76 | 4.4 | 29.70 | 31.81 |
| | Yoga | 131 | 32.33** | 3.9 | 31.64 | 33.02 |
| | MY | 54 | 32.15** | 4.2 | 31.07 | 33.21 |
| Depression | Control | 85 | 2.41 | 2.97 | 1.87 | 3.39 |
| | Microdose | 69 | 3.95* | 3.54 | 3.03 | 4.70 |
| | Yoga | 131 | 2.15 | 2.44 | 1.73 | 2.60 |
| | MY | 54 | 2.62 | 2.87 | 1.87 | 3.39 |
| Anxiety | Control | 85 | 2.16 | 2.54 | 1.61 | 2.71 |
| | Microdose | 69 | 2.00 | 1.80 | 1.57 | 2.43 |
| | Yoga | 131 | 3.60** | 2.83 | 3.11 | 4.09 |
| | MY | 54 | 2.52 | 2.02 | 1.97 | 3.07 |
| Stress | Control | 85 | 3.13 | 2.95 | 2.50 | 3.80 |
| | Microdose | 69 | 4.48 | 3.27 | 3.70 | 5.26 |
| | Yoga | 131 | 2.18** | 1.95 | 1.84 | 2.52 |
| | MY | 54 | 3.96 | 3.34 | 2.96 | 4.80 |
| Openness | Control | 85 | 3.64 | .502 | 3.54 | 3.75 |
| | Microdose | 69 | 4.21** | .433 | 4.10 | 4.31 |
| | Yoga | 131 | 4.08** | .491 | 4.00 | 4.17 |
| | MY | 54 | 4.13** | .425 | 4.01 | 4.24 |
| Neuroticism | Control | 85 | 2.28 | .756 | 2.11 | 2.44 |
| | Microdose | 69 | 2.44 | .803 | 2.25 | 2.63 |
| | Yoga | 131 | 2.17 | .709 | 2.05 | 2.29 |
| | MY | 54 | 2.22 | .710 | 2.04 | 2.42 |
| Absorption | Control | 85 | 15.40 | 9.30 | 13.40 | 17.40 |
| | Microdose | 69 | 20.58** | 7.03 | 18.90 | 22.27 |
| | Yoga | 131 | 21.53** | 6.72 | 20.36 | 22.69 |
| | MY | 54 | 22.18** | 7.17 | 20.23 | 24.14 |

*Note:* SD = standard deviation, CI = confidence intervals, * $p <$. 005 and ** $p <$ .001.

**Figure 1**

*Mean Ryff Scales of Psychological Wellbeing Subscale Scores by Condition*




*Note*: Error bars represent 95% confidence intervals and * $p$ <.001.