Perceived harm, motivations for use, and subjective experiences of recreational psychedelic ‘magic’ mushroom use

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Abstract:

**Background:** Data on actual harm of magic mushrooms suggest that toxicity and abuse potential is low, however its legal status suggests otherwise. We aimed to gauge perception of harm of magic mushrooms in both users and mushroom naïve participants. We also aimed to observe differences in expectations of effects between users, and mushroom naïve participants, and also whether motivations for use predicted their expected effects.

**Method:** Seventy-three polydrug users with experience of using magic mushrooms, and 78 mushroom naïve participants completed an online survey. We asked participants to rank a list of 10 substances from most dangerous to least dangerous, and questions about expectation of effect using a modified magic mushroom expectation (MM-EXP) questionnaire. Users were asked about their motivations for using magic mushrooms.

**Results:** Both groups perceive mushrooms to be safer than; heroin, cocaine, prescription painkillers, GHB, ecstasy, tobacco and alcohol. However the mushroom naïve group ranked mushrooms as significantly more dangerous than the user group. Non-users reported greater expectancy for negative intoxication. Users reported greater expected entactogenic, prosocial, aesthetic and mood effects, and perceptual alterations. Finally, expectant effects of mushroom use were associated with different motivations for use, for example using for personal psychotherapy was associated with expectation of increased entactogenic effects, and decreased negative effects.

**Conclusion:** Our data suggest a general perception of harm which is in-line with data on actual harm, but at odds with current legal classifications. Future clinical investigations may require management of negative intoxication expectation of participants with no prior experience of psilocybin.

**Introduction:**

Psilocybe mushrooms, known colloquially as “magic mushrooms”, have been used for millennia in various shamanic cultures as an entheogen and for divinatory purposes (Wasson, 1957). Psilocybin (4-phosphoryloxy-*N,N*-dimethyltryptamine), along with its non-phosphorylated counterpart; psilocin, is the primary psychoactive compound found within “magic” mushrooms (Studerus et al., 2011), typically occurring at concentrations of 0.5% - 1% (m/m) per mushroom (Dinis-Oliviera, 2017; Freye, 2009). Psilocybin can also be chemically synthesised (Shirota et al., 2003). The compound has recently shown efficacy in clinical trials for the treatment of anxiety and depression in patients with life threatening cancer (Grifiths et al., 2016; Ross et al., 2016). Currently psilocybin is also the subject of open-label feasibility work as an adjunct to psychological support for treatment-resistant depression (Carhart-Harris et al., 2016; Carhart-Harris et al., 2018).

Psilocybin abuse potential has never been assessed to standards set out by the FDA’s 2017 Guidance: Assessment of the Abuse Potential of Drugs (Johnson et al., 2018). However preclinical work suggests that psilocybin has weak, transient reinforcing effects, in comparison to drugs of high abuse potential, resulting in sporadic self-administration (Fantegrossi et al., 2004), and no evidence of dependence, or withdrawal (Johnson et al, 2018; Martin, 1973). Office for National Statistics found that magic mushroom use is relatively uncommon in the UK, with around 0.5% of 16 to 59 year olds reporting using them within the past year, a figure that has been broadly consistent since 1996. In the USA, 2018 NIDA estimates suggest approximately 1.3% of over-26 year olds had used hallucinogens in the past year, and approximately 7% of 18 to 25 year olds, however, this was not broken down to separate out magic mushrooms from other hallucinogens such as LSD, DMT or others

Psilocybin is generally accepted as having low toxicity. Preclinical work suggests an LD50 of 280-285mg/kg for rats and mice (Cerletti, 1958; Dinis-Oliviera et al., 2017; Passe et al., 2002). Freye (2009) calculates that given psilocybin can make up to 1% of a magic mushroom, that 1.7kg of dried mushrooms or 17kg of fresh mushrooms would be necessary for a 60kg human to reach the equivalent LD50 observed in preclinical work. A ‘recommended’ recreational psychedelic dose is reported to be 1-5g of dried mushrooms, or 10-50g of fresh mushrooms (van Amsterdam et al., 2011). Thus a lethal dose is somewhere in the order of >340 times the recreational dose. For these reasons human deaths from toxic doses of psilocybin are extremely rare, especially in people who did not use mushrooms in combination with other drugs (van Amsterdam, 2011), although two fatal cases have been documented from magic mushroom poisoning without concomitant use of other substances (Gerault & Picart, 1996).

Though magic mushrooms are in the same legal classification as drugs with high abuse potential and toxicity such as heroin and cocaine, recreational users and drug experts rate the health harm of magic mushrooms as low. For example experienced drug users rank psilocybin as being one of the least harmful (perceived harm) psychoactive substances (Carhart-Harris & Nutt, 2013), and Nutt et al.’s (2010) multicriteria decision analysis (MCDA) placed mushrooms at the bottom of a list of 20 psychoactive substances ranked on their relative harms (evidence based harm, based on 16 criteria, relating to harm to self, as well as harm to others). Other MCDAs globally have drawn similar conclusions about relative harms of magic mushrooms e.g. Bonomo et al., 2019

However, whilst abuse potential and toxicity of psilocybin are low, there are examples of adverse reactions, and other complications which may contribute to its legal classification. For example, the phenomenon known as a ‘bad trip’ which is an acute experience of serious negative effects. Such symptoms include extreme anxiety/panic, severe agitation, and confusion (van Amsterdam et al., 2011). In some more serious cases acute psychotic episodes have been reported, characterised by severe paranoia and loss-of reality, followed by persisting depression and paranoia for days and weeks following use (van Amsterdam et al., 2011). Research suggests that individuals with a history of psychiatric health complications, polydrug abuse, and ingestion of drugs in an unsupervised environment have a greater tendency to experience these complications. Moreover, adverse reactions are not necessarily dose dependent, and the psychedelic experience can vary dramatically even when the dose is kept constant (Nichols, 2004). In addition to this, ‘bad trips’ have occasionally resulted in serious accidents and there are a number of documented cases of fatalities from falling or jumping out of buildings (van Amsterdam et al., 2011; Honyiglo et al., 2019). Therefore magic mushroom use does pose a risk of self-injurious behaviour in the absence of a sober attendant.

Clearly many extra-psychopharmacological factors contribute to the magic mushroom psychedelic experience; including anticipated effects, previous experience, and motivations for drug use (components that would all fall under the umbrella term of ‘set’, in Zinberg’s 1984 description of the basis for controlled intoxicant use). This is important because the role of expectancies in actual experience is critical if this research is to be translated to psychiatric treatments for patients with no prior experience of psychedelic drugs.

This study aimed to explore how users and non-users of magic mushrooms ranked the drug’s relative harms versus other substances such as alcohol and tobacco (legally available), prescription opiates e.g. codeine and tramadol (legal with prescription), heroin, cocaine, ecstasy, LSD (Class A), cannabis (class B) and GHB (Class C). We wished to observe whether those who had previous experience with magic mushrooms differed in their expectation of the subjective effects following ingestion of magic mushrooms. Moreover, due to the extra-psychopharmacological factors that influence the psychedelic state, we wanted to observe whether user motivation for use was associated with their expected effects.

We predicted that (1) participants who have had previous experience with magic mushrooms will rank them as significantly less dangerous than mushroom naïve participants, (2) mushroom naïve participants will report more expected negative effects of magic mushroom use, and (3) different motivations for using magic mushrooms (assessed in users only) will be associated with differences in expected effects.  
**Methods**:

Participants:

A power calculation for ranks was conducted using the sample size package in R. For ranking data, specific estimates must be made about the proportion of responses in each rank. In this case we had ten ranks and kept the portion of five higher ranks (i.e. mushrooms being in the top five most dangerous drugs as 0), we predicted the other proportions of ranks (from least to sixth most dangerous) to differ in users (0.35, 0.35, .20,.05,.05) compared to non-users (0.20, 0.20, .20, .20,.20). At 95% power with two-tailed an alpha of .05 this suggested we needed at least 64 participant in each condition.

A total of 151 participants completed the survey in full (73 users, 78 non-users). Participants were recruited by advertising a study link to psilocybin/magic mushroom – or drug related social media pages, forums of websites that provide information about recreational drug use (e.g., www.bluelight.org, [www.drugs-forum.com](http://www.drugs-forum.com), [www.reddit.com](http://www.reddit.com)), and the researchers’ social media network. The study was advertised as an investigation into perceived safety and subjective effects of psilocybin (magic) mushrooms in users and non-users, and was open only to adults (> 18 years of age). To qualify as a user participants must have used magic mushrooms at least once in the last 6 months. To qualify as a non-user, participants must never have used magic mushrooms. It was however specified on the information sheet that previous use of other drugs does not exclude participation in either the user, or non-user groups. Participants were required to be able to read English, and to live in the UK, USA, Canada, or inside the European Union. Participants were given no monetary incentive, or reimbursement for their participation in the study. The study was approved by the University of Liverpool Research Ethics Committee, and participants were required to provide informed consent prior to undertaking the survey.

**Measures and procedure:**

All participants completed the survey online at [www.qualitrics.com](http://www.qualitrics.com). Participants were provided with study information, following which they gave informed consent. There were four main components to the survey, the first of which requested demographic information (age, sex, country of residence), information about their use of magic mushrooms (user or not, as specified in the eligibility criteria), and information about the frequency with which they have used a range of other substances in the last three months (on a 4 point likert sale ranging from 1= always, to 4 = never). The remaining three components of the survey related to perceived safety, subjective effects and reasons for using magic mushrooms.

*Perceived safety of magic mushrooms:* This was based on a survey of perceived safety of ecstasy in Gamma et al. (2005). In brief, participants were required to rank a list of commonly used substances (both illicit and legally available) in order from 1 (safest), to 10 (most dangerous). The list included alcohol and tobacco (legally available), prescription opiates (e.g. codeine and tramadol), heroin, cocaine, ecstasy, magic mushrooms, cannabis, LSD and GHB.

In addition to ranking each drug on their perceived relative harms, participants were asked specifically how dangerous they thought magic mushrooms were on a 5 point likert scale, ranging from 1 = very safe to 5 = very dangerous.

*Subjective effects of magic mushrooms (MM-EXP):* We wanted to understand what both users and non-users thought about the effects of magic mushrooms. In order to do this we asked users to report their subjective experiences, and non-users to report their expectations of the effects of magic mushrooms on a 29 item scale based on the ‘ecstasy effects and effect expectations’ questionnaire created by Sumnall et al. (2006), which we modified to relate to magic mushrooms (we confirmed the modified factor structure using Confirmatory Factor Analysis, see data analysis). This questionnaire contained six subscales (1) *Perceptual alterations* (e.g., Everything I look at seems to vibrate or pulse when I am on magic mushrooms), (2) *Entactogenesis* (e.g., On magic mushrooms, I can deliberately generate insights concerning myself, my personality, and my relationships with other people), (3) *Prosocial effects* (e.g., When I am on magic mushrooms I have strong feelings of caring or compassion for people who I am with), (4) *Aesthetic and mood effects* (e.g., on magic mushrooms, wherever I am looks especially beautiful), (5) *Negative intoxication effects* (e.g., I get anxious when I am on magic mushrooms), (6) *Sexual effects* (e.g., sexual orgasm has new qualities when I am on magic mushrooms). Participants responded to each item on a 7 point likert scale from 1 = strongly disagree, to 7 = strongly agree. A high score on each subscale reflected high levels of self-reported effects or expectation of effects. We reverse scored two items that were negatively worded on the sexual effects subscale (“sexual orgasm is difficult to achieve”, and “I find it hard to remain physiologically stimulated during sex (e.g. male erection/female lubrication)”) in order to maintain positive inter-item correlations.

*Reasons for using magic mushrooms:* In order to test the hypothesis that use function/motivation for use of magic mushrooms would affect subjective experiences, we employed the same use function components as those reported in Sumnall et al. (2006). We asked participants to say whether they agreed (yes/no) with a list of statements proposing reasons for their mushroom use (e.g. ‘I use magic mushrooms to explore altered states of consciousness’, ‘I use magic mushrooms to enhance sex’, ‘I use magic mushrooms to enjoy dancing’, ‘I use magic mushrooms for personal psychotherapy’, ‘I use magic mushrooms for group psychotherapy’, ‘I use magic mushrooms to be creative’, ‘I use magic mushrooms to be sociable’, ‘I use magic mushrooms to get closer to nature’, ‘I use magic mushrooms for fun’, ‘I use magic mushrooms to enjoy music’, ‘I use magic mushrooms to go to raves’.

***Data analysis*:** Data analysed using SPSS (version 24) and R version 3.6.0. Preliminary data screening involved removal of all participants who did not complete all components of the survey (*n* = 83, 35%). Responses to the question asking how dangerous magic mushrooms are (from 1=very safe to 5 = very dangerous) were compared between groups using a Mann-Whitney U test. In order to analyse the ranking of perceived harm of each substance, related-samples Kendall’s coefficient of concordance tests were run for each group (user/non-user) separately. Where significant, *post hoc* Wilcoxon tests were used to compare magic mushroom ranks to other drugs. The mean ranking of magic mushrooms was assessed between the two groups using a Mann-Whitney U test.

Confirmatory factor analyses (CFA) of the factor structure of the modified *magic mushrooms* effects and expected effects questionnaire (MM-EXP) were conducted in AMOS (version 24), using the maximum likelihood estimation. We conducted CFA on each subscale independently. Model fit was assessed using a normed χ2 statistic (χ2/df), and the standardized root mean residual (SRMR) absolute fit index (Hu & Bentler, 1999). A χ2/df score <2 and SRMR <0.08 represent a good model fit. In addition the root mean square error of approximation (RMSEA) non-centrally based index of model fit was computed for which a value <0.06 is accepted as a good fit, and values between <0.06 and <0.08 are deemed acceptable (Browne & Crudeck, 1993). Internally reliability of each subscale was measured using Macdonald’s Omega (ωt) (Revelle & Zinbarg, 2009).

Between-group comparisons of users and non-users on the individual subscales of the MM-EXP were conducted using Mann-Whitney U tests. With group status (user/non-user) as the independent variable, and subscale total (perceptual, entactogenic, prosocial, aesthetic and mood, negative effects, sexual effects) as dependent variables.

Finally in order to explore the association between expected effects of magic mushrooms and self-reported use function (in users only) a series of penalised likelihood logistic regressions were ran. Penalised likelihood regression were preferred to standard logistic regression as some self-reported use functions were uncommon e.g. sexual reasons were only given by 8 participants). This increases the likelihood of spurious associations caused by (partial) separation in the data. By adding constraints to the regression equation it also penalizes the model for having several predictors and reduces small sample bias (Bruce & Bruce 2017).

Results:

***Sample characteristics***

Magic mushroom users (n = 73) had a mean age of 29.68 ± 11.04, and consisted of 57 (78.1%) males, and 16 (21.9%) females. Non-users (n = 78) had a mean age of 29.23 ± 9.56, and consisted of 26 males (33.3%) and 50 females (64.1%). There was a statistically significant association between user-group and gender χ2 (1, N=149)=29.05, p<.001, with a higher percentage of males in the user group than the non-user group.

Respondents were primarily from the UK (47.9%) or the USA (20.5%), the remaining participants were from various countries in the EU. Non-users also primarily resided in the UK (52.0%), or the USA (43.6%), remaining respondents were from the EU.

Of the magic mushrooms users, 8 (11.4%) reported using magic mushrooms frequently in the last 3 months, 48 (68.6%) reported occasional use in the last 3 months, and 14 (20%) reported that they had not used magic mushrooms in the last 3 months. Frequency of use of other drugs in the last 3 months for both users and non-users are reported in table 1. Table 1 shows polydrug use in both user, and non-user groups. There were significant differences in reported frequencies of use in cannabis, cocaine, DMT, ketamine, LSD, poppers, salvia, tobacco (p < .01) and tranquilisers and Viagra (p<.05), in each case users reported more frequent use than non-users (Mann-Whitney U tests). There were no between group differences in alcohol use, or amphetamine use. Other drugs showed minimal use by either group.

***Perceived harm of psilocybin mushrooms***

On the responses to the question “how dangerous do you think psilocybin (magic) mushrooms are?” users believed it to be safer than non-users U = 1075.00, *p*< .001, r = .52. See table 2 for breakdown of responses.

We conducted Related-Samples Kendall’s Coefficient of Concordance tests for both users and non-users of magic mushrooms independently, to observe both group’s perception of relative harm of magic mushrooms compared to other commonly used substances. Mean ranks of each drug can be seen in Table 3.

For the magic mushroom users there was a significant overall effect of substance type on perceived harm χ2 (9) = 361.74, *p* <.001, *W* = .55. Pairwise comparisons suggest that magic mushroom users perceived mushrooms to be significantly less harmful than heroin, cocaine, alcohol, prescription opiates, tobacco, GHB and ecstasy (p’s<.001). As can be seen in table 3 and figure 1, magic mushrooms users perceive psilocybin mushrooms to be the least harmful substance listed.

For non-users there was also a significant effect of substance type on perceived harm χ 2 (9) = 256.65, *p* <.001, *W* = .37. Pairwise comparisons suggest that non-users perceived use of magic mushrooms to be significantly less harmful that heroin, cocaine, prescription painkillers, GHB, ecstasy, tobacco (*p*<.001) and alcohol (*p*<.01), neither group rated the perceived harm of magic mushrooms as significantly different to LSD or cannabis.

As there were a small number of participants in the non-user group who reported using other classical hallucinogens (LSD or DMT – Table 1), we reran this test following exclusion of these participants. The overall effect remained χ 2 (9) = 240.870, *p* <.001, *W* = .38. The pairwise comparisons remained the same, although statistical significance level between mushrooms and alcohol changed to *p*=.05.

We also compared responses from our non-mushroom-user sample between those who report use of other drugs and drug naïve respondents. There were no differences in perceived harm of magic mushrooms in this analysis (see supplementary material).

A Mann-Whitney U test suggested that there was a significant difference between users and non-users in the relative perceived harm of magic mushrooms (U = 1305.50, *p*<.001, *r* = .48) whereby users ranked mushrooms as less harmful than non-users did. This result remained unchanged following removal of participants reporting use of classical hallucinogens in the non-mushroom user group.

***Expected effects of magic mushrooms (MM-EXP)***

First we performed CFA on each subscale of the MM-EXP. In brief the four items that comprise the Perceptual effects total provided a good model fit (χ2/df = 0.21; SRMR = 0.0013; RMSEA < .001; ωt = 0.66), as did the four items comprising the Entactogenic effects scale (χ2/df = 0.23; SRMR = 0.012; RMSEA < .001; ωt = 0.71), six items on the aesthetic and mood effects subscale χ2/df = 1.99; SRMR = 0.062; RMSEA = 0.08; ωt = 0.73), six items on the negative effects subscale χ2/df = 0.90; SRMR = 0.035; RMSEA < .001; ωt = 0.8) and the five items on the sexual effects subscale (χ2/df = 2.01; SRMR = 0.059; RMSEA = .08; ωt = 0.69). However although the prosocial effects scale maintained a good model fit (χ2/df = 1.35; SRMR = 0.032; RMSEA = 0.049; ωt = 0.77) item 4 “magic mushrooms lower my inhibitions so that I say and do things I'm normally to inhibited to do” was subsequently dropped from analysis due to having a non-significant factor loading (p=.438).

Mann-Whitney U tests on the individual subscales of the MM-EXP questionnaire revealed that users scored significantly higher than non-users on expected perceptual alterations U = 1797.00, *p*<.001, *r* = .32, entactogenic effects U = 1283.00, *p*<.001, *r* = .48, prosocial effects U = 1050.50, *p*<.001, *r* = .55, and aesthetic and mood effects U = 1708.50, *p*<.001, *r* = .35.

Non-users scored significantly higher than users on expected negative effects U = 1616.00, *p*<.001, *r* = .37. There were no significant differences between groups on expected sexual effects (table 4).

All of the above results remained unchanged following removal of participants in the non-user group who report use of other classical hallucinogens.

***Motivations for use and expected outcomes (table 5)***

We conducted a series of Firth’s penalised likelihood logistic regressions. In each case the dependent variable was reason/motivation to use magic mushrooms. Total subscale scores from the MM-EXP were entered as predictor variables. As there were eleven regression models in total, we considered *p*<.01 as significant. Full regression models can be observed in table 5, but in brief: Using for spiritual reasons had a positive association with the perceptual, and entactogenic subscales of the MM-EXP (*p*<.001), and a negative association with the negative effects subscale (*p*<.01). Using for altered consciousness was associated with perceptual effects of the MM-EXP (*p*<.01) and negatively associated with the negative effects subscale of the MM-EXP (*p*<.001). Using to enhance sex was positively associated with the sexual subscale (*p*<.001), and the perceptual subscale of the MM-EXP. Using for personal psychotherapy was positively associated with the entactogenic subscale (*p*<.001) and negatively associated with the negative effects subscale of the MM-EXP (*p*<.001). Using for creativity was positively associated with the aesthetic and mood subscale (*p*<.01) and negatively associated with the negative effects subscale of the MM-EXP (*p*<.001). Using to get closer to nature was positively associated with the entactogenic subscale of the MM-EXP (*p*<.01) and finally using to enjoy music was positively associated with the perceptual

**Discussion**

Our results suggest that in line with hypothesis 1, participants reporting previous use of magic mushrooms ranked use of magic mushrooms as significantly less dangerous than mushroom naïve respondents. Magic mushrooms were ranked 10th, as the least harmful of the 10 listed substances, by users. However, they were also ranked 9th by non-users, who only rated cannabis use as less harmful. Pairwise comparisons found they were considered significantly safer than heroin, cocaine, prescription painkillers, GHB, ecstasy, tobacco and alcohol by both groups. In line with hypothesis 2 non-users reported significantly greater expectancy for negative intoxication effects of magic mushrooms, whereas users reported greater expected perceptual alterations, entactogenic effects, prosocial effects, and aesthetic and mood effects. And in line with hypothesis 3, penalised maximum likelihood logistic regression results showed that different expectant effects of mushroom use were associated with different motivations for use.

To our knowledge this is the first study to compare perception of harm of magic mushrooms relative to other drugs in both user and non-user populations. Whilst, as predicted users did rank mushrooms as less harmful than non-users, it is interesting that users and non-users alike ranked magic mushrooms as less harmful than several legal substances (tobacco, alcohol), legal prescription substances, and substances which are of a lower drugs classification category (GHB – class C). These results support a general perception of harm of magic mushrooms which is in line with data on actual harm (abuse potential and toxicity), and the scientifically recognised relative harms of psilocybin mushrooms compared to other drugs (Gamma et al., 2005; Nutt et al., 2010) This indicates that public health messaging based on scientific evidence about relative harms of drugs are seen as more credible information sources than government legal drugs classification systems.

In terms of expectation of drug effects of psilocybin mushrooms we see clear differences between those who have previous experience with mushrooms, and those who do not. The expected negative intoxication effects reported by the mushroom naïve participants are likely the result of well documented adverse reactions of psychedelic drug use, in uncontrolled settings (Strassman, 1984). However, the great variability in the subjective experience is at least in part underscored by personal expectation (set), and the environment (setting) in which the experience takes place (Nichols, 2004). This suggests negative effects can be reduced significantly by educating the naïve user prior to a psychedelic episode (e.g. in the clinical therapeutic setting, accompanied by sober attendants), and creating a safe setting (Tylš et al., 2014). Taken together this indicates that it would be necessary to address negative intoxication expectancies in psilocybin naïve patients prior to any clinical investigation of therapeutic effect (e.g. Johnson et al., 2008).Other reported differences in expected effects included perceptual alterations, entactogenic effects, prosocial effects, and aesthetic and mood effects, whereby experienced users of magic mushrooms showed significantly increased expectation of these positive effects relative to magic mushroom naïve participants.

We explored the same motivations for magic mushroom use (in users only) as those explored by Sumnall et al. (2006) for ecstasy use. As predicted different motivations for use predicted differences in subjective experiences of magic mushrooms. We observed significant positive associations between expected perceptual and entactogenic effects when people reported using magic mushrooms for spiritual reasons. There was also a negative association between spiritual use, and negative intoxication expectancy. The term entactogen means “touching within” (Nichols, 1986), and relates to the generation of insights concerning oneself, personality and relationships. . Interestingly two other functions of use which also predicted by entactogenic expectation were; ‘to get closer to nature, and ‘personal psychotherapy’. It seems that the generation of insights relating to oneself, and personal relationships which can be focused by psilocybin makes this substance appealing as a form of personal psychotherapy. It is also noteworthy that there was a negative association between negative intoxication expectancies and use for personal psychotherapy which is encouraging for researchers exploring the utility of psilocybin as an adjunct to talking therapy for treatment resistant depression.

Other use function positive associations include perceptual effects, for those using to alter their state of consciousness, sexual effects for those using to enhance sex, and for those who use it for dancing. Aesthetic and mood effects for those who are motivated for creativity, and perceptual effects for those who want to enjoy music. Each of these associations serves to further highlight the impact of the extra-psychopharmacological factor of expectancy on the psilocybin/magic mushroom experience (Sellers, 2017). Such extra-psychopharmacological, and expectation effects, require careful management in any clinical investigations with psilocybin mushrooms.

***Limitations***

There are several limitations for the current study. Firstly in order to improve retention of respondents for the duration of the online survey we kept the survey brief to complete. Due to the brevity of the survey we did not collect in depth information about background drug use history, nor did we collect information about dose. As such we cannot provide any information about whether there are tolerances to expected effects following prolonged use, or doses at which expected effects may occur. However, as the main focus of the paper was about perceptions of harm, and motivations for use with a psychedelic dose, we do not believe that this is confounds our results to any large extent. Secondly, half of our mushroom naïve population do report experiences with several illicit drugs other than magic mushrooms. So whilst our non-user group may be psilocybin naïve, they are a mix of polydrug users, and non-drug users, which is arguably more representative of the background drug use of the mushroom naïve portion of the general population who may, in the future be offered psilocybin as an adjunctive therapy for a clinical condition. Nevertheless this may have implications for the data on relative harms of a list of substances, as we may have recruited a particularly well drug-informed control group which may have led to desired responding of relative harms based on the scientific literature. Our supplementary analysis shows there were no differences between mean ranks of any of the listed substances between those who reported use of other drugs and those who did not in the mushroom naïve sample.

Due to the online nature of this study there is a potential selection bias for participants who are interested in this research area, which cannot be accounted for in supplementary analysis. The online nature of the study could produce further bias inasmuch as it exudes those individuals without access to the internet. Furthermore the sample is predominately UK and US based. There are also differences in the sex ratio of our user, and mushroom naïve groups, whereby there are more females in our mushroom naïve group which may limit the generalizability of our findings (see supplementary materials for reanalysis of MM-EXP differences after splitting the data by sex). Indeed future work could comprehensively analyse the impact of demographics including socioeconomic status, gender, mental health history, and location the factors explored in the current study.

Finally, this study provides no information about potential negative long-term health effects of using psilocybin mushrooms in controlled and uncontrolled settings.

Finally, whilst the MM-EXP was modified from the E-EXP detailed in Sumnall et al. (2006), this is not a bespoke tool for measuring magic mushroom effects and effect expectations. It is notable that we report CFA and internal reliability statistics for this scale, however a bespoke tool measuring magic mushroom effects and expectations, as well as motivations for use, could prove beneficial for future research. The items included in this paper may prove to be a useful framework for this work.

***Conclusion***

Our study shows that the perceived relative harm of magic mushrooms compared to several other substances in considered to be low in both users, and magic mushroom naïve participants. Previous experience of magic mushroom use is associated with more positive expectation effects, whereas use naivety is associated with greater negative intoxication expectation effects. Intoxication effect expectancies are also different in people who report different motivations for use.

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