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Title: Psychedelics, Personality and Political Perspectives

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Abstract

Aims: There is evidence that the psychedelic experience (including psychedelic-induced ego-dissolution) can occasion lasting change in a person's attitudes and beliefs, which may be of therapeutic value. We aimed to investigate the association between recreational psychedelic-use and personality, political perspectives and nature-relatedness using an anonymous internet survey.

Methods: Subjects provided information about their recreational psychedelic, cocaine and alcohol-use, and answered questions relating to personality traits of openness and conscientiousness (Ten Item Personality Inventory), nature-relatedness (Nature-Relatedness Scale), and political attitudes (1-item liberalism-conservatism measure and 5-item libertarian-authoritarian measure). Subjects also rated the degree of ego-dissolution experienced during their 'most intense' recalled psychedelic experience (Ego-Dissolution Inventory).

Results: Eight hundred and ninety-three subjects completed the survey. Multivariate linear regression analysis indicated that lifetime psychedelic-use (but not lifetime cocaine-use or weekly alcohol-consumption) positively predicted liberal political views, openness and nature-relatedness, and negatively predicted authoritarian political views, after accounting for demographic confounders. Ego-dissolution experienced during a subject's 'most intense' psychedelic experience also positively predicted liberal and anti-authoritarian political views, openness and nature-relatedness.

Conclusions: Further work is needed to investigate the nature of the relationship between the peak psychedelic experience and openness to new experiences, egalitarian political views, and concern for the environment.

Key words

Psychedelic, ego-dissolution, liberalism, openness, conscientiousness, nature-relatedness

Introduction

The transpersonal or mystical experience is perhaps the most powerful and transformative in the human psychological repertoire (James, 1985). It is of primary importance in all spiritual / religious traditions, where it is considered to be a catalyst for positive psychological change within an individual (James, 1985). Mystical experiences, including those of awe and self-transcendence, may also be encountered in many non-religious contexts, including the beauty and vastness of the natural world, and the feeling of being connected to others experienced in large gatherings of individuals unified by a common cause (Emerson, 2003; Haidt, 2013; James, 1985; Piff, Dietze, Feinberg, Stancato, & Keltner, 2015). In addition, certain psychoactive drugs (specifically, serotonergic 'classical' psychedelic drugs) have been used to occasion mystical-type experiences in many cultures around the world for centuries, if not millennia (Nichols, 2016; Sessa, 2012).

In recent years there has been an increased interest in the scientific study of self-transcendent emotions, including awe (Darbor, Lench, Davis, & Hicks, 2015; Haidt & Morris, 2009; Piff et al., 2015; Rudd, Vohs, & Aaker, 2012) . This has been paralleled by a renewed scientific interest in psychedelic drugs, including psilocybin (the active ingredient in 'magic mushrooms'), lysergic acid diethylamide (LSD) and N,N-dimethyltryptamine (DMT, the active ingredient in the South American decoction, ayahuasca), with a particular emphasis on the psychological, behavioral and therapeutic consequences of the mystical (or 'peak') psychedelic experience (Bogenschutz et al., 2015; Carhart-Harris et al., 2016; Carhart-harris et al., 2016; Doblin, 1991; Grob et al., 2011; Grof, 1980;

Haidt, 2013; Johnson, Garcia-Romeu, Cosimano, & Griffiths, 2014; Lebedev et al., 2016; MacLean, Johnson, & Griffiths, 2011; Moreno, Wiegand, Taitano, & Delgado, 2006; Nichols, 2016; Unger, 1963). Although serotonergic psychedelic drugs have diverse pharmacological effects (Ray, 2010), their shared psychedelic effects are thought to be primarily mediated by agonism of the serotonin 2A (5-HT_{2A}) receptor on Layer V cortical pyramidal neurons (Halberstadt, 2015; Kometer, Schmidt, Jäncke, & Vollenweider, 2013; Muthukumaraswamy et al., 2013; Nichols, 2016; F X Vollenweider, Vollenweider-Scherpenhuyzen, Bäbler, Vogel, & Hell, 1998; Franz X. Vollenweider & Kometer, 2010).

Psychological and behavioral correlates of psychedelic drug-use in healthy individuals may be studied either in large cross-sectional population surveys (P. S. Hendricks, Johnson, & Griffiths, 2015; Peter S Hendricks, Thorne, Clark, Coombs, & Johnson, 2015), or in small well-controlled experimental settings (Carhart-Harris et al., 2016). There are advantages and disadvantages to both approaches. Whilst cross-sectional population studies are unable to demonstrate causal relationships, their results have good external validity owing to large samples, minimal exclusion criteria and assessment of subjects in real-world settings (Peter S Hendricks et al., 2015; Kelley, Clark, Brown, & Sitzia, 2003) . By contrast, experimental studies afford the investigator the ability to measure beliefs, attitudes and behaviors in a fine-grained manner, both before and after an intervention. Controlled experimental studies are limited, however, by small sample sizes, strict exclusion criteria and the legal and financial barriers inherent in working with controlled substances (Rucker, 2015).

Large population studies have shown that psychedelic-use is associated with reduced rates of suicidality and psychological distress in the general population (P. S. Hendricks et al., 2015; Peter S Hendricks et al., 2015; Johansen & Krebs, 2015; Teri S Krebs & Johansen, 2013), and reduced recidivism and partner violence in criminal justice populations (P. S. Hendricks, Clark, Johnson, Fontaine, & Cropsey, 2014; Walsh et al., 2016). There is also evidence that within certain communities, individuals who use classical psychedelics may score higher in assessments of confidence and optimism than those who do not (Grob, McKenna, Callaway, & Brito, 1996), and may place increased value on spiritual/mystical beliefs, as well as concern for others and nature/the environment compared with individuals who use cannabis, amphetamine or heroin (Lerner & Lyvers, 2006). Nature-relatedness, in particular, may be associated with reduced anxiety and increased personal well-being (Capaldi, Dopko, & Zelenski, 2014; Martyn & Brymer, 2014; Zelenski & Nisbet, 2014), and exposure to awe-inspiring nature has been shown to increase pro-social attitudes and behavior (Piff et al., 2015).

In experimental settings there is evidence that even one dose of the classical psychedelic drugs psilocybin and LSD may cause increases in the personality trait of 'openness', which in some cases can persist for many months (Carhart-Harris et al., 2016; MacLean et al., 2011; Schmid et al., 2015). Increases in trust, optimism and subjective well-being were also noted in these studies. Moreover, in recent years a number of small studies have demonstrated the therapeutic potential of psilocybin to improve symptoms of anxiety, depression and addiction when administered in a psychologically supportive setting

(Bogenschutz et al., 2015; Carhart-harris et al., 2016; Grob et al., 2011; Johnson et al., 2014; Moreno et al., 2006). Together these results suggest that classical psychedelics may cause lasting changes in personality traits, beliefs and attitudes.

The purpose of the present study was to investigate the association between lifetime recreational psychedelic-use and political perspectives, nature-relatedness and the personality traits of openness and conscientiousness in a large anonymous internet survey. We constrained our analysis of personality to trait openness and conscientiousness as these are the 'Big Five' personality domains that have been most consistently associated with political orientation (Carney, Jost, Gosling, & Potter, 2008; Sibley, Osborne, & Duckitt, 2012; Xu, Mar, & Peterson, 2013), and in which changes have been reported after psychedelic-use (Carhart-Harris et al., 2016; MacLean et al., 2011; Schmid et al., 2015). In addition to collecting information on lifetime psychedelic-use, we also collected information on recreational use of cocaine and alcohol, allowing us to test the specificity of the relationship between psychedelic-use and political perspectives, personality traits and nature-relatedness. Given the proposed link between 'peak' psychedelic experiences and persisting effects on personality and outlook (Doblin, 1991; Haidt, 2013; Lebedev et al., 2016; MacLean et al., 2011; Unger, 1963), we also investigated the relationship between psychedelic-induced ego-dissolution and personality traits and attitudes.

Method

1. Survey structure

The present study used a large anonymous internet survey to collect data. A subset of the data collected in this survey has recently been published (Nour, Evans, Nutt, & Carhart-Harris, 2016).

Subjects completing the survey first answered questions on demographic details (age, sex and educational background) and personal recreational drug-use (lifetime use of psychedelic drugs, lifetime use of cocaine, and weekly alcohol-consumption). All possible answer options for educational attainment and recreational drug and alcohol-use are presented in **Table 1**). Subjects then answered a series of questions designed to measure political perspectives, personality traits and nature-relatedness.

We assessed political perspectives of subjects using two measures. To assess political views on the dimension of liberalism to conservatism we used a 1-item measure, similar to previous studies (Carney et al., 2008; Graham, Haidt, & Nosek, 2009; Sibley et al., 2012). This consisted of the question: 'What is your political orientation?', with possible answers ranging from '1=very conservative' to '7=very liberal' on a 7-pont scale.

The liberal-conservative (or left-right) political dimension is primarily concerned with the value placed on social and economic equality, whereas the libertarian-authoritarian dimension emphasizes personal freedoms and limited government (Evans, Heath, & Lalljee, 1996; Iyer, Koleva, Graham, Ditto, & Haidt,

2012). To assess political views on the dimension of libertarianism to authoritarianism we used a subset of questions from a previously published libertarian-authoritarian questionnaire (Evans et al., 1996) in which subjects rated the degree to which they agreed with statements on a 5 point scale from '1=strongly disagree' to '5=strongly agree'. The questionnaire included the following items: 'Young people today don't have enough respect for traditional values', 'People who break the law should be given stiffer sentences', 'Schools should teach children to obey authority', 'The law should always be obeyed, even if a particular law is wrong', and 'Organizing public meetings to protest against the government should not be allowed'. The mean score over all 5 items was used as a measure of authoritarianism. As this measure was based on a subset of questions from a previously published questionnaire, before using the results of the questionnaire in subsequent analyses we first confirmed that it had a uni-dimensional factor structure and adequate psychometric properties.

To assess nature-relatedness, we used the validated 6-item Nature-Relatedness Scale (Nisbet & Zelenski, 2013), in which subjects rated the degree to which they agreed with 6 statements on a 5 point scale from '1=disagree strongly' to '5=agree strongly'. The 6-items were as follows: 'My ideal vacation spot would be a remote, wilderness area', 'I always think about how my actions affect the environment', 'My connection to nature and the environment is a part of my spirituality', 'I take notice of wildlife wherever I am', 'My relationship to nature is an important part of who I am', and 'I feel connected to all living things and the earth'. The mean of the answers to each item was used as a measure of 'nature-relatedness'.

To assess the personality traits of openness and conscientiousness, we used the relevant items from the Ten-Item Personality Inventory (TIPI), (Gosling, Rentfrow, & Swann, 2003) which has been widely used by other studies (Carney et al., 2008; Gosling et al., 2003; Sibley et al., 2012). Subjects expressed the degree to which they endorsed each statement on a 7-point scale from '1=disagree strongly' to '7=agree strongly'. Our measure of 'openness' was the mean of the subject's score for the statement 'I see myself as open to new experiences', and the reverse-marked score for the statement 'I see myself as conventional, uncreative'. Our measure of 'conscientiousness' was the mean of the subject's score for the statement 'I see myself as dependable, self-disciplined', and the reverse-marked score for the statement 'I see myself as disorganized, careless'. Despite comprising of only two items for each Big Five trait, the TIPI has been shown to have adequate construct validity, test–retest reliability and patterns of external correlates, when compared to more time-consuming measures (Gosling et al., 2003).

Finally, all subjects were then given the opportunity to retrospectively rate the degree of ego-dissolution experienced for their 'most intense' psychedelic experience, using the validated Ego-Dissolution Inventory (an 8-item self-report visual-analogue scale) (Nour et al., 2016). We have recently shown that ego-dissolution is a paradigmatic feature of the psychedelic experience (Nour et al., 2016). Subjects were also asked 'Do you believe that the experience and your contemplation of that experience have led to a change in your current sense of personal well-being or life satisfaction?' using a 7-point rating scale from

'−3=decreased very much' to '+3=increased very much', taken from the 'Persisting Effects Questionnaire' as used in previous psychedelic research (Barrett, Johnson, & Griffiths, 2015).

2. Dissemination of the survey

This study was approved by the local ethics committee. The full survey was implemented and hosted by the online service Survey Gizmo (http://www.surveygizmo.eu/), and was estimated to take 38 minutes to complete. Survey Gizmo has comprehensive privacy policies and security features that maintain the anonymity of responses in line with ethics requirements.

Participants were recruited to the online survey via web-link advertisements posted on Facebook groups, Twitter pages, email newsletters, and online drug forums with a short request ('Please participate in our anonymous online questionnaire designed to learn more about experiences with classical psychedelics, cocaine, and alcohol'). Recruitment targeted online communities interested in psychoactive substances and altered states of consciousness (e.g. Psychedelic Society: http://www.psychedelicsociety.org.uk, and Multidisciplinary Association for Psychedelic Studies: http://www.maps.org), as well as websites visited by more diverse populations, (e.g. Reddit: https://www.reddit.com/, and Mumsnet: http://www.mumsnet.com/). The collection of IP addresses and geographical locations of participants was disabled and participants were informed of the anonymity of their responses. After reading a summary of the inclusion criteria and instructions, participants

provided informed consent by clicking 'next' on the first page of the questionnaire.

Inclusion criteria for participants were (1) at least 18 years of age and (2) had had at least one experience with a classical psychedelic (LSD, psilocybin, DMT, ayahuasca or mescaline), cocaine, and/or alcohol. Data collection occurred over a 4-week period in 2015.

3. Statistical analysis

3.1 Relationship between psychedelic-use and personality traits, political perspectives and nature-relatedness

Multivariate linear regression was used to assess the relationship between lifetime psychedelic-use and each dependent variable of interest, whilst controlling for potentially-relevant covariates, similar to previous population studies of psychedelic-use (Peter S Hendricks et al., 2015). Specifically, separate multivariate linear regression analyses were used to identify the independent variables that predicted the five dependent variables of interest (authoritarianism, liberalism, nature-relatedness, openness and conscientiousness). For each multivariate regression, independent variables were 'sex' (coded as female=1, male=0), 'age' (mean-centered), 'highest educational attainment' (quantified from 1='Left school before age 16 (no qualifications)' to 6='Post-graduate degree (or equivalent)'), 'lifetime psychedelic-use (number of occasions)' (quantified as the middle value in the selected range), 'lifetime cocaine-use (number of occasions)' (quantified as the

middle value in the selected range) and 'weekly alcohol-consumption (units)' (quantified as the middle value in the selected range).

3.2 Relationship between ego-dissolution and personality traits, political perspectives and nature-relatedness

We assessed whether the degree of ego-dissolution experienced during the most intense psychedelic experience predicted authoritarianism, liberalism, nature-relatedness, openness or conscientiousness using multivariate linear regression. Similar to the previous analysis, five separate multivariate linear regression models were used for the five dependent variables of interest (authoritarianism, liberalism, nature-relatedness, openness, and conscientiousness). For each multivariate regression, independent variables were 'Ego-Dissolution experienced during most intense psychedelic experience', 'sex' (coded as female=1, male=0), 'age' (mean-centered), and 'highest educational attainment' (quantified from 1='Left school before age 16 (no qualifications)' to 6='Post-graduate degree (or equivalent)').

Spearman's rho is used to quantify all bivariate correlations. Statistical significance is defined as $p<0.05$ (2-tailed). All statistical analysis was performed using MatLab (MathWorks, Version 2015b including Statistics and Machine Learning Toolbox).

Results

1. Baseline demographics of survey responders

Eight hundred and ninety-three subjects answered all questions relating to demographic details, recreational drug use, political perspectives, nature-relatedness and personality traits. **Table 1** summarizes the demographic information for these subjects. The within-subject correlations between authoritarianism, liberalism, nature-relatedness, openness and conscientiousness are shown in **Table 2**. Our subjects identified as politically liberal (median answer was '6=somewhat liberal', skewness=-1.4, on a 7-point scale), scored low on authoritarianism (median answer 1.8, skewness=0.8, on a scale of 1 to 5), and highly on nature-relatedness (median answer 4.2, skewness=-0.8, on a scale of 1 to 5), openness (median answer 6.0, skewness=-1.0, on a scale of 1 to 7), and conscientiousness (median answer 5.5, skewness=-0.6, on a scale of 1 to 7).

2. Psychometric properties of the liberalism-authoritarianism questionnaire

We assessed the political perspectives on the dimension of libertarianism-authoritarianism using a subset of the questions from a previously published libertarianism-authoritarianism questionnaire (Evans et al., 1996). As predicted, the subset of questions chosen for this study was found to have a 1-factor psychometric structure, as determined by Cattell's scree-plot criterion (Cattell, 1966) and Parallel Analysis for principle components (1000 random draws) (Horn, 1965; O'Connor, 2000) (Parallel Analysis observed and 95% confidence-interval simulated eigenvalues for the 2nd component were 0.89 and 1.07, respectively). The first component explained 51.3% of the variance in the

questionnaire responses. All other components explained <20% of the variance in the sample. The questionnaire had acceptable internal consistency (Cronbach's alpha=0.70) (Cronbach, 1951).

3. Relationship between psychedelic-use and personality traits, political perspectives and nature-relatedness

Five multivariate linear regression models, with authoritarianism, liberalism, nature-relatedness, openness and conscientiousness as the dependent variables, found that lifetime psychedelic-use negatively predicted authoritarianism but positively predicted liberalism, nature-relatedness and openness, after controlling for the influence of confounding variables. Conversely, weekly alcohol-consumption positively predicted authoritarianism and negatively predicted openness and nature-relatedness. Lifetime cocaine-use also positively predicted openness. Full results from these models are shown in **Table 3.**

Openness was predicted both by lifetime psychedelic-use and lifetime cocaine-use. In an exploratory analysis we investigated the relationship between 'preferential psychedelic-use (vs. cocaine-use)' and openness in the subset of individuals who had reported exclusive use of one or the other substance (n=235). This variable was coded '1' for cocaine-naïve individuals who had used psychedelics on at least one occasion, and '0' for psychedelic-naïve individuals who had used cocaine on at least one occasion. 'Preferential psychedelic-use (vs. cocaine-use)' was predictive of openness in a multivariate linear regression within this subgroup (unstandardized regression coefficient=0.50, SE=0.15,

$p<0.001$) (sex, age and education included as other independent variables in the model).

4. Relationship between ego-dissolution and personality traits, political perspectives and nature-relatedness

A subset of 604 subjects provided additional information on the degree of 'ego-dissolution' experienced during their most intense psychedelic experience by completing the 8-item Ego-Dissolution Inventory (Nour et al., 2016). The median time elapsed between this experience and survey completion was '1-5 years'. The median reported 'intensity' of this experience (on a visual analogue scale from 1-100, with '0=Not at all' and '100=The most intense imaginable') was 76 (skewness=-0.8, interquartile range=23).

Five multivariate linear regression models, with authoritarianism, liberalism, nature-relatedness, openness and conscientiousness as the dependent variables, found that the degree of ego-dissolution experienced during one's most intense psychedelic experience significantly negatively predicted authoritarianism and positively predicted liberalism, nature-relatedness and openness, after controlling for the influence of confounding variables. Full results from these models are shown in **Table 4.**

Subjects were also asked to what extent the psychedelic experience in question affected their subjective well-being on a 7-point scale from -3 ('decreased very much') to +3 ('increased very much'). The median answer to this question was +2 ('moderately increased', skewness=-1.1). Reported positive change in well-

being was positively correlated with ratings of ego-dissolution for this experience (rho=0.37, p<0.001).

Discussion

In this study, we provide evidence that recreational psychedelic-use (but not cocaine or alcohol-use) is associated with anti-authoritarian and liberal political views, openness to new experiences and nature-relatedness, using a large anonymous internet survey. Furthermore, we show that the degree of ego-dissolution experienced during the most intense recalled psychedelic experience is positively associated with these same four subject variables, providing evidence for the predictive validity of the Ego-Dissolution Inventory (Nour et al., 2016).

Of note, political perspectives, openness and nature-relatedness showed significant associations within individuals, suggesting that common causal factors may underlie inter-individual variability in these domains. By extension, the nature of the relationships between psychedelic-use (or ego-dissolution) and these subject variables may also be related.

Aldous Huxley, reflecting on his now-famous experience with mescaline, wrote, *'The man who comes back through the Door in the Wall will never be quite the same as the man who went out'* (Huxley, 1954, p. 50). Several early studies of the psychological effects of LSD and psilocybin, given in experimental and therapeutic settings, reported largely positive subjective changes months, years, and in some cases decades, after the psychedelic experience (Doblin, 1991; W.

McGlothlin, Cohen, & McGlothlin, 1967; W. H. McGlothlin & Arnold, 1971). These changes included increased aesthetic appreciation, self-understanding, tolerance of others' views, reduced anxiety, and valuable contributions to subjects' spiritual lives (Doblin, 1991; W. McGlothlin et al., 1967; W. H. McGlothlin & Arnold, 1971). Recent controlled studies with psilocybin have largely confirmed these findings, with subjective and objective positive effects persisting at 14-month follow-up (R R Griffiths, Richards, Johnson, McCann, & Jesse, 2008; R. R. Griffiths, Richards, McCann, & Jesse, 2006; Roland R. Griffiths et al., 2011). LSD was also used extensively in the treatment of alcoholism in the 1960s, with reports that some patients attained abstinence after a single therapeutic administration (T. S. Krebs & Johansen, 2012; Unger, 1963). These findings are consistent with evidence that psychedelic drugs are among the least harmful of all misused drugs, with limited dependence potential (D. J. Nutt, King, & Phillips, 2010; D. Nutt, King, Saulsbury, & Blakemore, 2007; Rucker, 2015; Studerus, Kometer, Hasler, & Vollenweider, 2011).

1. Psychedelics and Openness

There is increasing evidence that the Big Five personality trait of openness may be particularly affected by psychedelic drug-use. Openness encompasses aesthetic appreciation and sensitivity, imagination, fantasy, and tolerance of others' viewpoints (MacLean et al., 2011). People with high levels of openness are 'permeable to new ideas and experiences' and 'motivated to enlarge their experience into novel territory' (DeYoung, Peterson, & Higgins, 2005 p. 830). Given that openness is related to intellectual and creative activities (Xu et al., 2013), it is of relevance that one cross-sectional study found that psychedelic-

users place higher value on creativity (as measured by the Life Values Inventory) compared with those who use other illicit substances (amphetamine, cannabis or heroin) (Lerner & Lyvers, 2006). In another study, Studerus and colleagues found that at 8-16 month follow-up after 1-4 experimental psilocybin sessions, a substantial proportion of subjects reported positive changes in their attitude to altered states of consciousness (56%) and aesthetic experiencing (37%) (Studerus et al., 2011).

DMT-containing ayahuasca is consumed approximately once every 2 weeks by members of certain Brazilian syncretic churches in the context of religious rituals (Nichols, 2016). Studies comparing ayahuasca-using church members with matched controls have found that ayahuasca-users score lower in the temperamental dimension of Harm Avoidance and higher in the character trait of Self-Transcendence compared with matched controls (measured using Cloninger's Temperament and Character Inventory) (Jose Carlos Bouso et al., 2015; José Carlos Bouso et al., 2012). Interestingly, openness is positively associated with Self-Transcendence and a negatively associated with Harm Avoidance (De Fruyt, Van De Wiele, & Van Heeringen, 2000).

Recently, several small laboratory studies have directly investigated the relationship between psychedelic drug-use and openness, finding within-subject increases in trait openness after psilocybin or LSD use (Carhart-Harris et al., 2016; MacLean et al., 2011; Schmid et al., 2015). MacLean and colleagues, for example, measured the Big Five personality domains in 52 hallucinogen-naïve healthy subjects before and after taking psilocybin (between 1 and 4 psilocybin

sessions, one of which was with a high dose of 30mg/70kg). They reported increases in trait openness over 1 year after psilocybin, which were associated with subject-reported mystical experiences during the psilocybin session (MacLean et al., 2011). No other personality traits were significantly altered after psilocybin.

Our results are consistent with these findings in two ways. Firstly, in our sample, psychedelic-use was predictive of trait openness, and not trait conscientiousness. Secondly, the degree of ego-dissolution experienced during a subject's most intense psychedelic experience was predictive of trait openness. In our sample cocaine-use also predicted trait openness. Our finding of a positive relationship between preferential psychedelic-use (but not preferential cocaine-use) and openness, however, is again supportive of the hypothesis that psychedelic-use, rather than illicit-substance-use *per se*, is associated with high trait openness.

2. Psychedelics and Political attitudes

We found a significant association between psychedelic-use and both liberal (or left-leaning) and libertarian (or anti-authoritarian) values. Liberal (or left-leaning) individuals place emphasis on social justice and equality, and are wary of unregulated capitalistic practices (Evans et al., 1996). Psychedelic-use in the 1960s and 1970s was strongly associated with anti-establishment and egalitarian counter-culture movements (Nichols, 2016; Sessa, 2012). No recent study has explicitly evaluated the association between psychedelic drug-use and political orientation. An early study reported that individuals who used LSD in

'non-medical' settings scored higher on attitudes of 'personal liberty' and 'foreign policy liberalism' than control subjects (W. H. McGlothlin & Arnold, 1971). Another study found that psychedelic-users score higher on Concern for Others, and placed lower value on Financial Prosperity (as measured by the Life Values Inventory) compared with people who do not use illicit substances, or those who use amphetamine, cannabis or heroin (Lerner & Lyvers, 2006). Furthermore, a well-established positive association exists between openness and liberalism within individuals (Carney et al., 2008; Sibley et al., 2012; Xu et al., 2013), a result replicated in the present study.

3. Psychedelics and Nature-Relatedness

In our sample, psychedelic-use and ego-dissolution were more strongly predictive of nature-relatedness than any other dependent variable (as measured by both the magnitude of the unstandardized regression coefficient and the overall model fit). Very few studies have investigated the relationship between psychedelic-use and nature-relatedness or environmental concern. One study found that psychedelic-users scored higher on Concern for Environment (as measured by the Life Values Inventory) compared with those who use other illicit substances (amphetamine, cannabis or heroin) (Lerner & Lyvers, 2006). One experimental study found that 38% of subjects reported positive changes in their relationship to nature and the environment 8-16 months following 1-4 experimental psilocybin sessions (Studerus et al., 2011). Previous studies suggest that nature-relatedness is associated with reduced anxiety (Martyn & Brymer, 2014) and increased personal well-being (Capaldi et al., 2014; Zelenski

& Nisbet, 2014), and that exposure to awe-inspiring nature may increase pro-social behavior (Piff et al., 2015).

4. Ego-Dissolution, Personality and Attitudes

Our results indicate that the degree of ego-dissolution experienced during an individual's most intense psychedelic experience is associated with inter-individual differences in openness, liberalism, and nature-relatedness, and is negatively predictive of authoritarianism. Clearly, our results are not able to answer the question of whether this relationship is a causal one; nor can they determine the direction of any causality. Encounters with nature, for example, can themselves induce powerful and transformative self-transcendental experiences of awe (Emerson, 2003; Haidt, 2013; James, 1985; Piff et al., 2015). In support of the hypothesis that ego-dissolution experiences cause changes in personality traits and attitudes, several recent experimental studies have reported that the increases in openness following psilocybin or LSD experiences are related to the degree of mystical experience/ego-dissolution reported (Lebedev et al., 2016; MacLean et al., 2011). One recent study provided further evidence that the relationship between psychedelic-induced ego-dissolution and increases in openness may be strengthened by contextual features like the presence of music, and may be mediated by an increase in the sample entropy of cortical neuronal dynamics (Lebedev et al., 2016).

The experience of psychedelic-induced ego-dissolution encompasses feelings of unity with others and the universe and a reduction in personal self-importance (Nour et al., 2016). This experience is highly correlated with both the

mystical/peak psychedelic experience and the intensity of the psychedelic experience (Nour et al., 2016). Ego-dissolution is related to the experience of awe, which occurs in response to *'stimuli that are vast, that transcend current frames of reference, and that require new schemata to accommodate what is being perceived'* (Piff et al., 2015, p. 884). It has been suggested that self-transcendental experiences such as awe have the potential to catalyze psychological change within an individual (Haidt, 2013; James, 1985; Lebedev et al., 2016; Majic, Schmidt, & Gallinat, 2015; Unger, 1963), and may increase pro-social behavior and ethical decision making by shifting attention away from one's individual concerns, and towards the larger entities that an individual is part of (Piff et al., 2015; Rudd et al., 2012).

Self-transcendental experiences, such as awe and ego-dissolution, may make an individual more willing to accept that their pre-existent perspectives on reality are limited/socially determined, and so be more ready to see value in new experiences. These experiences also cause subtle shift in attention towards more collective dimensions of personal identity (Piff et al., 2015), which, if sustained, naturally resonate with egalitarian political views, increased feelings of connectedness with the natural world and increased tolerance for others' viewpoints.

Although these proposed causal relationships have not been experimentally investigated, they resonate with anecdotal descriptions of psychedelics as 'consciousness-expanding' drugs (Huxley, 1954; Leary, Metzner, & Alpert, 1964; Sessa, 2012), and are in line with certain models of psychedelic therapy, which

view the peak psychedelic experience as central to the therapeutic process (Grof, 1980; Majic et al., 2015; Unger, 1963).

5. Limitations

This study has some limitations. Firstly, although we demonstrate several significant associations between psychedelic-use and personal attitudes and personality traits, these cross-sectional results cannot provide evidence that psychedelic-use (or psychedelic-induced ego-dissolution) causes increases in liberalism, nature-related or openness. This hypothesis can only be tested with longitudinal or experimental studies. Secondly, our sample is skewed in many ways. The majority of subjects were under 30 years old, male and well educated. Half of our subjects had used psychedelics on over 10 occasions, and a third had used cocaine on over 10 occasions. Moreover, most subjects identified as politically liberal, and scored highly on trait openness, conscientiousness, and nature-relatedness, whilst scoring low on authoritarianism. This limits the generalizability of our results. Thirdly, the use of retrospective and unverified ratings of drug-use, and retrospective ratings of previous psychedelic experiences, introduces a potential source of inaccuracy into our results. Finally, we used short validated scales to measure subject variables in an attempt to reduce questionnaire length and fatigue-related inaccuracies, and maximize the diversity of information collected. The use of short scales, however, limits the accuracy with which certain constructs can be measured. Importantly, these final two limitations would be predicted to weaken any associations found.

Conclusions

In conclusion, our results support the conclusion that recreational psychedelic-use is associated with increased liberalism, nature-relatedness and openness, and decreased authoritarianism, in the general population. This pattern of associations is unlikely to be driven by illicit drug-use in general, as it did not extend to recreational cocaine-use. Moreover, this pattern of associations also existed between the same four subject variables and the degree of ego-dissolution experienced under psychedelics, indicating that the associations are related to a paradigmatic aspect of the psychedelic experience itself. This also provides evidence for the predictive validity of the Ego-Dissolution Inventory (EDI), a recently developed measure of ego-dissolution (Nour et al., 2016). Future experimental studies are required to determine whether these associations are causal in nature. Such studies should also endeavor to recruit samples that are more representative of the general population.

Author contributions

MMN, LE and RLC-H conceived of and designed this study and interpreted the results, contributed to drafting the work and revised it critically for important intellectual content. All authors approved the final version of this manuscript to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work be appropriately investigated and resolved. MMN undertook statistical analysis of the data. LE managed the implementation of the questionnaire and subsequent data collection. MMN wrote the article, with editing from RLC-H.

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TABLE 1

Demographic information for full sample (n=893)

Total	893	
Female	320 (35.8%)	
Age at time of survey		
Median	28.0	
Inter-quartile range	13.0	
Skewness	1.40	
Education		
Left school before age 16 (no qualifications)	5 (0.6%)	
Left school at 16 / GCSE (UK)	33 (3.7%)	
High school diploma / A-Level (UK)	92 (10.3%)	
Some university (or equivalent)	231 (25.9%)	
Bachelor's degree (or equivalent)	278 (31.1%)	
Post-graduate degree (or equivalent)	254 (28.4%)	
Lifetime illicit drug use	**Psychedelic**	**Cocaine**
Never	155 (17.4%)	312 (34.9%)
Once only	38 (4.3%)	85 (9.5%)
2 - 5 times	136 (15.2%)	122 (13.7%)
6 - 10 times	120 (13.4%)	69 (7.7%)
11 - 15 times	85 (9.5%)	43 (4.8%)
16 - 25 times	87 (7.7%)	61 (6.8%)
26 - 50 times	114 (12.8%)	64 (7.2%)
51 – 100 times	78 (8.7%)	63 (7.1%)
>100 times	80 (9.0%)	74 (8.3%)

Weekly alcohol-consumption	
No alcohol	227 (25.4%)
1 – 6 units	278 (31.1%)
7 – 12 units	167 (18.7%)
13 – 18 units	83 (9.3%)
19 – 24 units	44 (4.9%)
25 – 30 units	29 (3.3%)
31 – 36 units	20 (2.2%)
37 – 42 units	14 (1.6%)
43 – 48 units	9 (1.0%)
49 – 54 units	9 (1.0%)
55 – 60 units	5 (0.6%)
> 60 units	8 (0.9%)

TABLE 2

Bivariate Spearman's rank correlations between authoritarianism (Authorit.), liberalism, nature-relatedness (NR), openness and conscientiousness (Conscien.) within-subjects.

	Authorit.	**Liberalism**	**NR**	**Openness**	**Conscien.**
Authorit.	1	-0.44**	-0.12**	-0.16**	0.14**
Liberalism		1	0.16**	0.20**	-0.09*
NR			1	0.34**	0.06
Openness				1	0.09*
Conscien.					1

**statistically significant at $p<0.001$, *statistically significant at $p<0.01$.

TABLE 3 Recreational psychedelic-use and subject-variables.

	Authoritarianism			**Liberalism**			**Nature-relatedness**			**Openness**			**Conscientiousness**		
	B	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Intercept	2.016	0.108	0.000	5.027	0.228	0.000	3.809	0.142	0.000	5.775	0.148	0.000	3.746	0.219	0.000
Sex (F)	**0.128**	**0.047**	**0.006**	0.051	0.099	0.605	0.116	0.062	0.062	-0.018	0.064	0.779	0.098	0.095	0.304
Age	**0.007**	**0.002**	**0.000**	0.002	0.004	0.520	0.005	0.003	0.085	-0.005	0.003	0.071	**0.014**	**0.004**	**0.001**
Education	**-0.066**	**0.020**	**0.001**	**0.130**	**0.042**	**0.002**	-0.027	0.026	0.304	**-0.060**	**0.027**	**0.028**	**0.181**	**0.041**	**0.000**
Psychedelic-use	**-0.002**	**0.001**	**0.012**	**0.044**	**0.011**	**0.000**	**-0.055**	**0.011**	**0.000**	**-0.032**	**0.011**	**0.003**	0.001	0.001	0.414
Cocaine-use	0.001	0.001	0.158	0.001	0.001	0.678	0.000	0.001	0.918	**-0.002**	**0.001**	**0.021**	0.000	0.001	0.772
Alcohol-use	**-0.004**	**0.002**	**0.014**	0.003	0.004	0.445	**-0.010**	**0.002**	**0.000**	**-0.005**	**0.002**	**0.031**	0.006	0.004	0.089

Results from multivariate linear regression models. Each model contains 6 independent variables: Sex (coded as female=1), Age (mean-centered), highest educational attainment (quantified from 1='Left school before age 16 (no qualifications)' to 6='Post-graduate degree (or equivalent)'), lifetime psychedelic-use (number of occasions), lifetime cocaine-use (number of occasions) and weekly alcohol-consumption (units). Results from five models are shown, one for each of five dependent variables: authoritarianism (model adjusted R-square=0.042), liberalism (model adjusted R-square=0.022), nature-relatedness (model adjusted R-square=0.071), openness (model adjusted R-square=0.032) and conscientiousness (model adjusted R-square=0.043). Values in **bold** represent statistically-significant associations (underlined values for positive associations, non-underlined values for negative associations). All five model fits were highly significant vs. a constant model ($p<0.001$). B=unstandardized regression coefficient, SE=standard error, p=P-value.

TABLE 4 Ego-dissolution and subject-variables.

	Authoritarianism			**Liberalism**			**Nature-relatedness**			**Openness**			**Conscientiousness**		
	B	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Intercept	2.090	0.126	0.000	4.899	0.253	0.000	3.393	0.168	0.000	5.570	0.175	0.000	3.969	0.285	0.000
Sex (F)	0.078	0.051	0.128	0.025	0.103	0.812	**0.154**	**0.068**	**0.025**	**0.199**	**0.071**	**0.006**	0.172	0.116	0.140
Age		**0.000**	**0.000**				**0.008**	**0.003**	**0.003**				**0.019**	**0.005**	**0.000**
	0.009	**2**	**0**	0.003	0.004	0.465				0.000	0.003	0.950			
Education	**-0.074**	**0.002**	**0.001**	**0.169**	**0.042**	**0.000**	0.037	0.029	0.202	0.039	0.030	0.200	0.083	0.049	0.094
Ego-Dissolution	**-0.003**	**0.001**	**0.005**	**0.004**	**0.002**	**0.026**	**0.009**	**0.001**	**0.000**	**0.005**	**0.001**	**0.000**	0.001	0.002	0.636

Results from multivariate linear regression models. Each model contains 5 independent variables: Sex (coded as female=1), Age (mean-centered), highest educational attainment (quantified from 1='Left school before age 16 (no qualifications)' to 6='Post-graduate degree (or equivalent)') and Ego-Dissolution experienced during most intense psychedelic experience. Results from five models are shown, one for each of five dependent variables: political

authoritarianism (model adjusted R-square=0.05), liberalism (model adjusted R-square=0.030), nature-relatedness (model adjusted R-square=0.092), openness (model adjusted R-square=0.031) and conscientiousness (model adjusted R-square=0.033). Values in **bold** represent statistically-significant associations (underlined values for positive associations, non-underlined values for negative associations). All five model fits were highly significant vs. a constant model ($p<0.001$). B=unstandardized regression coefficient, SE=standard error, p=P-value.