

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/327938183>

# Awe: a putative mechanism underlying the effects of classic psychedelic-assisted psychotherapy

Article in *International Review of Psychiatry* · September 2018

DOI: 10.1080/09540261.2018.1474185

---

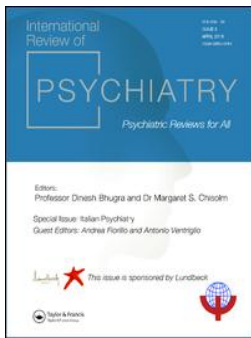
CITATIONS

118

---

READS

2,978



## Awe: a putative mechanism underlying the effects of classic psychedelic-assisted psychotherapy

Peter S. Hendricks

To cite this article: Peter S. Hendricks (2018): Awe: a putative mechanism underlying the effects of classic psychedelic-assisted psychotherapy, International Review of Psychiatry, DOI: [10.1080/09540261.2018.1474185](https://doi.org/10.1080/09540261.2018.1474185)

To link to this article: <https://doi.org/10.1080/09540261.2018.1474185>



Published online: 27 Sep 2018.



Submit your article to this journal [↗](#)



View Crossmark data [↗](#)

## Awe: a putative mechanism underlying the effects of classic psychedelic-assisted psychotherapy

Peter S. Hendricks

Department of Health Behavior, School of Public Health, University of Alabama at Birmingham, Birmingham, AL, USA

### ABSTRACT

A psychological model of classic psychedelic-assisted psychotherapy informed by contemporary scientific data is presented in this paper. It is suggested that classic psychedelic-occasioned mystical experience is characterized by profound awe, a discrete emotion experienced in the presence of a vast stimulus requiring accommodation of mental structures. Awe, in turn, promotes the small self, a construct that, in the extreme, is analogous to those of unitive experience and ego dissolution. The small self is conceptualized as key to understanding the downstream effects of mystical experience occasioned in the context of classic psychedelic-assisted psychotherapy. With this novel theoretical framework in mind, a number of clinical implications and recommendations are provided so as to advance this incipient field of study.

### ARTICLE HISTORY

Received 11 January 2018  
Accepted 3 May 2018

### KEYWORDS

Psychedelics; psilocybin; psychotherapy; awe; mechanisms of change

### Introduction

After decades of dormancy, scientific exploration of classic psychedelics, most notably psilocybin, is experiencing a reawakening. Consistent with an older body of research, classic psychedelics have been shown to produce enduring positive change across a range of psychological and behavioural outcomes among healthy subjects (Griffiths et al., 2018; Griffiths, Richards, Johnson, McCann, & Jesse, 2008; Griffiths et al., 2011; Griffiths, Richards, McCann, & Jesse, 2006; Lebedev et al., 2016; MacLean, Johnson, & Griffiths, 2011) and have demonstrated safety and initial signals of efficacy for depression (Carhart-Harris, Bolstridge, et al., 2016; Carhart-Harris, Bolstridge, & Day, 2018; Osório et al., 2015; Sanches et al., 2016), end-of-life distress (Gasser et al., 2014; Gasser, Kirchner, & Passie, 2015; Griffiths et al., 2016; Grob et al., 2011; Ross et al., 2016), and addiction (Bogenschutz et al., 2015; Johnson, Garcia-Romeu, Cosimano, & Griffiths, 2014; Johnson, Garcia-Romeu, & Griffiths, 2017; Thomas, Lucas, Capler, Tupper, & Martin, 2013) when administered in carefully controlled therapeutic contexts. Corroborating these findings are observational population- and cohort-based studies indicating that naturalistic classic psychedelic use is associated with a reduced likelihood of psychological distress and suicidality (Argento et al., 2017;

Hendricks, Thorne, Clark, Coombs, & Johnson, 2015; Hendricks, Johnson, & Griffiths, 2015), a decreased risk of opioid abuse and dependence (Pisano et al., 2017), and a reduced likelihood of criminal behaviour (Hendricks, Clark, Johnson, Fontaine, & Cropsey, 2014; Hendricks, Crawford, & Cropsey, 2018; Walsh et al., 2016).

As was the case during the first wave of classic psychedelic research in the 1950s through the 1970s, results have been met with enthusiasm from the scientific community, including calls for further investigation (e.g. Hendricks, 2014; Kleber, 2016; Nutt, 2016). Indeed, at the time of this writing, clinical-trials.gov reports more than 15 ongoing or planned clinical trials of classic psychedelic-assisted psychotherapy for applications including demoralization in long-term AIDS survivors (NCT02950467), obsessive-compulsive disorder (NCT03356483), major depressive disorder (NCT03181529), nicotine dependence (NCT01943994), cocaine dependence (NCT02037126), alcohol dependence (NCT02061293), and end-of-life distress (NCT03153579). Yet, despite the re-emerging focus on classic psychedelics as therapeutic agents, little is known about their mechanisms of action. A leading hypothesis at the neurological level concerns changes in default mode network functional connectivity (Carhart-Harris et al., 2014). However, an understanding of effects at the psychological level is lacking.

Of course, explanations at the neurological and psychological level should not be viewed as incompatible or competing, but connected and complementary.

Early pioneers of classic psychedelic-assisted psychotherapy focused almost exclusively on the treatment modality's psychological mechanisms of action. For instance, Humphry Osmond and Abram Hoffer, known for their groundbreaking development of lysergic acid diethylamide (LSD)-assisted psychotherapy for alcohol dependence, first equated the psychedelic experience to 'hitting rock bottom' in the parlance of Alcoholics Anonymous, only to later emphasize its insightful, transcendent, and spiritual components (Dyck, 2006). Others interpreted classic psychedelic-assisted psychotherapy from the lens of the predominant theoretical orientation at the time, psychodynamic psychology (especially in the case of low-dose or 'psycholytic' psychotherapy), but the experience was, nonetheless, conceptualized as akin to a transformative religious conversion (especially in the case of high-dose or 'psychedelic' psychotherapy; Majić, Schmidt, & Gallinat, 2015; Metzner, 1998). In a similar vein, contemporary understanding of classic psychedelic-assisted psychotherapy underscores the importance of mystical experience in producing change (e.g. Griffiths et al., 2016; Ross et al., 2016). However, how or why mystical experience might elicit long-lasting benefit has not been adequately addressed.

The objective of the current manuscript is to propose that the emotion awe is the primary psychological mechanism of action undergirding the

salubrious effects of mystical experience occasioned by classic psychedelic-assisted psychotherapy. The similarities between the core features of awe and classic psychedelic-occasioned mystical experience will first be highlighted, followed by a comparison of the predictors and outcomes of awe and classic psychedelic-occasioned mystical experience. A brief discussion of potential overlapping neurological mechanisms of awe and classic psychedelic-occasioned mystical experience will then be offered, and finally, clinical implications and recommendations of the proposed psychological mechanism will be discussed. Of course, as the literatures on both awe and classic psychedelics are emerging, the novel framework presented here is not intended to be complete. Nonetheless, in presenting a psychological model of classic psychedelic-assisted psychotherapy rooted in contemporary empirical findings (see Figure 1), the current manuscript posits that mystical experiences elicited by classic psychedelics are typified by profound awe, and in doing so, advances the nascent science of a developing treatment paradigm.

### The core features of awe and classic psychedelic-occasioned mystical experience

In a seminal theoretical piece, Keltner and Haidt (2003) introduced awe as an emotion 'in the upper reaches of pleasure and on the boundary of fear ...' (p. 297) experienced in the face of two key appraisals: *vastness* and *accommodation*. *Vastness* refers to any stimulus perceived as much larger

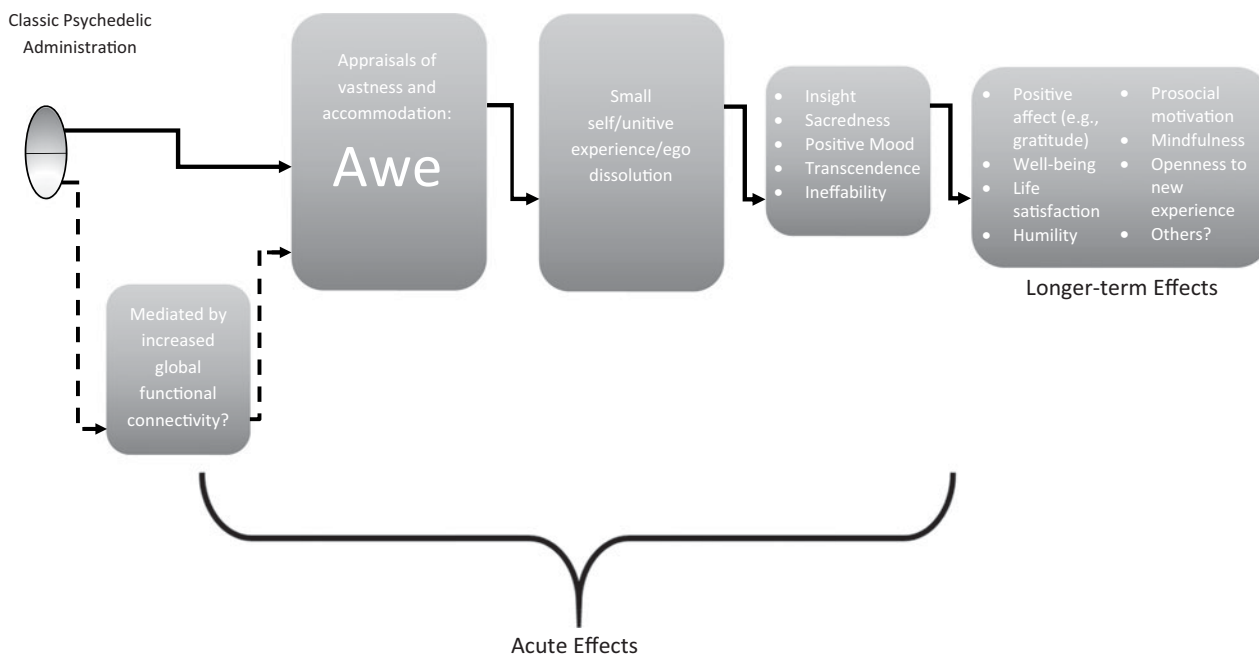


Figure 1. Proposed psychological model of classic psychedelic-assisted psychotherapy.

than the self, including physical objects, loud sounds, shaking ground, or markers of social status such as fame or authority. *Accommodation* refers to the need to adjust mental structures so as to integrate a new experience, sometimes involving fear, disorientation, and even ego dissolution (also known as ego death) and subsequent rebirth, as well as enlightenment when mental structures adapt to assimilate new information. Thus, awe might be expected to occur whenever one encounters something perceived as so vast and novel that he or she has to change the way he or she views reality.

Awe can be reliably elicited and is typically assessed with single items using a Likert-type scale (e.g. 'I feel awe'; 1 = *not at all* to 7 = *extremely*) that demonstrate validity (Bai et al., 2017; Piff, Dietze, Feinberg, Stancato, & Keltner, 2015; Prade & Saroglou, 2016; Rudd, Vohs, & Aaker, 2012; Shiota, Keltner, & Mossman, 2007; Valdesolo & Graham, 2014; Yang, Yang, Bao, Liu, & Passmore, 2016), and less frequently with multiple items using a Likert-type scale (e.g. 'I feel awe'; 'I feel wonder'; 'I feel amazement'; 1 = *not at all* to 7 = *completely*) that demonstrate reliability and validity (Gordon et al., 2017; Preston & Shin, 2017; Stellar, Gordon, & Anderson, 2018; Van Elk, Karinen, Specker, Stamkou, & Baas, 2016). Common elicitors of awe include nature, art/music, another's accomplishments, and spiritual/religious experiences (Bai et al., 2017; Gordon et al., 2017; Piff et al., 2015; Preston & Shin, 2017; Shiota et al., 2007; Van Elk et al., 2016). Consistent with theoretical conceptualizations, although awe is frequently experienced as pleasurable, if not blissful, it can also be infused with dread (Gordon et al., 2017). Perhaps the defining characteristic of awe's acute effects is the small self, which involves attention being directed away from the self, feelings of connectedness or oneness with others and/or the environment, diminishment of individualistic tendencies, devaluation of self-relevant goals, and the perception that one is physically smaller (Bai et al., 2017; Piff et al., 2015; Preston & Shin, 2017; Shiota et al., 2007; Stellar et al., 2018; Van Cappellen & Saroglou, 2012; van Elk et al., 2016). Viewed from the perspective of a social functional approach to emotions in which emotions help individuals coordinate social interactions (Neidenthal & Brauer, 2012), awe is believed to promote subordination of one's individual needs in deference to the social collective, or social integration (Bai et al., 2017; Keltner & Haidt, 2003; Piff et al., 2015; Shiota et al., 2017). In other words, awe is thought to facilitate a class of behaviours prized by evolution: cooperation (e.g. Gowdy & Krall, 2016; Nowak, 2006).

Two additional findings on the acute effects of awe bear brief mention here as they relate to the ensuing discussion of classic psychedelic-occasioned mystical experience. First, awe appears to orient attention to the present moment, and in doing so elongates the perception of time (Rudd et al., 2012). Second, awe appears to decrease tolerance for uncertainty, which is in turn associated with the tendency to endorse the role of supernatural agents in the experience (Valdesolo & Graham, 2014). Interestingly, emotion scientists have yet to consider the role of classic psychedelics in eliciting awe. This does not mean, however, that the awe literature does not occasionally allude to the psychedelic experience. For instance, Keltner and Haidt (2003), in discussing the role of awe in religion, describe a passage from the *Bhagavadgita* 'that sounds to the modern reader like a psychotic break or a psychedelic experience' (p. 298). Moreover, consistent with the very salient visual effects produced by classic psychedelics (Carbonaro, Johnson, & Hurwitz, 2018), Keltner and Haidt (2003) note that people may feel awe in response to objects with infinite repetition, including fractals.

Mystical experiences elicited by classic psychedelics appear to exemplify awe. Consider the Mystical Experience Questionnaire (MEQ30; Barrett, Johnson, & Griffiths, 2015), a well validated and widely used measure that taps the range of classic psychedelic-occasioned mystical effects. Two items on the MEQ30 relate explicitly to awe: 'Sense of awe or awesomeness' and 'Experience of amazement'. These items belong to a scale that otherwise captures the feelings of peace, ecstasy, and joy that accompany awe. Other scales assess feelings of small self or unitive experience (e.g. 'Experience of the fusion of your personal self into a larger whole'), insight (e.g. 'Gain of insightful knowledge experienced at an intuitive level'), sacredness (e.g. 'Feeling that you experienced something profoundly sacred and holy'), and time/space transcendence (e.g. 'Experience of timelessness') that have each been linked to awe, as well as ineffability (e.g. 'Sense that the experience cannot be described adequately in words') that would be expected of an experience requiring accommodation. A newer measure of classic psychedelic effects, the Ego-dissolution Inventory (Nour, Evans, Nutt, & Carhart-Harris, 2016) emphasizes the small self, which is of course central to awe, but also long believed to have critical therapeutic value in classic psychedelic-assisted psychotherapy (Majić et al., 2015). Finally, the Challenging Experience Questionnaire (Barrett, Bradstreet, Leoutsakos, Johnson, & Griffiths, 2016)

highlights the acute feelings of emotional distress (e.g. fear, paranoia, the subjective experience of death), that can sometimes be prompted by classic psychedelic use (Carbonaro et al., 2016). These acute feelings of emotional distress appear to overlap with feelings of dread sometimes associated with awe.

Although classic psychedelic-occasioned mystical experiences appear to be characterized by awe, such experiences are certainly not quotidian. They are consistently rated among the most personally and spiritually meaningful experiences of participants' lives (Barrett & Griffiths, 2018), and mystical experiences prompted by psychedelic substances, broadly defined, are rated as more mystical and associated with more pronounced positive psychological change than those not prompted by psychedelic substances (Yaden et al., 2017). Perhaps, then, classic psychedelic-occasioned mystical experiences represent the upper ranges of awe, similar to the most exceptional of organic awe phenomena. To illustrate this point, four quotations are presented below, two of which are associated with known elicitors of awe and two of which are associated with classic psychedelic use. The reader is encouraged to note similarities, and, if up for a challenge, attempt to distinguish between them.

#### Quotation #1

Standing on the bare ground—my head bathed by the blithe air and uplifted into infinite space—all mean egotism vanishes. I become a transparent eyeball; I am nothing; I see all; the currents of the Universal Being circulate through me; I am part or parcel of God ... I am the lover of uncontained and immortal beauty.

#### Quotation #2

The most impressive and intense part of this experience was the WHITE LIGHT of absolute purity and cleanness. It was like a glowing and sparkling flame of incandescent whiteness and beauty, but not really a flame—more like a gleaming white hot ingot, yet much bigger and vaster than a mere ingot. The associated feelings were those of absolute AWE, REVERENCE, and SACREDNESS ... Then I had a vision of absolute DIVINE love. It was like a flowing spring of silvery white liquid overflowing upward and was very beautiful to watch and feel. The feeling was of love and compassion toward the Divine and toward all men. I had the insight that all men had this same potential and worth within themselves. All men were equal in the sight of God and to my own feelings at this moment.

#### Quotation #3

You see how diminutive your life and concerns are compared to other things in the universe. Your life and concerns are important to you, of course. But

you can see that a lot of the things you worry about do not make much of a difference in an overall sense. The result is that you enjoy the life that is before you ... it allows you to have inner peace.

#### Quotation #4

I became nature and life, and I lived as one and moved as one with life ... I became all things of life, beings falling into my own body, and seeing me enter other things, as a one cell creature and big, beautiful colours. In space, I lost track of time and body. I was the universe, the big, beautiful universe, and the universe spoke to nature and nature spoke to me, saying, 'I am God, you are God, all is God'.

Quotation #1 source: Ralph Waldo Emerson, "Nature" (1836/1982, p.39). Quotation #2 source: Walter Pahnke, "First Impressions of First LSD Experience of March 30, 1964" (1964). Quotation #3 source: Astronaut Ed Gibson, on the effects viewing Earth from space (as quoted in Yaden et al., 2016b, p.6). Quotation #4 source: "Wally," LSD-assisted psychotherapy patient, (Savage & McCabe, 1973, p. 813).

Just as emotion scientists have yet to consider classic psychedelics as elicitors of awe, scientists working with classic psychedelics have largely overlooked the potential centrality of awe to mystical experience. However, a few recent publications pertaining to classic psychedelics contain references to the awe literature (Carhart-Harris, Erritzoe, & Haijen, 2018; Hendricks et al., 2018; Nour, Evans, & Carhart-Harris, 2017), suggesting a budding focus of attention on this discrete emotion.

### **Predictors and outcomes of awe and classic psychedelic-occasioned mystical experience**

As an epistemological emotion requiring accommodation, awe may play an important role in curiosity and exploration (e.g. Stellar et al., 2015). It would make sense, then, that those high in personality openness and related traits would be more likely to experience awe. This appears to be the case. For example, Shiota et al. (2007) found that awe-prone individuals reported less need for cognitive closure, and Stellar et al. (2015) reported a robust correlation between the daily experience of awe and openness ( $r=0.50$ ). Nusbaum and Silvia (2011) found that openness was the strongest predictor of experiencing chills, a peripheral physiological response associated with awe, when listening to music, and Pilgrim, Norris, and Hackathorn (2017) found that a greater need for cognitive closure was related to a reduced experience of awe in response to reflective and complex music. Finally, van Elk et al. (2016) demonstrated that those

high in trait absorption, which reflects an individual's propensity to become fully engaged or immersed in sensory and imaginative experiences (see Tellegen & Atkinson, 1974) was a strong predictor of awe across a number of experiments, and instructing participants to fully absorb themselves in an external stimulus yielded stronger feelings of awe (these findings are consistent with the conceptualization of absorption as both a trait and state; e.g. Hall, Schubert, and Wilson (2016)). Although predictors of awe-related dread have not yet been established, high need for cognitive closure in addition to neuroticism, mood, and context have each been speculated as potential determinants (Gordon et al., 2017). With regard to the awe-inducing stimulus, its novelty is considered critical insofar that awe is unlikely to occur in response to a stimulus to which one has habituated (Piff et al., 2015).

In classic psychedelic-assisted psychotherapy, an emphasis during the period of preparation for drug administration is placed on openness to the forthcoming experience (Johnson, Richards, & Griffiths, 2008). Indeed, participants are urged to immerse (i.e. absorb) themselves in the unfolding experience during the period of drug action, welcoming all images, visions, and insights as gifts. This component of classic psychedelic-assisted psychotherapy was developed during the first wave of classic psychedelic research during the 1950s through the 1970s through trial and error, informed by clinical observation, as well as empirical findings suggesting that those with rigid personality traits experienced less intense drug effects (McGlothlin, Cohen, & McGlothlin, 1967). Further bolstering the importance of personality openness and related traits to classic psychedelic-occasioned mystical experience is a contemporary analysis of pooled data from 23 controlled experimental studies involving 409 psilocybin administrations to 261 healthy human volunteers (Studerus, Gamma, Kometer, & Vollenweider, 2012). In this analysis, trait absorption was the second strongest predictor of mystical experience (regression coefficient = 0.35), trailing only drug dose (regression coefficient = 0.78). The overlap here with the awe literature is obvious. Mirroring conjecture in the awe literature, neuroticism (Barrett, Johnson, & Griffiths, 2017), mood, and context (Studerus et al., 2012) are associated with challenging experiences with psilocybin, and earlier experiences with psilocybin may be more meaningful than later experiences, suggesting a habituation to drug effects (Maclea, Leoutsakos, Johnson, & Griffiths, 2012).

Predictors of awe and classic-psychedelic elicited mystical experience, therefore, appear to coincide. The

same may be the case regarding the outcomes of these phenomena. Although awe induction has not been explicitly evaluated as a clinical intervention, experimental manipulations of awe have been shown to increase positive affect (e.g. gratitude, joy, and happiness), well-being and life satisfaction, humility, and prosocial behaviour in the short-term (Gordon et al., 2017; Piff et al., 2015; Prade & Saroglou, 2016; Rudd et al., 2012; Stellar et al., 2018; Valdesolo & Graham, 2014; Yang et al., 2016). Mediation analyses indicate that awe's impact on these outcomes may be accounted for by the small self (Piff et al., 2015; Stellar et al., 2018). A systematic review indicating urban green space may decrease violence and crime lends support for the potential longer-term effect of awe on prosocial behaviour (Bogar & Beyer, 2016), inasmuch that nature is a common elicitor of awe (see also Zhang, Piff, Iyer, Koleva, & Keltner, 2014). Awe has also been shown to increase perceived time availability, it is thought, by bringing people into the present moment (Rudd et al., 2012). Finally, Stellar et al. (2015) found that dispositional awe was the strongest predictor of lower levels of the proinflammatory cytokine interleukin-6 (IL-6).

The classic psychedelic literature offers parallels to these awe-related outcomes. Among healthy volunteers, psilocybin-occasioned mystical experience produces enduring change in positive affect including gratitude, well-being and life satisfaction, humility, and a range of prosocial attitudes and behaviours (Griffiths et al., 2006, 2008, 2011, 2018). Two recent placebo-controlled trials among distressed individuals with life-threatening cancer showed that psilocybin-occasioned mystical experience accounted for enduring decreases in anxiety and depression and increases in quality-of-life (Griffiths et al., 2016; Ross et al., 2016). Consistent with these laboratory findings, naturalistic classic psychedelic use has been linked to a reduced likelihood of psychological distress, suicidality, and criminal behaviour (Hendricks et al., 2014, 2015, 2018; Walsh et al., 2016). Moreover, use of the Amazonian admixture ayahuasca, which contains the classic psychedelic dimethyltryptamine, is associated with increased mindfulness (e.g. Soler et al., 2016; Thomas et al., 2013), a cornerstone of which is attention to the present moment and perceived elongation of time (Droit-Volet, Fanget, & Dambrun, 2015; Keng, Smoski, & Robins, 2011). Finally, an emerging literature suggests that classic psychedelics may lower levels of proinflammatory cytokines, including IL-6 (Nau, Yu, Martin, & Nichols, 2013; Nichols, Johnson, & Nichols, 2017; Yu et al., 2008). Although

the induction of awe has not yet been associated with increases in personality openness, it is noteworthy that classic psychedelic-occasioned mystical experience leads to increases in this trait (Lebedev et al., 2016; MacLean et al., 2011). Should future research demonstrate an effect of awe on openness, the theoretical connection between awe and mystical experience elicited by classic psychedelics would be strengthened.

### Potential overlapping neurological mechanisms of awe and classic psychedelic-occasioned mystical experience: considerations for future research

The neurological foundations of awe have not yet been investigated, so the following section is necessarily more speculative in nature. Nevertheless, two topics bear brief discussion here. First are findings from human brain imaging. Classic psychedelics produce acute default mode network disintegration and whole brain integration (i.e. augmented global functional connectivity), in which there is increased communication between all brain networks, despite a decrease in communication within those networks. These effects are associated with self-reported ratings of ego dissolution post-classic psychedelic administration. Of note, the increase in functional connectivity in the bilateral temporoparietal junction and bilateral insular cortex (structures associated with the self-other boundary, orienting oneself in physical space, and out-of-body experiences) are among the most strongly correlated with ego-dissolution (Carhart-Harris, Muthukumaraswamy, et al., 2016; Nour & Carhart-Harris, 2017; Tagliazucchi et al., 2016). Considering the conceptual overlap between ego dissolution and the small self-characteristic of awe's effects, these findings suggest that increased global functional connectivity could well be important to both awe and classic psychedelic-occasioned mystical experience. Should future human brain imagining research in the awe domain confirm this hypothesis, support for the current theoretical framework would be provided. Second are findings related to serotonergic activity. Serotonin plays an important role in social dominance, which is in turn associated with increased drug administration, risk-taking, and aggression in rats (Shiota et al., 2017), as well as some antisocial behaviour in humans (Galinsky, Gruenfeld, & Magee, 2003). Classic psychedelics primarily act as serotonin 2A-receptor agonists and down-regulate serotonin-2A receptors in the prefrontal cortex (Nichols, 2016). These findings suggest a potential, albeit tentative, molecular link between an emotion (awe) that

promotes subservience of one's own needs in favour of the greater social good—a type of submission or humility that contrasts with dominance—and classic psychedelic-occasioned mystical experience. Clearly this is a topic requiring further exploration.

### Clinical implications and recommendations

Figure 1 presents the proposed psychological model of classic psychedelic-assisted psychotherapy. As seen in this figure, classic psychedelic administration results in a subjective experience appraised as both vast and requiring accommodation, that is, awe. This relationship might be mediated by increased global functional connectivity in the brain. Acute effects centre on the small self/unitive experience/ego dissolution, which may mediate the relationships between awe and other acute effects including insight, sacredness, positive mood, transcendence of time/space, and ineffability. Longer-term effects include increased positive affect, including gratitude, well-being and life satisfaction, humility, prosocial motivation, mindfulness, and openness to new experience.

What underlies the therapeutic value of awe as elicited by classic psychedelics? Awe may be the quintessential binding emotion that drives social integration and cooperation. If evolution ultimately selects for cooperation (e.g. Gowdy & Krall, 2016; Nowak, 2006), it follows that awe represents the pinnacle of human experience. Indeed, in Abraham Maslow's later, amended hierarchy of needs, self-transcendence (seeking to further a cause and experience a communion beyond the boundaries of the self via peak experience) was placed beyond self-actualization, resting atop the motivational hierarchy (Koltko-Rivera, 2006). A lasting hallmark of classic psychedelic-occasioned mystical experience may be a sense of connectedness or oneness with others and/or the external universe. It is this heightened sense of connectedness or oneness that may account for the promising effects of classic psychedelic-assisted psychotherapy across a range of applications. Consistent with this view, Carhart-Harris, Erritzoe, & Haijen (2018) recently proposed that connectedness is key to understanding the therapeutic potential of classic psychedelics, although they did not specify awe as the catalyst of this effect. Thus, for those suffering from depression, end-of-life distress, or other conditions marked by rumination, attention diverted away from the self and toward the transcendent (e.g. family, community, the external universe, a belief system) is likely experienced as liberating if not sublime. For those struggling with addictive



disorders characterized by social dysfunction, the experience of discrepancy between the compulsive pursuit of a hedonic pleasure and commitment to a cause greater than self may fuel the desire for sustained abstinence. For those involved in transgressive behaviour, a profound experience highlighting the inter-relatedness and inter-connectedness of all life may foster greater empathy and concern for the welfare of others.

Classic psychedelic-assisted psychotherapy is thought to spur quantum change, or change that is sudden, dramatic, and long lasting (e.g. Griffiths et al., 2018). How or why classic psychedelic-occasioned mystical experience might prompt quantum change has not been delineated, although from the current theoretical framework, an explanation emerges. In describing non-linear and discontinuous patterns of change in psychotherapy, Hayes, Laurenceau, Feldman, Strauss, and Cardaciotto (2007) point to *critical fluctuations* in dynamical systems theory. According to this theory, 'when challenges to the current steady state of a system are too great to assimilate, change often is not gradual and linear but rather is characterized by sudden disturbance and increased variability in system behaviour before reorganization' (p. 716). Thus, it may be awe's need for accommodation that accounts for the Ebenezer Scrooge-like enlightenment and rebirth that are believed to accompany classic psychedelic-assisted psychotherapy.

No classic psychedelic is currently approved for medical use by the US Food and Drug Administration or regulatory bodies of other nations, and these substances remain highly controlled by the US and other countries. Classic psychedelics have, therefore, not been integrated into clinical practice, although this may be the case in the future should they meet established standards of safety and efficacy. In the meantime, the current manuscript offers a number of recommendations for clinical science:

- Although items used to assess awe demonstrate reliability and validity, and although measures of classic psychedelic effects appear to capture awe and/or its acute outcomes, there is no singular, standard, psychometrically-validated measure of awe (note, however, that the Dispositional Positive Emotion Scale can be used to assess the disposition to experience awe; Shiota, Keltner, and John (2006)). The formal development of such a measure could prove useful in testing some of the relationships in the current proposed model.
- Insofar that trait absorption is a strong predictor of both awe and psilocybin-occasioned mystical experience, and elevating state absorption by instructing participants to fully absorb themselves in an external stimulus produces stronger feelings of awe (Studerus et al., 2012; van Elk et al., 2016), the efficacy of classic psychedelic-assisted psychotherapy may be potentiated by promoting absorption during the period of preparation for drug administration. Mindfulness meditation, with its emphasis on sustaining attention on the present-moment experience, may be a means to promote absorption (Keng et al., 2011).
- Although in contemporary studies classic psychedelics have been administered in controlled settings with participants wearing eyeshades to block out external stimuli, the administration of classic psychedelics in settings known to elicit awe (e.g. natural or religious settings) may enhance treatment efficacy, provided safety is ensured. This recommendation is not without precedent, as in 1962 psilocybin was administered to divinity students in the basement of Boston University's Marsh Chapel during a sermon. These students reported enduring positive change in attitude and behaviour secondary to this experience as long as 25 years after their participation (Doblin, 1991). Of course, the modern era offers technological advances not available in the 1960s, and to that end virtual reality may also have a place in classic psychedelic-assisted psychotherapy. Indeed, virtual reality paradigms may hold promise in their capacity to elicit awe (Gallagher, Reinerman-Jones, Sollins, & Janz, 2014).
- Contemporary studies of classic psychedelics typically incorporate music during the period of drug action, with the expectation that it will provide psychological support and facilitate mystical experience. Although research into the role of music in classic psychedelic-assisted psychotherapy has only recently begun (Barrett, Robbins, Smooke, Brown, & Griffiths, 2017), the capacity of music to elicit awe may depend on the listener's personality and preference (Pilgrim et al., 2017). Future studies may, therefore, consider tailoring music on these and other variables as more research becomes available.
- Considering awe may be the ultimate collective emotion, participants may demonstrate renewed commitment to social collectives (e.g. family) after the administration of a classic psychedelic. Classic psychedelic-assisted psychotherapy may, therefore,

benefit from a systems therapy approach (e.g. Corey, 2015).

- Although classic psychedelic-occasioned mystical experience has been shown to produce enduring positive change, it is believed that such experience may produce an ‘afterglow’ that wanes with time (Majić et al., 2015). The efficacy of classic psychedelic-assisted psychotherapy may, therefore, be augmented by activities that serve to maintain awe, including exposure to nature, art, and music, and participation in spiritual or religious practices. Initial data indicate that spiritual practices may indeed act in synergy with psilocybin-occasioned mystical experience (Griffiths et al., 2018), suggesting an auspicious line of work.
- Although scant data inform the matter, consistent with older psychodynamic models (Majić et al., 2015; Metzner, 1998) the insight elicited by classic psychedelic-occasioned mystical experience may facilitate adaptive reframing of prior traumatic or adverse events. From this perspective, classic psychedelic-assisted psychotherapy may converge with trauma therapies designed to facilitate post-traumatic growth. Some participants may, thus, benefit from these therapy components (e.g. Jim & Jacobsen, 2008; Zoellner & Maercker, 2006).
- Following classic psychedelic-occasioned mystical experience, a number of constructs with therapeutic value in their own right are expected to increase. Efforts to capitalize on these gains may prove fruitful, for instance, in the form of mindfulness training (Keng et al., 2011) or interventions designed to boost gratitude (see Wood, Froh, & Geraghty, 2010).
- Finally, as novelty is critical to the experience of awe, it is possible that individuals habituate to the effects of classic psychedelics. This habituation could be counteracted with escalating doses or sufficient time between administrations of the drug. Still, by definition, quantum change is not expected to occur within the same person more than once. An inherent quality of classic psychedelic-assisted psychotherapy may, therefore, be a limited number of drug administration sessions. This, of course, has advantages with regard to treatment adherence and cost-effectiveness (Hendricks, 2014).

## Conclusion

The present manuscript proposed a psychological model of classic psychedelic-assisted psychotherapy informed by rigorous empirical science. The emotion awe was offered as the principal catalyst for change in

this burgeoning treatment paradigm, along with a number of clinical implications and recommendations. Of course, no model is perfect or complete, and modifications to the current model are expected with time. Nonetheless, it is hoped that the current theorizing will generate hypotheses, inspire new lines of research, and ultimately advance an emerging treatment approach with the potential to revolutionize the mental health field.

## Acknowledgements

The author thanks Dacher Keltner, James Sexton, and Noah Wiles Sweat for comments and suggestions.

## Disclosure statement

The author reports no conflicts of interest.

## References

- Argento, E., Strathdee, S. A., Tupper, K., Braschel, M., Wood, E., & Shannon, K. (2017). Does psychedelic drug use reduce risk of suicidality? Evidence from a longitudinal community-based cohort of marginalised women in a Canadian setting. *BMJ Open*, 7, e016025. doi:10.1136/bmjopen-2017-016025
- Bai, Y., Maruskin, L. A., Chen, S., Gordon, A. M., Stellar, J. E., McNeil, G. D., ... Keltner, D. (2017). Awe, the diminished self, and collective engagement: Universals and cultural variations in the small self. *Journal of Personality and Social Psychology*, 113, 185–209. doi:10.1037/pspa0000087
- Barrett, F. S., Bradstreet, M. P., Leoutsakos, J.-M.S., Johnson, M. W., & Griffiths, R. R. (2016). The challenging experience questionnaire: Characterization of challenging experiences with psilocybin mushrooms. *Journal of Psychopharmacology (Oxford)*, 30, 1279–1295. doi:10.1177/0269881116678781
- Barrett, F. S., & Griffiths, R. R. (2018). Classic hallucinogens and mystical experiences: Phenomenology and neural correlates. *Current Topics in Behavioral Neurosciences*, 36, 393–430. doi:10.1007/7854\_2017\_474
- Barrett, F. S., Johnson, M. W., & Griffiths, R. R. (2015). Validation of the revised mystical experience questionnaire in experimental sessions with psilocybin. *Journal of Psychopharmacology (Oxford)*, 29, 1182–1190. doi:10.1177/0269881115609019
- Barrett, F. S., Johnson, M. W., & Griffiths, R. R. (2017). Neuroticism is associated with challenging experiences with psilocybin mushrooms. *Personality and Individual Differences*, 117, 155–160. doi:10.1016/j.paid.2017.06.004
- Barrett, F. S., Robbins, H., Smooke, D., Brown, J. L., & Griffiths, R. R. (2017). Qualitative and quantitative features of music reported to support peak mystical experiences during psychedelic therapy sessions. *Frontiers in Psychology*, 8, 1238. doi:10.3389/fpsyg.2017.01238
- Bogar, S., & Beyer, K. M. (2016). Green space, violence, and crime: A systematic review. *Trauma, Violence, & Abuse*, 17, 160–171. doi:10.1177/1524838015576412

- 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 (Oxford)*, *29*, 289–299. doi:10.1177/0269881114565144
- Carbonaro, T. M., Bradstreet, M. P., Barrett, F. S., MacLean, K. A., Jesse, R., Johnson, M. W., & Griffiths, R. R. (2016). Survey study of challenging experiences after ingesting psilocybin mushrooms: Acute and enduring positive and negative consequences. *Journal of Psychopharmacology (Oxford)*, *30*, 1268–1278. doi:10.1177/0269881116662634
- Carbonaro, T. M., Johnson, M. W., & Hurwitz, E. (2018). Double-blind comparison of the two hallucinogens psilocybin and dextromethorphan: Similarities and differences in subjective experiences. *Psychopharmacology*, *235*, 521–534. doi:10.1007/s00213-017-4769-4
- Carhart-Harris, R. L., Bolstridge, M., & Day, C. M. J. (2018). Psilocybin with psychological support for treatment-resistant depression: Six-month follow-up. *Psychopharmacology*, *235*, 399–408. doi:10.1007/s00213-017-4771-x
- Carhart-Harris, R. L., Bolstridge, M., Rucker, J., Day, C. M. J., Erritzoe, D., Kaelen, M., ... Nutt, D. J. (2016). Psilocybin with psychological support for treatment-resistant depression: An open-label feasibility study. *Lancet Psychiatry*, *3*, 619–627. doi:10.1016/S2215-0366(16)30065-7
- Carhart-Harris, R. L., Erritzoe, D., & Haijen, E. (2018). Psychedelics and connectedness. *Psychopharmacology*, *235*, 547–550. doi:10.1007/s00213-017-4701-y
- Carhart-Harris, R. L., Leech, R., Hellyer, P. J., Shanahan, M., Feilding, A., Tagliazucchi, E., ... Nutt, D. (2014). The entropic brain: A theory of conscious states informed by neuroimaging research with psychedelic drugs. *Frontiers in human neuroscience*, *8*, 20. doi:10.3389/fnhum.2014.00020
- Carhart-Harris, R. L., Muthukumaraswamy, S., Roseman, L., Kaelen, M., Droog, W., Murphy, K., ... Nutt, D. J. (2016). Neural correlates of the LSD experience revealed by multimodal neuroimaging. *Proceedings of the National Academy of Sciences of the United States of America*, *113*, 4853–4858. doi:10.1073/pnas.1518377113
- Corey, G. (2015) Family systems therapy. In *Theory and practice of counseling and psychotherapy* (pp. 403–425). Boston, MA: Cengage Learning.
- Doblin, R. (1991). Pahnke's "Good Friday Experiment": A long-term follow-up and methodological critique. *Journal of Transpersonal Psychology*, *23*, 1–28.
- Droit-Volet, S., Fanget, M., & Dambrun, M. (2015). Mindfulness meditation and relaxation training increases time sensitivity. *Consciousness and Cognition*, *31*, 86–97. doi:10.1016/j.concog.2014.10.007
- Dyck, E. (2006). 'Hitting Highs at Rock Bottom': LSD treatment for alcoholism, 1950–1970. *Social History of Medicine*, *19*, 313–329. doi:10.1093/shm/hkl039
- Emerson, R. W. (1836) *Nature*. Reprinted in *Ralph Waldo Emerson, selected essays* (1982). New York: Penguin.
- Galinsky, A. D., Gruenfeld, D. H., & Magee, J. C. (2003). From power to action. *Journal of Personality and Social Psychology*, *85*, 453–466. doi:10.1037/0022-3514.85.3.453
- Gallagher, S., Reinerman-Jones, L., Sollins, B., & Janz, B. (2014). Using a simulated environment to investigate experiences reported during space travel. *Theoretical Issues in Ergonomics Science*, *15*, 376–394. doi:10.1080/1463922X.2013.869370
- Gasser, P., Holstein, D., Michel, Y., Doblin, R., Yazar-Klosinski, B., Passie, T., & Brenneisen, R. (2014). Safety and efficacy of lysergic acid diethylamide-assisted psychotherapy for anxiety associated with life-threatening diseases. *The Journal of Nervous and Mental Disease*, *202*, 513–520. doi:10.1097/NMD.0000000000000113
- Gasser, P., Kirchner, K., & Passie, T. (2015). LSD-assisted psychotherapy for anxiety associated with a life-threatening disease: A qualitative study of acute and sustained subjective effects. *Journal of Psychopharmacology (Oxford)*, *29*, 57–68. doi:10.1177/0269881114555249
- Gordon, A. M., Stellar, J. E., Anderson, C. L., McNeil, G. D., Loew, D., & Keltner, D. (2017). The dark side of the sublime: Distinguishing a threat-based variant of awe. *Journal of Personality and Social Psychology*, *113*, 310–328. doi:10.1037/pspp0000120
- Gowdy, J., & Krall, L. (2016). The economic origins of ultrasociality. *Behavioral and Brain Sciences*, *39*, e92. doi:10.1017/S0140525X1500059X
- Griffiths, R. R., Johnson, M. W., Carducci, M. A., Umbricht, A., Richards, W. A., Richards, B. D., ... Klinedinst, M. A. (2016). Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer: A randomized double-blind trial. *Journal of Psychopharmacology (Oxford)*, *30*, 1181–1197. doi:10.1177/0269881116675513
- Griffiths, R. R., Johnson, M. W., Richards, W. A., Richards, B. D., McCann, U., & Jesse, R. (2011). Psilocybin occasioned mystical-type experiences: Immediate and persisting dose-related effects. *Psychopharmacology*, *218*, 649–655. doi:10.1007/s00213-011-2358-5
- 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*, 49–69. doi:10.1177/0269881117731279
- Griffiths, R., Richards, W., Johnson, M., McCann, U., & Jesse, R. (2008). Mystical-type experiences occasioned by psilocybin mediate the attribution of personal meaning and spiritual significance 14 months later. *Journal of Psychopharmacology (Oxford)*, *22*, 621–632. doi:10.1177/0269881108094300
- Griffiths, R. R., Richards, W. A., McCann, U., & Jesse, R. (2006). Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance. *Psychopharmacology*, *187*, 268–283. doi:10.1007/s00213-006-0457-5
- Grob, C. S., Danforth, A. L., Chopra, G. S., Hagerty, M., McKay, C. R., Halberstadt, A. L., & Greer, G. R. (2011). Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. *Archives of General Psychiatry*, *68*, 71–78. doi:10.1001/archgenpsychiatry.2010.116

- Hall, S. E., Schubert, E., & Wilson, S. J. (2016). The role of trait and state absorption in the enjoyment of music. *PLoS ONE*, *11*, e0164029. doi:10.1371/journal.pone.0164029
- Hayes, A. M., Laurenceau, J.-P., Feldman, G., Strauss, J. L., & Cardaciotto, LAnn. (2007). Change is not always linear: The study of nonlinear and discontinuous patterns of change in psychotherapy. *Clinical Psychology Review*, *27*, 715–723. doi:10.1016/j.cpr.2007.01.008
- Hendricks, P. S. (2014). Back to the future: A return to psychedelic treatment models for addiction. *Journal of Psychopharmacology (Oxford)*, *28*, 981–982. doi:10.1177/0269881114550935
- Hendricks, P. S., Clark, C. B., Johnson, M. W., Fontaine, K. R., & Cropsey, K. L. (2014). Hallucinogen use predicts reduced recidivism among substance-involved offenders under community corrections supervision. *Journal of Psychopharmacology (Oxford)*, *28*, 62–66. doi:10.1177/0269881113513851
- Hendricks, P. S., Crawford, M. S., & Cropsey, K. L. (2018). The relationships of classic psychedelic use with criminal behavior in the United States adult population. *Journal of Psychopharmacology*, *32*, 37–48. doi:10.1177/0269881117735685
- Hendricks, P. S., Thorne, C. B., Clark, C. B., Coombs, D. W., & Johnson, M. W. (2015). Classic psychedelic use is associated with reduced psychological distress and suicidality in the United States adult population. *Journal of Psychopharmacology*, *29*, 280–288. doi:10.1177/0269881114565653
- Hendricks, P. S., Johnson, M. W., & Griffiths, R. R. (2015). Psilocybin, psychological distress, and suicidality. *Journal of Psychopharmacol. (Oxford)*, *29*, 1041–1043. doi:10.1177/0269881115598338
- Jim, H. S., & Jacobsen, P. B. (2008). Posttraumatic stress and posttraumatic growth in cancer survivorship: A review. *Cancer Journal (Sudbury, Mass.)*, *14*, 414–419. doi:10.1097/PPO.0b013e31818d8963
- Johnson, M. W., Garcia-Romeu, A., Cosimano, M. P., & Griffiths, R. R. (2014). Pilot study of the 5-HT<sub>2A</sub> agonist psilocybin in the treatment of tobacco addiction. *Journal of Psychopharmacol. (Oxford)*, *28*, 983–992. doi:10.1177/0269881114548296
- Johnson, M. W., Garcia-Romeu, A., & Griffiths, R. R. (2017). Long-term follow-up of psilocybin-facilitated smoking cessation. *The American Journal of Drug and Alcohol Abuse*, *43*, 55–60. doi:10.3109/00952990.2016.1170135
- Johnson, M. W., Richards, W. A., & Griffiths, R. R. (2008). Human hallucinogen research: Guidelines for safety. *Journal of Psychopharmacol. (Oxford)*, *22*, 603–620. doi:10.1177/0269881108093587
- Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cogn Emot*, *17*, 297–314. doi:10.1080/026999303022297
- Keng, S. L., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review*, *31*, 1041–1056. doi:10.1016/j.cpr.2011.04.006
- Kleber, H. D. (2016). The successful return of psychedelics to psychiatry. *Journal of Psychopharmacol. (Oxford)*, *30*, 1211. doi:10.1177/0269881116675779
- Koltko-Rivera, M. E. (2006). Rediscovering the later version of Maslow's hierarchy of needs: Self-transcendence and opportunities for theory, research, and unification. *Review of General Psychology*, *10*, 302–317. doi:10.1037/1089-2680.10.4.302
- Lebedev, A. V., Kaelen, M., Lövdén, M., Nilsson, J., Feilding, A., Nutt, D. J., & Carhart-Harris, R. L. (2016). LSD-induced entropic brain activity predicts subsequent personality change. *Human Brain Mapping*, *37*, 3203–3213. doi:10.1002/hbm.23234
- 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 Psychopharmacol. (Oxford)*, *25*, 1453–1461. doi:10.1177/0269881111420188
- Maclean, K. A., Leoutsakos, J.-M.S., Johnson, M. W., & Griffiths, R. R. (2012). Factor analysis of the mystical experience questionnaire: A study of experiences occasioned by the hallucinogen psilocybin. *Journal for the Scientific Study of Religion*, *51*, 721–737. doi:10.1111/j.1468-5906.2012.01685.x
- Majić, T., Schmidt, T. T., & Gallinat, J. (2015). Peak experiences and the afterglow phenomenon: When and how do therapeutic effects of hallucinogens depend on psychedelic experiences? *Journal of Psychopharmacol. (Oxford)*, *29*, 241–253. doi:10.1177/0269881114568040
- McGlothlin, W., Cohen, S., & McGlothlin, M. S. (1967). Long lasting effects of LSD on normals. *Archives of General Psychiatry*, *17*, 521–532. doi:10.1001/archpsyc.1967.01730290009002
- Metzner, R. (1998). Hallucinogenic drugs and plants in psychotherapy and shamanism. *Journal of Psychoactive Drugs*, *30*, 333–341. doi:10.1080/02791072.1998.10399709
- Nau, F., Yu, B., Martin, D., & Nichols, C. D. (2013). Serotonin 5-HT<sub>2A</sub> receptor activation blocks TNF- $\alpha$  mediated inflammation in vivo. *PLoS One*, *8*, e75426. doi:10.1371/journal.pone.0075426
- Niedenthal, P. M., & Brauer, M. (2012). Social functionality of human emotion. *Annual Review of Psychology*, *63*, 259–285. doi:10.1146/annurev.psych.121208.131605
- Nichols, D. E. (2016). Psychedelics. *Pharmacological Reviews*, *68*, 264–355. doi:10.1124/pr.115.011478
- Nichols, D. E., Johnson, M. W., & Nichols, C. D. (2017). Psychedelics as medicines: An emerging new paradigm. *Clinical Pharmacology and Therapeutics*, *101*, 209–219. doi:10.1002/cpt.557
- Nour, M. M., & Carhart-Harris, R. L. (2017). Psychedelics and the science of self-experience. *British Journal of Psychiatry*, *210*, 177–179. doi:10.1192/bjp.bp.116.194738
- Nour, M. M., Evans, L., & Carhart-Harris, R. L. (2017). Psychedelics, personality and political perspectives. *Journal of Psychoactive Drugs*, *49*, 182–191. doi:10.1080/02791072.2017.1312643
- Nour, M. M., Evans, L., Nutt, D., & Carhart-Harris, R. L. (2016). Ego-dissolution and psychedelics: Validation of the Ego-Dissolution Inventory (EDI). *Frontiers in Human Neuroscience*, *10*, 269. doi:10.3389/fnhum.2016.00269
- Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, *314*, 1560–1563. doi:10.1126/science.1133755
- Nusbaum, E. C., & Silvia, P. J. (2011). Shivers and timbres: Personality and the experience of chills from music.

- Social Psychological and Personality Science*, 2, 199–204. doi:10.1177/1948550610386810
- Nutt, D. (2016). Psilocybin for anxiety and depression in cancer care? Lessons from the past and prospects for the future. *Journal of Psychopharmacol. (Oxford)*, 30, 1163–1164. doi:10.1177/0269881116675754
- Osório, F. de L., Sanches, R. F., Macedo, L. R., dos Santos, R. G., Maia-de-Oliveira, J. P., Wichert-Ana, L., ... Hallak, J. E. (2015). Antidepressant effects of a single dose of ayahuasca in patients with recurrent depression: A preliminary report. *Revista Brasileira Psiquiatria*, 37, 13–20. doi:10.1590/1516-4446-2014-1496
- Pahnke, W. (1964). First impressions of first LSD experience of March 30, 1964. Retrieved from <http://earchives.lib.purdue.edu/cdm/singleitem/collection/psyc/id/7>
- Piff, P. K., Dietze, P., Feinberg, M., Stancato, D. M., & Keltner, D. (2015). Awe, the small self, and prosocial behavior. *Journal of Personality and Social Psychology*, 108, 883–899. doi:10.1037/pspi0000018
- Pilgrim, L., Norris, J. I., & Hackathorn, J. (2017). Music is awesome: Influences of emotion, personality, and preference on experienced awe. *Journal of Consumer Behaviour*, 16, 442–451. doi:10.1002/cb.1645
- Pisano, V. D., Putnam, N. P., Kramer, H. M., Franciotti, K. J., Halpern, J. H., & Holden, S. C. (2017). The association of psychedelic use and opioid use disorders among illicit users in the United States. *Journal of Psychopharmacol. (Oxford)*, 31, 606–613. doi:10.1177/0269881117691453
- Prade, C., & Saroglou, V. (2016). Awe's effects on generosity and helping. *The Journal of Positive Psychology*, 11, 522–530. doi:10.1080/17439760.2015.1127992
- Preston, J. L., & Shin, F. (2017). Spiritual experiences evoke awe through the small self in both religious and non-religious individuals. *Journal of Experimental Social Psychology*, 70, 212–221. doi:10.1016/j.jesp.2016.11.006
- Ross, S., Bossis, A., Guss, J., Agin-Liebes, G., Malone, T., Cohen, B., ... Schmidt, B. L. (2016). Rapid and sustained symptom reduction following psilocybin treatment for anxiety and depression in patients with life-threatening cancer: A randomized controlled trial. *Journal of Psychopharmacol. (Oxford)*, 30, 1165–1180. doi:10.1177/0269881116675512
- Rudd, M., Vohs, K. D., & Aaker, J. (2012). Awe expands people's perception of time, alters decision making, and enhances well-being. *Psychological Science*, 23, 1130–1136. doi:10.1177/0956797612438731
- Sanches, R. F., de Lima Osório, F., Dos Santos, R. G., Macedo, L. R. H., Maia-de-Oliveira, J. P., Wichert-Ana, L., ... Hallak, J. E. C. (2016). Antidepressant effects of a single dose of ayahuasca in patients with recurrent depression: A SPECT study. *Journal of Clinical Psychopharmacology*, 36, 77–81. doi:10.1097/JCP.0000000000000436
- Savage, C., & McCabe, O. L. (1973). Residential psychedelic (LSD) therapy for the narcotic addict. A controlled study. *Archives of General Psychiatry*, 28, 808–814. doi:10.1001/archpsyc.1973.01750360040005
- Shiota, M. N., Campos, B., Oveis, C., Hertenstein, M. J., Simon-Thomas, E., & Keltner, D. (2017). Beyond happiness: Building a science of discrete positive emotions. *Am Psychol*, 72, 617–643. doi:10.1037/a0040456
- Shiota, M. N., Keltner, D., & John, O. P. (2006). Positive emotion dispositions differentially associated with big five personality and attachment style. *The Journal of Positive Psychology*, 1, 61–71. doi:10.1080/17439760500510833
- Shiota, M. N., Keltner, D., & Mossman, A. (2007). The nature of awe: Elicitors, appraisals, and effects on self-concept. *Cognition and Emotion*, 21, 944–963. doi:10.1080/02699930600923668
- Soler, J., Elices, M., Franquesa, A., Barker, S., Friedlander, P., Feilding, A., ... Riba, J. (2016). Exploring the therapeutic potential of Ayahuasca: Acute intake increases mindfulness-related capacities. *Psychopharmacology*, 233, 823–829. doi:10.1007/s00213-015-4162-0
- Stellar, J. E., Gordon, A., & Anderson, C. L. (2018). Awe and humility. *Journal of Personality and Social Psychology*, 114, 258–269. doi:10.1037/pspi0000109
- Stellar, J. E., John-Henderson, N., Anderson, C. L., Gordon, A. M., McNeil, G. D., & Keltner, D. (2015). Positive affect and markers of inflammation: Discrete positive emotions predict lower levels of inflammatory cytokines. *Emotion*, 15, 129–133. doi:10.1037/emo0000033
- Studerus, E., Gamma, A., Kometer, M., & Vollenweider, F. X. (2012). Prediction of psilocybin response in healthy volunteers. *PLoS One*, 7, e30800. doi:10.1371/journal.pone.0030800
- Tagliazucchi, E., Roseman, L., Kaelen, M., Orban, C., Muthukumaraswamy, S. D., Murphy, K., ... Carhart-Harris, R. (2016). Increased global functional connectivity correlates with LSD-induced ego dissolution. *Curr. Biol*, 26, 1043–1050. doi:10.1016/j.cub.2016.02.010
- Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences (“absorption”), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology*, 83, 268–277. doi:10.1037/h0036681
- Thomas, G., Lucas, P., Capler, N. R., Tupper, K. W., & Martin, G. (2013). Ayahuasca-assisted therapy for addiction: Results from a preliminary observational study in Canada. *Current Drug Abuse Reviews*, 6, 30–42. doi:10.2174/15733998113099990003
- Valdesolo, P., & Graham, J. (2014). Awe, uncertainty, and agency detection. *Psychological Science*, 25, 170–178. doi:10.1177/0956797613501884
- Van Cappellen, P., & Saroglou, V. (2012). Awe activates religious and spiritual feelings and behavioral intentions. *Psychology of Religion and Spirituality*, 4, 223–236. doi:10.1037/a0025986
- Van Elk, M., Karinen, A., Specker, E., Stamkou, E., & Baas, M. (2016). ‘Standing in awe’: The effects of awe on body perception and the relation with absorption. *Collabra*, 2, 4. doi:10.1525/collabra.36
- Walsh, Z., Hendricks, P. S., Smith, S., Kosson, D. S., Thiessen, M. S., Lucas, P., & Swogger, M. T. (2016). Hallucinogen use and intimate partner violence: Prospective evidence consistent with protective effects among men with histories of problematic substance use. *Journal of Psychopharmacol. (Oxford)*, 30, 601–607. doi:10.1177/0269881116642538
- Wood, A. M., Froh, J. J., & Geraghty, A. W. A. (2010). Gratitude and well-being: A review and theoretical integration. *Clinical Psychology Review*, 30, 890–905. doi:10.1016/j.cpr.2010.03.005

- Yaden, D. B., Le Nguyen, K. D., Kern, M. L., Belser, A. B., Eichstaedt, J. C., Iwry, J., ... Newberg, A. B. (2017). Of roots and fruits: A comparison of psychedelic and nonpsychedelic mystical experiences. *Journal of Humanistic Psychology*, 57, 338–353. doi:[10.1177/0022167816674625](https://doi.org/10.1177/0022167816674625)
- Yaden, D. B., Iwry, J., Slack, K. J., Eichstaedt, J. C., Zhao, Y., Vaillant, G. E., & Newberg, A. B. (2016). The overview effect: Awe and self-transcendent experience in space flight. *Psychology of Consciousness: Theory, Research, and Practice*, 3, 1–11. doi:[10.1037/cns0000086](https://doi.org/10.1037/cns0000086)
- Yang, Y., Yang, Z., Bao, T., Liu, Y., & Passmore, H.-A. (2016). Elicited awe decreases aggression. *Journal of Pacific Rim Psychology*, 10, e11. doi:[10.1017/prp.2016.8](https://doi.org/10.1017/prp.2016.8)
- Yu, B., Becnel, J., Zerfaoui, M., Rohatgi, R., Boulares, A. H., & Nichols, C. D. (2008). Serotonin 5-hydroxytryptamine(2A) receptor activation suppresses tumor necrosis factor-alpha-induced inflammation with extraordinary potency. *The Journal of Pharmacology and Experimental Therapeutics*, 327, 316–323. doi:[10.1124/jpet.108.143461](https://doi.org/10.1124/jpet.108.143461)
- Zhang, J. W., Piff, P. K., Iyer, R., Koleva, S., & Keltner, D. (2014). An occasion for unselfing: Beautiful nature leads to prosociality. *Journal of Environmental Psychology*, 37, 61–72. doi:[10.1016/j.jenvp.2013.11.008](https://doi.org/10.1016/j.jenvp.2013.11.008)
- Zoellner, T., & Maercker, A. (2006). Posttraumatic growth in clinical psychology - a critical review and introduction of a two component model. *Clinical Psychology Review*, 26, 626–653. doi:[10.1016/j.cpr.2006.01.008](https://doi.org/10.1016/j.cpr.2006.01.008)