

Psychedelics and inner dimensions of sustainability: A Literature Review

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Abstract

Tackling sustainability issues requires engagement with inner dimensions of sustainability, including the beliefs, values, worldviews and paradigms that influence how people perceive and behave in society and in relation to the natural world. Research on classic psychedelics is undergoing a renaissance, and despite the often-stated positive effects and potentials for perceptual and behavioural change, research on psychedelics has previously not been systematically linked with sustainability. This paper aims to explore the role of classic psychedelics for sustainability transformations by outlining the links between the inner dimensions of sustainability and psychedelic research. Through a systematic literature review, we identify how the effects of classic psychedelics have been linked to inner dimensions of sustainability across a range of fields including neuroscience, psychology, psychopharmacology, sustainability studies, ecopsychology, and psychotherapy up until June 2020. We categorise the literature into the overlapping themes: i) values & personality, ii) (nature) connectedness, and iii) worldviews & spirituality. Overall, a small sample of papers made explicit links to inner dimensions of sustainability, and a larger sample of papers could be implicitly linked to inner sustainability. This review shows that classic psychedelics bear potential as a deep leverage point for inner sustainability transformations, and further research is warranted.

Keywords: classic psychedelics, inner transformation, personal sustainability, values, nature connectedness, pro-environmental behaviour

1. Introduction

In order to create transformative change for sustainability, systemic shifts in worldviews and mental models at a collective level are necessary to reshape norms, institutions, and structures (Westley et al., 2013; Abson et al., 2017; McAlpine et al., 2015; Martin et al., 2016). Tackling sustainability issues such as climate change and ecosystem collapse requires not only systemic and structural reforms, but also consideration of inner dimensions of sustainability (Ives et al., 2019; O'Brien, 2009;

Fischer & Riechers, 2019; Barragan-Jason et al., 2022; IPBES 2019). This includes the beliefs, values, worldviews and paradigms that influence how people perceive and behave in society and in relation to the natural world (O'Brien, 2018). While recent efforts have focused on the role of inner dimensions for sustainability (Woiwode et al., 2021), different potential leverage points or catalysts that can evoke or sustain changes in these dimensions are underexplored.

1.1 Psychedelic Renaissance

Research into psychedelic drugs is currently undergoing a renaissance. From being highly stigmatised for decades, classic psychedelics have in just a few years become widely recognised and popularised for their potential for mental health research and practice (Doblin et al., 2019). Psychedelic substances have been used in traditional plant-medicine, divination, shamanic, and sacramental rituals and practices by indigenous groups since ancient times (Samorini, 2019; Schultes & Hofmann, 1979). The roots of modern psychedelic medicine owes much of its success to the history of Indigenous practices (George et al., 2020). The focus of this paper is on the published research on classic psychedelics (see section 2.1), which has been conducted mostly from a western clinical and scientific perspective, and is thereby biased towards a European and North American context and outlook on psychedelics.

Europe and North American culture became increasingly exposed to psychedelics after Albert Hofmann synthesized lysergic acid diethylamide (LSD) in 1943. LSD has attracted a lot of public attention not only for its controversial recreational use but also for its medical capacity and therapeutic potential within psychiatry and psychotherapy. Psychedelics have also been associated with emergence of environmental movements, and the development of the deep ecology movements during the 1970's (Luke, 2013). Despite promising clinical trials with scientists and psychiatrists advocating psychedelic medicine in the 1950s (Nutt, King & Nichols, 2013), widespread recreational use and abuse resulted in governments prohibiting the substances (Belouin & Henningfield, 2018). By 1971, most of classic psychedelics were classed as Schedule 1 drugs¹. Resulting administrative hindrances and disproportionate costs for academic institutions eventually lead to a halt on clinical trials and research in the 1970s (Forstmann & Sagioglou, 2017; Nutt et al., 2013). Promising results have been reported from the resurgence of experimental studies on the treatment of a range of serious psychiatric disorders such as anxiety, depression, post-traumatic stress disorder, and exploration of substance addiction (Andersen et al., 2021), resulting in a gradual normative shift in research. Studies have highlighted

¹ Schedule I drugs – drugs with no currently accepted medical use and a high potential for abuse.

the capacity of psychedelics to: reduce anxiety for terminally ill patients (Gasser, Kirchner & Passie, 2014); decreased depression symptoms, particularly for those who are treatment resistant (Carhart-Harris et al., 2017a; Carhart-Harris et al., 2021); and aid alcohol or other illicit drug addictions (Krebs & Johansen, 2012; Noorani, Garcia-Romeu, Swift, Griffiths & Johnson, 2018; Bogenschutz et al., 2022). Recent clinical trials with the use of psilocybin have been conducted in institutions such as John Hopkins University (US), Imperial College (UK) and Karolinska Institutet (Sweden). The Australian government has in 2023 announced that they will allow psilocybin and MDMA to be prescribed by psychiatrists (Haridy, 2023). In North America, states and provinces are rapidly revising their legal frameworks, with seven states having adopted legislation to decriminalise psychedelics at state and city levels for therapeutic purposes since 2019 (Siegel et al., 2022).

Classic psychedelics have been found to modulate neuroplasticity, by facilitating the formation of new synapses and dendrites between neurons (Ly et al., 2018). This may partly underlie the long-term therapeutic effects in healthy psychological functioning and long-term therapeutic effect, with them having been labelled a “psychoplastogen” (Ly et al., 2018). Neuroplasticity is believed to be the key mechanism of modifying the brain’s structure, functions or connections, enabling one to learn and adapt in response to life experiences, potentially contributing to shifts in behavioural and personality traits (Gandy, 2019; Ly et al., 2018). Moreover, psychedelics are argued to generate acute and long-term effects on mood, personality (e.g. increases in openness), subjective wellbeing, empathy, pro-social attitudes, connectedness, compassion, cognitive flexibility, creativity, value orientation, spirituality, self-transcendence, and mindfulness (Jungaberle et al., 2018). These components also comprise personal expressions of sustainability (Ives et al., 2019) and are strong predictors of connection with nature and pro-environmental behaviour (Forstmann & Sagioglou, 2017).

1.2. Nature connectedness and psychedelics

Fostering a sense of connection to nature is increasingly recognized as an important lever for transformational sustainable change, through changing values and behaviour (Barragan-Jason et al., 2022; McAlpine et al., 2015; Reichers et al., 2019; Ives et al., 2019; Zylstra et al., 2014). Recently, it has been suggested that psychedelics have the ability to foster a greater sense of connection to nature in various ways. For example, psychedelics induce anthropomorphizing of natural entities, which is suggested to increase an empathic connection to natural environments (Forstmann & Sagioglou, 2017). Studies assessing use of psychedelics via self-report encounters with an “earth-soul”, Gaia, Mother Nature, or other spiritual entities (Luke, 2011). Increased

nature connectedness (also referred to as nature relatedness in the literature) measured through psychometric scales has also been documented (Kettner et al., 2019; Lyons & Carhart-Harris, 2018; Forstmann & Sagioglou, 2017), and psychedelics have been associated with pro-environmental behaviour (Forstmann & Sagioglou, 2017). Kettner et al. (2019) suggest that psychedelic use has the potential to influence people's self-concept 'from Egoism to Ecoism'. Thus, the various of ways that psychedelics are related to increased connectedness with nature and to behavioural change (Carhart-Harris, 2017b) suggests the need for further exploration of the potential role of psychedelics for sustainability transformations.

Individual level sustainability, or the 'personal' dimension for sustainability (O'Brien, 2018), directed at the inner worlds of individuals, encompass their emotions, values, worldviews, identities, thoughts, and beliefs (Ives, Freeth & Fischer, 2019). This field involves topics such as subjective wellbeing, sustainable behaviour and consumption, human-nature connections, equality issues, and activism (Ives et al., 2018, 2019). This study follows the plea for sustainability scientists to take stock of existing evidence on nature connectedness, to pursue novel interdisciplinary research that can generate knowledge for a sustainable future (Ives et al., 2017; 2018; Zylstra et al., 2014; Reichers et al., 2019), and the need to further investigate approaches and concepts that foster transformation related to inner dimensions as 'deep' leverage points (Fischer & Riechers, 2019).

1.3 Aim and Research Question

Despite literature on classic psychedelics indicating potential societal and environmental benefits (e.g. Jungaberle et al., 2018), the connections between classic psychedelic research and sustainability has not previously been systematically outlined. Therefore, this paper strives to narrow this knowledge gap by outlining links between psychedelic research and the personal sphere of transformation for sustainability. While there are crucial legal, political and economic impacts of psychedelics in relation to sustainability, we here focus on the *individual dimensions* of transformation for sustainability. This refers to the link between how psychedelics can induce changes in perception, beliefs, worldviews, attitudes and behaviours amongst individuals, with potential to create cultural and societal change. The aim of this paper is to explore the potential role of classic psychedelics in eliciting sustainability transformations by outlining the links between the inner (or personal) dimensions of sustainability (see section 2.2) and psychedelic research. We address the following research question: How are the effects of classic psychedelics linked to the inner dimensions of sustainability in the literature?

2. Conceptual framework

2.1 Classic psychedelics

Psychedelics is by definition rooted from the Greek words “psyche” and “delos”, which means “mind-manifesting”, or “mind-expanding”, (Aixalà, dos Santos, Hallak & Buoso, 2018), or “soul-manifesting”. There is some disagreement over what drugs constitute psychedelics, but classic psychedelics (CP) are serotonin 2A receptor (5-HT_{2A}R) agonists (Johnson et al., 2019), and the 5-HT_{2A}R receptor is known to be the most important receptor underlying psychedelic effects associated with these compounds (Nichols, 2016). Classic psychedelics include both synthetic and organic drugs. Entheogens, which means “revealing the divine within” (Trichter et al., 2009), are derived from plants and include e.g. mescaline, DMT (N, N- Dimethyltryptamine, the active psychedelic ingredient in ayahuasca), and psilocybin, while semi-synthetic psychedelics such as LSD (lysergic acid diethylamide) are created in a laboratory. Synthetic psychedelics also include variations on the structure of either tryptamine (e.g. LSD, psilocybin, DMT) or phenethylamine (e.g. mescaline) (Nichols, 2016). Other drugs that are sometimes referred to as psychedelic such as ketamine, MDMA or cannabinoids work on different receptors or interact with receptors differently than classic psychedelics, and are not included in this review. The neuroscientific mechanisms of classic psychedelics are not well understood, but psychedelics are known to inhibit the posterior cingulate cortex, a main area of the default mode network (Nichols, 2016). The default-mode network is highly active at rest and in self-referential activities, and is often associated with the ‘ego’ or sense of self, and is deactivated during non-self related tasks (Raichle et al., 2001). Deactivation of the posterior cingulate cortex and the rest of the default mode network have thus been proposed to underlie the psychedelic experience, and the brain state associated with multiple psychedelics is characterized by increasing global brain connectivity (Gattusu et al., 2023). This shift in brain dynamics appear to underlie effects which include increased attention to the inner world, and with ego-dissolution, mystical-type experiences, connectedness with self, others, and nature (Carhart-Harris et al., 2017b; Johnson et al., 2019; Lebedev et al., 2016). In psychedelic-assisted therapy, there is a large emphasis on *set* and *setting*. *Set* includes psychological factors such as mind-set, pre-existing beliefs, current cognitive wellbeing and expectations, intent, motivation, and *setting* are the environmental factors of the physical space that greatly shape and influence the psychedelic experience (Carhart-Harris et al., 2018; Lebedev et al., 2016).

2.2 The inner dimensions of sustainability transformations

We draw on O'Brien (2018) to conceptualise inner dimensions of sustainability, in terms of her definition of the 'personal' sphere of sustainability transformations. This includes the: "Individual and shared beliefs, values, worldviews and paradigms that influence how people perceive, define or constitute systems and structures, as well as their behaviours and practices (O'Brien, 2018, p. 156)". This personal sphere is thus related to the idea of 'inner' transformation as a leverage point for 'external' sustainability transformations (Woiwode et al., 2021). A focus on this sphere of sustainability transformation can have strong leverage to change systems, since it includes fundamental worldviews that define structures and political systems (O'Brien, 2018; Ives et al., 2018; Meadows, 1999). Individuals are here seen as part of a complex system with the agency to collectively shift the goals of that system (Sacks, 2018), or to influence system change by targeting other system levers such as designs, institutions and material flow of resources (Woiwode et al., 2021). Insights into mechanisms that affect personal dimensions of change are thus critical to explore in order to inform the premises for interventions that nurture or activate certain behaviours that shape institutions, structures, rules and norms at a collective level (Parodi, 2018; McAlpine et al., 2015).

One aspect of the idea of inner sustainability is the level of individuals' connectedness with nature (Ives et al., 2018). The idea of the need to re-connect people with nature in non-material ways in highly industrialised societies is a widely considered topic in sustainability research (Riechers et al., 2019; Ives et al., 2018; Barragan-Jason et al., 2022). While much of the research on connectedness to nature has been confined to psychology (Tam, 2013), the topic is also studied in many fields with varied methodologies across the social and behavioural sciences and humanities (Ives et al., 2017). The joint focus is an interest in peoples and groups cognitive, emotional and experiential relations with nature (Ives et al., 2017). Stronger connectedness is known to be related to pro-environmental behaviour, and its potential to foster individual and collective action to protect and restore ecosystems is increasingly emphasised (Amel et al., 2017; Mackay & Schmitt, 2019; Whitburn et al., 2020; Ives et al., 2018; Barragan-Jason et al., 2022).

3. Methods

3.1. Systematic Literature Review

This is a systematic literature review that combines quantitative database search with qualitative content analysis (Boland, Cherry & Dickson, 2017). This method is appropriate in order to systematically identify overlapping themes and interlinkages of research on psychedelics related to personal sustainability across

disciplines. Psychedelic research and links to sustainability span across a range of fields and we have here included literature from neuroscience, psychology, psychopharmacology, sustainability studies, ecopsychology, and psychotherapy (Nichols, 2016; Polk, 2014). We developed a protocol for the literature search string and analysis (see Figure 1) to search for literature in the Web of Science database. The methodology, including the search string and analysis protocol, was originally outlined in a master's thesis by the first author (Nilsson, 2020), but was subsequently further developed and applied for data collection for the purpose of this paper.

3.2 Data collection and analysis

A literature search using a search string was conducted in the database Web of Science. The search string included terms that represent concepts of both environmental and personal sustainability. The following search string was used: *TS= (psychedelic* AND behavior) or TS= (psychedelic* AND values) or TS= (psychedelic* AND environment) or TS= (psychedelic* AND sustainability) or TS= (psychedelic* AND Transformation) or TS= (psychedelic* AND nature) or TS= (psychedelic* AND psychotherapy) or TS=(psychedelic* AND climate) or TS=(psychedelic* AND sustainable) or TS= (psychedelic* AND ecology) or TS= (psychedelic*AND mindfulness) or TS= (psychedelic* AND connectedness) or TS= (psychedelic* AND spiritual).*

The search resulted in 1,075 hits and included only peer reviewed scientific articles published up until June 2020. A protocol for inclusion and exclusion of papers was applied to screen abstracts to determine which papers should be included or discarded (see Figure 1). Only papers that deal with classic psychedelics were included, which means that papers dealing with other substances e.g. ketamine, MDMA or cannabinoids were excluded. Studies employing animal testing were also excluded. As a next step, full papers were screened to outline studies that focus on the personal dimensions of sustainability transformations (see section 2.2), i.e. links between psychedelics and values, cognition, behavioural change, personality, nature connectedness, worldviews and spirituality. This resulted in the majority of papers being excluded, since many did not focus or mention effects on inner dimensions of sustainability, but instead focused on the psychotherapeutic, psychopharmacological or neuroscientific aspects of psychedelic research, typically on the use of psychedelics to treat addiction, depression, anxiety, and PTSD. We recognise that some of the papers that were excluded might have implicit links to personal sustainability, but since we are unaware of those links we deemed them outside the scope of this paper. Irrelevant material was also excluded, such as papers in languages other than English, duplicates, and false positives such as papers with the relevant keywords but irrelevant scope or focus. 65 articles were initially accepted for the analysis,

and 1 paper was added during the review process.

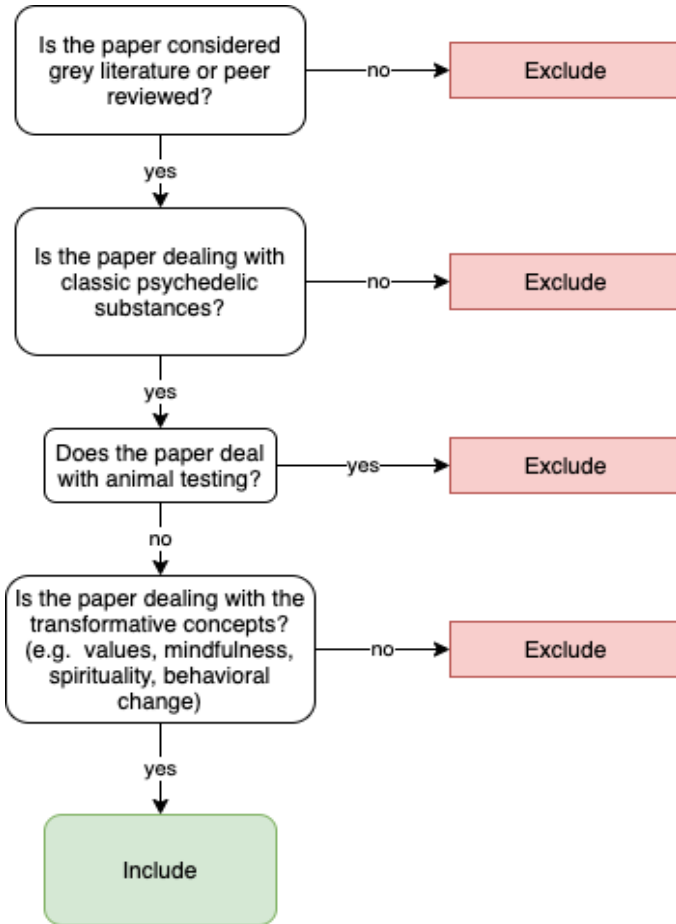


Figure 1. Protocol for analysis

We first categorised the articles into the type of study (overviews, reviews, empirical studies etc.). To analyse the results we clustered the articles into broad themes with studies that describe: a) values and personality b) nature connectedness c) spirituality and worldview. Under each theme, we categorised papers as either making *explicit* connections to personal sustainability, (meaning individual change, or societal change

at the individual level related to sustainability, or pro-environmental engagement was mentioned in the paper) or as *implicit*, for which links could be made, but were not part of the objectives, unit of analysis, or findings of the paper, or not articulated in those terms.

For each paper we applied the following review question: How is the link to personal sustainability described or studied? We expand on how the different links between psychedelics and personal sustainability is articulated under each theme below (section 4). The review includes literature from multiple fields, and the themes below are overlapping across papers and disciplines (see Figure 2 and Table 1). The results include journals on psychedelic studies, psychoactive drugs, psychology, neuroscience, psychopharmacology, religion, pharmacology, neuropsychopharmacology, psychological medicine, psychiatry, environmental research & public health, philosophy, contextual behavioural science, ecopsychology, and the behavioural neurobiology of psychedelic drugs.

4. Results

The literature can be divided into papers that make *explicit* connections to personal sustainability both empirically and theoretically (11), and those that are *implicitly* related to personal sustainability (54). We categorise the literature into three broad and overlapping themes of: i) values & personality, ii) (nature) connectedness, and iii) worldviews & spirituality (see Figure 2 and Table 1). The majority of papers (43) mention more than one theme, and 12 papers mention all three themes. The most recurring theme was values and personality. However, the link was implicit, and studies mostly focused on assessing different types of psychological constructs such as value orientation, which in turn can be linked to different types of pro-environmental behaviours. The theme of nature connectedness was the most salient theme, and included the most explicit link to sustainability.

Several papers in this sample are literature reviews or overviews (26%), and span across all three themes. For example Gandy (2019), presented a literature review on the benefits of classic psychedelics in “healthy normals”, which covers results on increases in the personality trait of openness, mystical-type experiences, and makes the link to personal sustainability through nature relatedness as a key predictor of pro-environmental awareness and behaviour. Similarly Jungaberle et al. (2018) conducted a literature review on psychedelics (and entactogens) related to positive psychology and reported acute and long-term effects across a range of psychological capacities and factors, and emphasise the link to pro-environmental behaviour through increased nature relatedness. Geiger et al. (2018) provide a synthesis of research on psilocybin in chemical neuroscience, and describe how

studies show increased empathy, simultaneous emotions, enhanced objective and situational analysis, increased spirituality, and a sense of interconnection between humanity and a higher power.

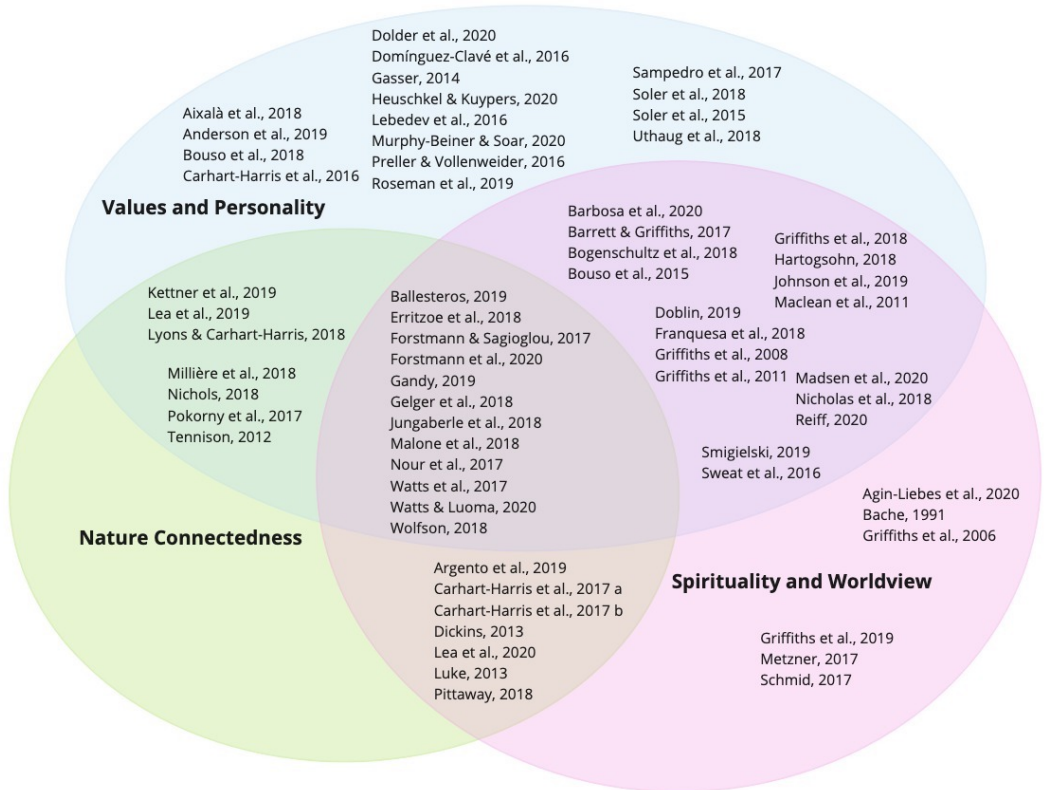


Figure 2. Themes and articles linking personal sustainability and classic psychedelics. While values and personality was the most commonly mentioned theme in our search, our analysis showed that nature connectedness was the most salient and explicit.

4.1. Values and personality

16 articles fall exclusively under the theme ‘values and personality’, in ways that can be linked to personal sustainability. All of these are identified as making implicit

links since none investigate or discuss the relationship between values and personality and personal sustainability directly. The implicit links we have identified are related to increases in openness, liberal political orientations, mindfulness, and overall moral capacities. The personality trait of openness and the psychological value of self-transcendence are known to be important predictors of environmentalism and pro-environmental behaviour (Puech et al., 2020; Shultz et al., 2005; Stern, 1994). Openness pertains to the ability and eagerness to change norms and adopt a more sustainable lifestyle (Hirsh, 2014), and is also correlated with more liberal political views (Verhulst et al., 2012). In turn, liberal political ideologies are known to be a predictor of environmentalism and pro-environmental behaviour (Dunlap et al., 2001). Moreover, mindfulness capabilities have been related to pro-environmental attitudes, engagement and climate adaptation (Thiermann & Shaete, 2021; Panno et al., 2018; Wamsler, 2018).

Implicit

Openness. A systematic literature review of the effects of classic psychedelics on personality (Bouso et al., 2018) shows that personality traits such as absorption and self-transcendence seem to influence the effects of psychedelics, and that personality changes such as positive shifts in openness and self-transcendence may be induced by psychedelics administered in controlled settings. Empirical studies that show increases in openness include Maclean et al. (2011) who assessed the five broad domains of personality, (i.e. neuroticism, extroversion, openness, agreeableness, and conscientiousness) and found that a single high dose of psilocybin on 52 healthy and psychedelic-naïve participants elicited an increase in personality trait openness. It was found that participants who had a mystical experience (see section 4.3.) remained significantly higher than baseline in openness even one year after the session. Lebedev et al. (2016) investigated biological predictors of post-LSD changes in personality amongst 19 healthy adults through placebo-controlled MRI scans and the revised NEO Personality Inventory (NEO-PI-R), and found pronounced increases in sensory and hierarchically higher networks across multiple times scales, which predicted increases in trait openness. Similarly, LSD administration has been shown to enhance openness scores in healthy volunteers two weeks after the conducted sessions (Carhart-Harris et al., 2016). Ayahuasca used regularly in a ceremonial context have also been associated with higher openness scores, as compared to non-ayahuasca using controls (Barbosa et al., 2020), as well as higher scores for self-transcendence and quality of life among long term users (Jiménez-Garrido et al. 2020). Furthermore, a larger online study (n=893) of self-reported lifetime recreational psychedelic use was shown to be positively correlated to openness scores, and to negatively predict authoritarian political views while positively predicting more liberal political views (Nour et al., 2017, see also section 4.2). The relationship between microdosing and various measures of mental health

including lower dysfunctional attitudes and higher open-mindedness and affect-valence has also been documented (Anderson et al., 2019). Watts et al. (2017) conducted qualitative interviews 6 months after psilocybin treatment and found that participants described a sense of sustained openness to emotion. Another qualitative study on the acute and sustained subjective effects of LSD-assisted psychotherapy found significant benefits and changes in perspectives, attitudes and values (including change in habit patterns, being less career-focused, increased patience, increased importance of family, and less materialism, less self-centred, more outspoken, more open) were sustained over a 12-month period (Gasser et al., 2014). Other studies have investigated how classic psychedelics induce changes in brain structures related to personality traits. Aixelá et al. (2018) present an overview of evidence on psychedelics involving changes in brain dynamics (in areas rich in serotonergic 5-HT_{2A} receptors), and changes in personality traits, even from single exposure treatments. Bouso et al. (2015) investigated differences in cortical thickness in regular users of ayahuasca and showed significant differences of cortical thickness in midline structures of the brain, thinning in the posterior cingulate cortex (a key node in the default mode network) and higher scores (than the control group) on the personality trait of self-transcendence.

Liberal worldviews and political orientations. Quantitative and qualitative data gathered in clinical trials and online questionnaires suggest a trend to take on more liberal worldviews and an increase in nature relatedness following the use of psychedelic substances (Forstmann & Sagioglou, 2017; Lyons & Carhart-Harris, 2018). A pilot study (n=7) suggested that psilocybin with psychological support might produce lasting changes in liberal-authoritarian political perspective, with authoritarianism significantly decreased 1 week after dosing sessions, and remained so 7-12 months post dosing (Lyons & Carhart-Harris, 2018).

Mindfulness capabilities. Mindfulness capabilities and practices has the potential to elicit pro-environmental attitudes and engagement (see Panno et al., 2018), and are thereby linked to personal sustainability. Madsen et al. (2020) conclude that a single psilocybin dose is associated with long term increases in both personality traits openness and in mindfulness, using [11C]Cimbi-36 positron emission tomography (PET) imaging and the Personality (NEO PI-R) and mindfulness (MAAS) questionnaires. Domínguez-Clavé et al. (2016) review available evidence on ayahuasca, and in line with Murphy-Beiner & Soar (2020) and Sampedro et al. (2017) show how ayahuasca increases mindfulness capabilities, including post-acute increased in “decentering”, that is, the capacity to reduce negative judgmental attitudes and reactivity, and to observe one’s thoughts and emotions in a detached manner. Soler et al. (2018) find comparable increases in the Non-Judging subscale of the Five Facet Mindfulness Questionnaire (FFMQ) by a group of ayahuasca users, compared to a control group participating in a mindfulness course. A literature

review also revealed how psilocybin and mindfulness meditation exert similar effects on mood, social skills, and neuroplasticity, and suggest that combined use could exert prolonged mutual positive effects (Heuschkel & Kuypers, 2020). Other studies report on the benefits and motivations for microdosing, which includes self-management of mental health issues, improved mindfulness, cognitive enhancement and psychosocial wellbeing and interactions (Lea et al., 2019). Pokorny et al. (2017) present results on how psilocybin significantly increases emotional empathy in comparison to placebo, but does not necessarily induce moral behaviour.

4.2. Nature connectedness

A prominent theme within the literature reviewed was nature connectedness. 11 papers describe how nature connectedness is in different ways explicitly related to personal sustainability, and 15 papers describe connection with nature with implications that we interpret as implicit links to personal sustainability.

Explicit

Nature connectedness resulting in pro-environmental behaviour The idea of increased social and nature connectedness has been a core aspect in the literature of classic psychedelics for decades (Dickins, 2013). In ecopsychology, psychedelics have been described as having the potential to bring about a deeper sense of communion with nature, extending as far as perceived interspecies communication, maintaining or creating animist worldviews, and giving rise to ecocentric activism (Luke, 2013). In social and environmental psychology in general, nature connectedness is known to be positively associated with pro-environmental behaviour and is often assessed via psychometric scales. Forstmann and Sagioglou (2017) report evidence from a large-scale (n=1487) general population online study using a correlational design of how past experience with classic psychedelic substances uniquely predict self-reported engagement in pro-environmental behaviours, and that this relationship was statistically explained by people's degree of self-identification with nature (based on Nisbet et al. 2009 construct of nature relatedness). The study suggests that individuals who are more experienced with the use of psychedelics are more likely to spend time in natural environments, and construe themselves as part of nature, which in turn is a predictor for self-reported engagement in pro-environmental behaviour (based on definition by Whitmarsh and O'Neill, 2010). Kettner et al. (2019) conducted an online prospective study (n= 654) and found nature relatedness (based on a short form NR-6 Nature Relatedness scale by Nisbet et al., 2013) to significantly increased at 2 weeks, 4 weeks, and 2 years after a psychedelic experience. The authors describe this as evidence of a context-and state-dependent causal effect of psychedelic use on nature relatedness and emphasise its relevance for motivating pro-environmental action to prevent the ongoing ecological crisis.

Implicit

Various studies have investigated the effects of psychedelics on nature connectedness empirically. Carhart-Harris et al. (2017a) argue that connectedness (to self, nature and to the world) is a core factor underlying the mental health benefits of psychedelics, and draw on published studies using psychometric scales to show that psychedelics target and increase a sense of connectedness. An open-label pilot study (n=7) used a mixed-model design to study the effects of psilocybin on measures of nature relatedness and political perspectives in patients with treatment-resistant depression, and showed a significant increase in nature relatedness (using the short form NR-6 scale) and decreased authoritarianism (using the Political Perspective Questionnaire PPQ-5 by Nour et al., 2017), 1 week and 7-12 months post session, in comparison to baseline scores (Lyons & Carhart-Harris, 2018). Nour et al. (2017) report from an online survey (n=893) that lifetime recreational psychedelic-use, and especially ego-dissolution experienced during psychedelic experiences, was predictive of increases in nature-relatedness (as well as openness, and liberal and antiauthoritarian political views and hence overlaps with 4.1.). Increased connectedness with self, other, nature and spirit has also been reported as central themes in qualitative interviews 6 months post Ayahuasca-assisted therapy retreats (Argento et al., 2019).

Psychedelics are known to create experiences of connection through eliciting altered states of self-consciousness, often referred to as “self-loss” or “ego dissolution”, which induces a loss of spatial self-location with associated loss of boundary between self and the world and resulting feelings of unity. Mixed-method and qualitative studies post psilocybin treatment report how patients describe experience of unity, connection and interconnectedness (Malone et al., 2018) and connection with nature and spirituality 6 months post psilocybin treatment, among other benefits (Watts et al., 2017; Watts & Louma, 2020). Millière et al., (2018) provide an overview and model for altered states of self-consciousness during psychedelic use (and meditation), and suggest a possible link between self-loss and trait increases in prosocial behaviour. Nichols (2018) provides an overview of research on how LSD has the capacity to increase prosocial behaviours and feelings of closeness to others, openness, trust and suggestibility, enhance emotional empathy, and compromises the perceptual boundaries between the self and the environment.

4.3. Spirituality and Worldview

This broad theme overlaps with, and for some articles spans across the two previous themes. For example ‘connectedness’, described in the previous theme, is also a core feature of a mystical experience, which may be triggered by a psychedelic experience (Johnson et al., 2019). The literature describes concepts and findings related to psychedelic experiences tied to spirituality, changes in worldviews and beliefs,

animism, moral capacities, and mystical experiences that are not easily assigned into distinct categories. The potential links to personal sustainability through these dimensions are explained as due to changes in personal insights and worldviews, such as adopting animist worldviews (Johnson et al., 2019), which in turn can give rise to eco-centrally motivated action for sustainability (Luke, 2013; Tam et al., 2013).

Explicit

Moral enhancement. Pittaway (2018) argues that psychedelics are worthy of further philosophical exploration, since they have the potential to foster deeply transformative philosophical learning, and deep reverence for life and ecological awareness, which is seen as an underlying condition for positive social change. Forstmann and Sagioglou (2017) argue that ego-dissolution associated with psychedelics leads to an inclination to anthropomorphize nature, which in turn is argued to potentially predict conservation and pro-environmental behaviour. Ballesteros (2019) builds on an anthropological account and argues that psychedelic drugs can be tools that improve our moral faculties in the realm of technology-related challenges and threats to humanity. She argues that psychedelics can function as tools for an ‘applied mysticism’ (see Hofmann, 1999), which can create a new outlook on life and nature with a stronger will to act in a morally desirable way, such as e.g. to carry out social collective actions, resistance, or activism. Similarly, Tennison (2012) draws on existing evidence to propose that psilocybin represents a viable, practical option for moral enhancement and suggests that further research in the context of moral psychology and psilocybin could comprise the next step in the development of ‘moral transhumanism’. In a similar vein, Wolfson (2018) draws on ongoing studies to suggest that psychedelics can be vehicles or a cultural ‘disruptive technology’, which can democratise and provide access to spiritual and mystical experience, without the necessity of institutionalised religion.

Implicit

Spirituality. Most papers under this theme discuss spirituality and worldview in ways that implicitly can be traced to personal sustainability. Empirical papers report on spirituality and spiritual well-being as an important aspect of the psychedelic experience (Argento et al., 2019; Barbosa et al., 2020), a common theme reported during and after psilocybin treatments (Watts et al., 2017). Mystical experiences have also been reported to be at least as salient as self-compassion and love (Bogenschutz et al., 2018). Griffiths et al. (2019) surveyed “god encounter experiences” and compared those naturally occurring and psychedelically induced, and found striking similarities where most participants reported vivid memories, encounters and communication with something having the attributes of being conscious, benevolent, intelligent, sacred, eternal, and all-knowing. Malone et al. (2018) illustrate narratives

from cancer patients undergoing psilocybin treatment that show persisting effects of increased spirituality, and behavioural changes including non-drug spiritual and/or meditative practices. Psilocybin has also been shown to enhance post-intervention mindfulness, the experience of self-dissolution, and produce changes in psychosocial functioning (Smigielski et al., 2019). In exploring long-lasting effects of LSD in healthy individuals, Schmid and Leichti (2017) found that 10 out of 14 participants rated the experience as among the top 10 most meaningful experiences in their lives.

Mystical experiences. Mystical experiences are often described as a general but key feature of psychedelic experiences and are characterised by feelings of unity, noetic quality, sacredness, positive mood, transcendence of time and space, and ineffability (Maclean et al., 2011). Mystical experiences have been documented to mediate the attribution of personal meaning and spiritual significance to the psychedelic experience (Griffiths et al., 2006; Reiff et al., 2020), with psilocybin users rating such mystical experiences as among the five most significant spiritual experiences of their lives (Griffiths et al., 2008; Pittaway, 2018). However, a “complete” mystical experience (where ratings exceed 60 % across all of the subdimensions that comprise the scale) might not be a prerequisite for positive outcomes of psilocybin treatment (Nicholas et al., 2018). Barrett and Griffiths (2017) provide a review of connections between classical psychedelics and mystical or religious experiences, highlight overlap in neural findings on psychedelics and meditative practices, and suggest that changes in the regions of the default mode network may underlie dimensions of mystical experience. The level of ego-dissolution (associated with the default mode network) has also been found to be significantly correlated with the changes in affect, satisfaction with life, and mindfulness following participation in ayahuasca ceremonies (Uthaug et al., 2018).

Mystical experiences are well documented in empirical research on classic psychedelics, often through psychometric scales (Hood et al., 2001; Maclean et al., 2011). Mystical experiences and ego-dissolution have been associated with anti-authoritarian and liberal political views, openness to new experiences and nature relatedness, and spiritual significance (Nour et al., 2017; Maclean et al., 2011; Lyons & Carhart-Harris, 2018; Sweat et al., 2016). It is suggested that these self-transcendent insights experienced within an individual may increase pro-social behaviour and ethical decision-making by shifting one's attention from personal concerns, and towards more collective dimensions (Nour et al., 2017). However, causal relationships have not been established and more longitudinal and experimental studies are called for (Nour et al., 2017). In combination with meditation and other spiritual practices, psilocybin-occasioned mystical-type experience has also been observed to produce enduring positive changes in psychological functioning and trait measures of prosocial attitudes and behaviours (Griffiths et al., 2018). Bache (1991) argues from a theological perspective that

therapeutic use of LSD can dramatically change ‘inner programming’ of individuals by forcing confrontations with one’s deepest fears, and accelerate the processes and practices for genuine spiritual development. Hartsogsohn (2018) suggests that the ‘meaning enhancing capacities’ of psychedelics should receive increased attention, since this can be a function to enhance meaning in late modernity in highly industrialised societies where life is increasingly atomized and individualised. Metzner (2017) suggests that psychedelic (and entheogenic) substances could provide an expansion of consciousness to a more ecocentric worldview, which enables a motivation to respond to different situations with mindful intention.

5. Discussion

In this review, we have identified three broad overlapping themes in the literature that link psychedelics to inner dimensions of sustainability; values and personality; connectedness to nature; and spirituality and worldview. Overall, in this review we found a small sample of papers that make explicit links to inner transformation for sustainability, and a larger sample of papers where implicit links can be inferred. Below we discuss the potential of further exploring research within these themes for sustainability transformations, outline research gaps and limitations, and avenues for future research below.

Despite this review focusing on the potential beneficial effects of psychedelics, we want to emphasise that there are substantial risks, and that the potential misuse and abuse of classic psychedelics can lead to negative short and long-term health and mental risks and outcomes amongst some subjects (Evans et al., 2023). This includes reports on rare cases of psychotic episodes, hallucinogen persisting perception disorder (HPPD), anxiety, paranoia, and nausea (Rajpal et al., 2022; Johnson et al., 2018; Jungaberle et al., 2018; Halpern et al. 2016). The risks are reduced with psychiatric screening, where those with a predisposition towards psychotic illnesses generally are excluded from clinical treatment (Johnson et al., 2008). We have here synthesised existing research, and we do not advocate private or non-facilitated use of psychedelics.

Studies on how classic psychedelics may induce changes in values and personality was a prominent theme in the literature sample. In psychology, values and personality traits are thought to be relatively stable characteristics, but there is also evidence that these can change over a lifetime, and the details of these changes are underexplored (Bleidorn et al., 2021). The papers identified under this theme showed implicit links to personal sustainability through increases in the personality traits openness and self-transcendence, as well as increases in political orientation of liberalism, and mindfulness capacities. The personality traits of openness and self-

transcendence, as well as liberal political views have previously been found to be correlated to more sustainable lifestyles, greater willingness to change norms, and pro-environmental behaviours (Erritzoe et al., 2018; Hirsh, 2014). Values and personality play an important role in behaviour (Aixalà et al., 2018), and a shift in values is argued to be integral to combat the environmental crisis (Ives et al., 2019). The papers presenting results on how different types of psychedelics increase mindfulness capacities in different ways, is also implicitly (indirectly) linked to inner sustainability. Mindfulness capacities have been shown to induce pro-environmental attitudes and engagement (Thiermann & Shaete, 2021; Panno et al., 2018), and are argued to have potential to facilitate motivation for climate adaptation (Wamsler, 2018), and thereby it can be speculated that an increase in these capacities can be assumed to have potential for increasing inner sustainability. However, we recognise that making these types of indirect connections to inner sustainability based on secondary literature can be problematic, and at worst misleading. The relationships between how psychedelics influence changes in values and personality (and in turn political orientations as well as mindfulness capacities) are not straightforward (cf. Pace and Devenot, 2021), and the studies reviewed here demonstrate correlational rather than causative relationships. Moreover, it is commonly agreed that values have a weak effect on total pro-environmental behaviour to begin with, since there are additional factors such as structural constraints and habits (Steg & Vlek, 2009). Nonetheless, we here provide an overview that can be used to get a sense of direction for future research on the links between psychedelics and sustainability that indicate potential for further fruitful exploration, and we thereby deem it necessary to include implicit links that we have identified in the literature.

The idea that psychedelics can induce nature connectedness, which in turn is known to be correlated with different types of sustainability beliefs and pro-environmental behaviour, was a prominent theme in the literature reviewed here. Many papers were psychological studies that rely on psychometric scales (e.g. Forstmann & Sagioglou, 2017), and there is much potential to further explore psychedelics in relation to nature connectedness from other methodological perspectives. There is some mention of explicit links and casual relationships, such as Kettner et al. (2019), who present a “context-and state-dependent causal effect” of psychedelic use on nature relatedness, and discuss their implications in relation to nature relatedness being a strong predictor of pro-environmental awareness, attitudes, and behaviour. In addition, Lyons & Carhart-Harris (2018) demonstrate the causal relationship between nature relatedness and psychedelics use with a prospective study design. Further investigation of the causal relationships on how experiences with psychedelics can alter people’s perceived relationship with nature, and in turn promote pro-environmental action in a lasting manner is needed.

The idea that psychedelics have the potential to foster animist worldviews, or induce

beliefs about non-living entities having the capacity for conscious awareness (Nayak & Griffiths, 2022; Forstmann & Sagioglou, 2017), and in this way can create or enhance a sense of oneness with non-human nature, deserves more careful and in-depth exploration. In such further exploration, we want to emphasise the importance of not conflating *animism* with *anthropomorphism*. These two ideas have different starting points concerning how human-nature relations are ontologically understood. Reference is sometimes made to how anthropomorphising nature by ascribing mental and emotional qualities to natural entities can positively predict pro-conservation behaviour (Tam et al., 2013; Forstmann & Sagioglou, 2017). The idea of ‘attributing’ or ‘ascribing’ mental and emotional qualities to natural entities is based on entirely different ontologies and objectivist epistemologies than animism, which is often characterised by an interrelational state of being, understood to be constituted prior to a bifurcation of subject-object relations, and which is often associated with different types of Indigenous knowledge systems (Ingold, 2006; West et al., 2020). While psychedelics may foster both anthropomorphism and animism, and both of these could result in more sustainable outcomes in different ways, we espouse that future work recognises the underlying epistemological differences between these.

The importance of delineating different underlying epistemological paradigms when discussing the implications of psychedelics is also critical for understanding central features of the psychedelic experience, such as the ‘mystical’ element of the experience. Bache (1991) argues that mainstream academic psychology coupled with the reductionist bias of clinical psychology lacks an adequate basis for understanding mystical consciousness. Descriptive studies of mystical experiences and studies showing evidence of experiences of animism cannot provide proof of ontological claims. The most fundamental questions regarding mystical experience evade neuroscientific explanations, even though the subjective descriptions are frequently captured in questionnaires and the biological correlates suggestive of underlying mechanisms are traceable (Barret & Griffiths, 2017). Some argue that applying a mystical framework creates a “black box” mentality where researchers treat some aspects of experience as beyond the scope of scientific inquiry (Sanders & Zijlmans, 2021). Yaden et al. (2021) argue that contrary to some recent popular views, psychedelics cannot explain the hard problem of consciousness, i.e. how the first person perspective emerges and how physical processes give rise to qualia. This is partly because the scientific method remains insufficient to address how phenomenal consciousness can only be observed by the conscious entity themselves. Despite opportunities for verification, psychedelics may be able to impact beliefs about different theories of phenomenal consciousness, such as monistic views associated with panpsychism (Yaden et al., 2021). Sjöstedt-Hughes (2023) argues that metaphysics has both intellectual and experiential facets, and that metaphysics should be used to integrate and understand psychedelic-induced metaphysical experiences. They offer a metaphysics matrix and a metaphysics matrix questionnaire, which can

be used to further understand the metaphysical nature of psychedelic experiences, and to help experiencers make sense of their experiences. Metaphysical questions around the nature of reality are beyond the scope of this review, but we want to emphasise the importance of further clarifying underlying ontological differences in how to understand psychedelics experiences, including interpretations of animism or mystical experiences in future studies on the potential of psychedelics for sustainability.

Some studies argue that the potential of psychedelics for sustainability should be seen in a broader cultural context as having the potential to shift from an individualistic to a more collective worldview, through an ‘applied mysticism’ (Ballesteros, 2019; Hofmann, 1999), moral enhancement (Tennison, 2012; Wolfson, 2018), and to foster ‘deep philosophical transformative learning’ (Pittaway, 2018). Psychedelics have been used in spiritual or religious contexts for healing and divination for centuries, and empirical studies report on spirituality and spiritual well-being as an important aspect of the psychedelic experience (Argento et al., 2019; Barbosa et al., 2020), and that mystical experiences were at least as salient as self-compassion and love (Bogenschutz et al., 2018). Spirituality or a spiritual experience can be religious or non-religious, and supernatural or non-supernatural, and has been argued to have potential to work as a deep leverage point for inner sustainability transformations (Ives et al., 2019).

Psychedelics as a catalyst for deep system leverage points

The framework of systems leverage points (Meadows, 1999), shows places to intervene in a system to create transformative change, and this can be suitably applied for future exploration of how psychedelics might play a role in eliciting changes in inner dimensions of sustainability as ‘deep leverage points’ (Ives et al., 2018). Deep leverage points are those that can create paradigm shifts in a system, and that can change mind-sets that determines the goals, structures and rules of a system (Meadows, 1999). These leverage points can comprise values, beliefs or worldviews which are considered difficult to shift but have large potential to bring about transformative change (Fischer & Riechers, 2019). Abson et al. (2017) outline people’s connections to nature as one of critical realms of deeper leverage points to engage with transformational sustainability. The idea of leverage points can help to further structure the investigation of how psychedelics affect connection to nature, value orientation, belief systems, worldviews and spirituality (Ives et al., 2018). As this review shows, psychedelics have the potential to induce spiritually meaningful experiences, affect values and beliefs, strengthen nature and social connectedness, create cognitive flexibility, and thus the need for further exploration in relation to sustainability transformations is warranted.

A challenge and research gap in the literature is the extent to which psychedelics can create lasting behavioural changes, and what factors might influence how and to what degree such changes are sustained in the ‘afterglow’ of an experience. Whether the effects translate into long lasting shifts in behaviour may depend not just on set and setting in psychedelic therapy, but on the therapeutic support that support and integrate personal changes in everyday life (Watts & Luoma, 2020; Ballesteros, 2019).

The overall aim of this study has been to contribute to an understanding of to what extent psychedelics can be a catalyst for change at the personal sphere of sustainability transformations. We want to underline that this paper focuses on a subfield of sustainability, i.e. inner dimensions. It thereby does not cover an analysis of other important dimensions of sustainability such as material, political, economic, legal, ecological and justice. These aspects are critical to investigate in order to understand the full implications of classic psychedelics for sustainability at the individual level. We call for additional research into these areas, as well as linking structural and material aspects with a more politicising analysis, and designs that link internal and external approaches in sustainability research (Wamsler et al., 2021; Bruhn, 2021).

We want to emphasize that this review does not suggest that psychedelics should be seen as a panacea for sustainability. The evidence for the various links to inner sustainability transformation is scattered, and future research also needs to engage with the counterexamples of these links (cf. Pace and Devenot, 2021). Moreover, a number of ethical, philosophical and political issues arise when considering the role of psychedelics for inner dimensions of sustainability, which are critical to engage with in future studies. This includes: medical health risks (Johnson et al., 2018); risks of a de-historicizing perspective of psychedelics in research and practice leading to cultural appropriation and eradication of Indigenous wisdom, with a reductionist understanding and commodification of the sacred roots of psychedelics (Williams et al., 2022; Devenot et al., 2022; Omágua-Kambeba et al., 2023). There are also political economic factors of de-criminalization, new markets and investments in psychedelic capitalism, with an individualization of responsibility for sustainability and social change (Sanchez Petrement, 2023; Tyorun-Dunn, 2022; Aday et al., 2023). Furthermore, problems of paternalism and encroachment on personal freedom arise when treating a mind-altering substance as a tool to induce changes in values, behaviour and worldviews for sustainability.

Limitations

We recognize that this paper has a number of limitations. An overall constraint is

that the review only covers papers published up until June 2020. Psychedelics are a rapidly evolving topic of research and numerous relevant papers have been published after the time that this literature search was undertaken. This includes for example Irvine et al. (2023) who report findings from an online survey (n=272) on previous use of psychedelics that suggest the capacity to elicit a connection with nature, even amongst not previously nature-oriented participants. Sagioglou and Forstmann (2022) suggest that the relationship of psychedelics with pro-environmental behaviour manifests in variables of emotional affinity towards nature and knowledge about climate change, rather than due to psychological biases. Paterniti et al. (2022) found that psychedelic-occasioned mystical experiences influence pro-environmental behaviour amongst 240 participants with prior psychedelic experience. Gandy et al. (2022) propose that the psychedelic states may support scientific creativity, due to its characteristic features of brain hyperconnectivity, meta-cognitive awareness, sustained altered state experience, and sustained shifts in trait openness. Timmermann et al. (2021) report on significant shifts in metaphysical beliefs away from 'hard materialist' views towards panpsychism, for at least 6 months after an independent controlled clinical trial; and Kähönen (2023) who present an empirically informed framework of philosophical psychology to understand how self-transcendence relates to psychedelic value change. See also Harrild and Luke (2020), Gandy et al. (2020) and Kangaslampi et al. (2020).

A limitation in this study is that the literature reviewed varied widely in terms of different disciplines, epistemologies, research designs and methods. This prevents direct comparison between their aims, methods, and results. Empirical studies also have their own limitations, such as a lack of longitudinal studies to infer causal relations, control groups or a small sample size, which adds to the uncertainty in aggregating findings from studies. Further literature reviews of the link to personal sustainability could benefit from structuring studies according to disciplines and research approaches in order to create a more detailed and systematic overview of the research landscape. Moreover, we see the potential problem of lumping together different types of psychedelic substances, with different origins, applications, and legal status, under the label of classic psychedelics, even though this is common in the literature. Future studies would benefit from further delineating these substances and their applications in relation to inner sustainability. For example, a recent study by Forstmann et al. (2023) analysed the relative degree to which lifetime experience with different psychedelic substances predict self-reported nature relatedness through combining five independent datasets (n=3817) and found that experience with psilocybin was the only reliable (and strongest) predictor. Another caveat is that the search string determines the sample of papers included, and some relevant papers might not be presented here. In addition, the papers identified as implicitly linked to sustainability were included based on our prior knowledge of such links and are therefore biased. There are most likely other possible implicit links to inner

dimensions of sustainability in the literature that we have not covered here that are worth exploring, such as for example how psychedelics enhance creativity and divergent thinking (Kuypers et al., 2018).

Future literature reviews could further refine links between psychedelics and inner sustainability building on our three themes and further categorise disciplines, research designs, methods, and substance types, as well as compare psychedelic research geographically, and with regards to the socio-economics of users and test groups.

6. Concluding remarks

We have here shown how psychedelics are linked, explicitly and implicitly, to inner dimensions of sustainability in the literature by outlining the themes: values and personality; nature connectedness; and spirituality and worldview. Taken together, this review shows that psychedelics bear potential to further explore as deep leverage points for sustainability transformations. Psychedelics can provide insights that challenge the dualistic worldview that underpins the environmental crisis in industrialised societies by enhancing connectedness with others, nature, and self, and to re-enchant one's perspective of nature and experience, as well as influence values and personality traits associated with pro-environmental behaviour and engagement. However, the literature shows scattered evidence for the strength of these effects, and more studies are needed to establish causal links, as well as to critically evaluate social and political outcomes and drivers.

Rather than escapism, psychedelics seen in terms of an applied mysticism (Hofmann, 1999), can be considered to provide access to the realities that elude perception and senses in everyday life. Psychedelic experiences, including mystical experiences, feelings of awe, an increased sense of connectedness, and 'ego-dissolution' can make individuals inclined to shift foundational beliefs, and to adopt more relational and reciprocal ways of perceiving and being in the world. In times of much needed societal transformation, with severe inequalities, the threat of climate breakdown and ecological despair, approaches that can activate inner dimensions of change for sustainability on individual and collective levels are vital to further explore in research and practice.

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Appendix.

Author	Title	Publi- cati- on Date	Journal Name	Discipline	Themes
Agin-Liebess, G., Malone, T., Yalch, M., Mennenga, S., Ponté, K., & Guss, J. et al.	Long-term follow-up of psilocybin-assisted psychotherapy for psychiatric and existential distress in patients with life-threatening cancer	2020	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Spirituality and Worldview
Aixalà, M., dos Santos, R., Hallak, J., & Bouso, J.	Psychedelics and Personality.	2018	<i>ACS Chemical Neuroscience</i>	Neuroscience	Values and Personality
Anderson, T., Petranker, R., Rosenbaum, D., Weissman, C., Dinh-Williams, L., & Hui, K. et al.	Microdosing psychedelics: personality, mental health, and creativity differences in microdosers.	2019	<i>Psychopharmacology</i>	Psychopharmacology	Values and Personality
Argento, E., Capler, R., Thomas, G., Lucas, P., & Tupper, K.	Exploring ayahuasca-assisted therapy for addiction: A qualitative analysis of preliminary findings among an Indigenous community in Canada.	2019	<i>Drug And Alcohol Review</i>	Substance Use, Public Health	Spirituality and Worldview, Connectedness
Bache, C.	Mysticism and psychedelics: The case of the dark night.	1991	<i>Journal Of Religion & Health</i>	Religion	Spirituality and Worldview
<i>Continues over page</i>					

Barbosa, P., Strassman, R., da Silveira, D., Areco, K., Hoy, R., & Pommy, J. et al.	Psychological and neuropsychological assessment of regular hoasca users.	2020	Comprehensive Psychiatry	Psychiatry	Values and Personality & Spirituality
Barrett, F., & Griffiths, R.	Classic Hallucinogens and Mystical Experiences: Phenomenology and Neural Correlates.	2017	<i>Behavioral Neurobiology Of Psychedelic Drugs</i>	Behavioural Neurobiology	Values & Personality, Spirituality and Worldview
Bogenschutz, M., Podrebarac, S., Duane, J., Amegadzie, S., Malone, T., & Owens, L. et al.	Clinical Interpretations of Patient Experience in a Trial of Psilocybin-Assisted Psychotherapy for Alcohol Use Disorder.	2018	<i>Frontiers In Pharmacology</i>	Pharmacology	Values & Personality, Spirituality and Worldview
Bouso, J., dos Santos, R., Alcázar-Córcoles, M., & Hallak, J.	Serotonergic psychedelics and personality: A systematic review of contemporary research.	2018	<i>Neuroscience & Biobehavioral Reviews</i>	Neuroscience	Values and Personality
Bouso, J., Palhano-Fontes, F., Rodríguez-Fornells, A., Ribeiro, S., Sanches, R., & Crippa, J. et al.	Long-term use of psychedelic drugs is associated with differences in brain structure and personality in humans.	2015	<i>European Neuropsychopharmacology</i>	Neuropsychopharmacology	Values and Personality, Spirituality and Worldview
Carhart-Harris, R., Erritzoe, D., Haijen, E., Kaelen, M., & Watts, R.	Psychedelics and connectedness.	2017	<i>Psychopharmacology</i>	Psychopharmacology	Spirituality and Worldview, Connectedness
Carhart-Harris, R., Erritzoe, D., Haijen, E., Kaelen, M., & Watts, R.	Psychedelics and connectedness.	2017	<i>Psychopharmacology</i>	Psychopharmacology	Spirituality and Worldview, Connectedness
<i>Continues over page</i>					

Carhart-Harris, R., Kaelen, M., Bolstridge, M., Williams, T., Williams, L., & Underwood, R. et al.	The paradoxical psychological effects of lysergic acid diethylamide (LSD).	2016	<i>Psychological Medicine</i>	Psychological Medicine	Values and Personality
Dickins, R.	Preparing the Gaia connection: An ecological exposition of psychedelic literature.	2013	<i>European Journal of Ecopsychology</i>	Ecopsychology	Spirituality and Worldview, Connectedness
Doblin, R., Christiansen, M., Jerome, L., & Burge, B.	The Past and Future of Psychedelic Science: An Introduction to This Issue.	2019	<i>Journal Of Psychoactive Drugs</i>	Psychedelic Studies	Values and personality, Spirituality and Worldview
Dolder, P., Schmid, Y., Müller, F., Borgwardt, S., & Liechti, M.	LSD Acutely Impairs Fear Recognition and Enhances Emotional Empathy and Sociality.	2020	<i>Neuropsychopharmacology</i>	Neuropsychopharmacology	Values and Personality
Domínguez-Clavé, E., Soler, J., Elices, M., Pascual, J., Álvarez, E., & de la Fuente Revenga, M. et al.	Ayahuasca: Pharmacology, neuroscience and therapeutic potential.	2016	<i>Brain Research Bulletin</i>	Neuropsychopharmacology	Values and Personality
Erritzoe, D., Roseman, L., Nour, M., MacLean, K., Kaelen, M., Nutt, D., & Carhart-Harris, R.	Effects of psilocybin therapy on personality structure.	2018	<i>Acta Psychiatrica Scandinavica</i>	Psychiatry	Values and personality, Connectedness, Spirituality and Worldview
Forstmann, M., & Sagioglou, C.	Lifetime experience with (classic) psychedelics predicts pro- environmental behavior through an increase in nature relatedness.	2017	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and personality, Connectedness, Spirituality and Worldview
<i>Continues over page</i>					

Forstmann, M., Yudkin, D., Prosser, A., Heller, S., & Crockett, M.	Transformative experience and social connectedness mediate the mood-enhancing effects of psychedelic use in naturalistic settings.	2020	<i>Proceedings Of The National Academy Of Sciences</i>	Psychology	Values and personality, Connectedness, Spirituality and Worldview
Franquesa, A., Sainz-Cort, A., Gandy, S., Soler, J., Alcázar-Córcos, M., & Bouso, J.	Psychological variables implied in the therapeutic effect of ayahuasca: A contextual approach.	2018	<i>Psychiatry Research</i>	Psychiatry	Values and Personality, Spirituality and Worldview
Gandy, S.	Psychedelics and potential benefits in "healthy normals": A review of the literature.	2019	<i>Journal Of Psychedelic Studies</i>	Psychedelic Studies	Values and personality, Connectedness, Spirituality and Worldview
Gasser, P., Kirchner, K., & Passie, T.	LSD-assisted psychotherapy for anxiety associated with a life-threatening disease: A qualitative study of acute and sustained subjective effects.	2014	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality
Geiger, H., Wurst, M., & Daniels, R.	<i>DARK Classics in Chemical Neuroscience: Psilocybin.</i>	2018	<i>ACS Chemical Neuroscience</i>	Neuroscience	Values and personality, Connectedness, Spirituality and Worldview
Griffiths, R., Hurwitz, E., Davis, A., Johnson, M., & Jesse, R.	Survey of subjective "God encounter experiences": Comparisons among naturally occurring experiences and those occasioned by the classic psychedelics psilocybin, LSD, ayahuasca, or DMT.	2019	<i>PLOS ONE</i>	Psychiatry and Behavioural Science, Medicine, Neuroscience, Psychology	Values and personality, Connectedness, Spirituality and Worldview
<i>Continues over page</i>					

Griffiths, R., Johnson, M., Richards, W., Richards, B., McCann, U., & Jesse, R.	Psilocybin occasioned mystical-type experiences: immediate and persisting dose-related effects	2011	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Spirituality and Worldview
Griffiths, R., Johnson, M., Richards, W., Richards, B., Jesse, R., & MacLean, K. et al.	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.	2018	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Spirituality and Worldview
Griffiths, R., Richards, W., Johnson, M., McCann, U., & Jesse, R.	Mystical-type experiences occasioned by psilocybin mediate the attribution of personal meaning and spiritual significance 14 months later.	2008	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Spirituality and Worldview
Griffiths, R., Richards, W., McCann, U., & Jesse, R.	Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance.	2006	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Spirituality and worldview
Hartogsohn, I.	The Meaning-Enhancing Properties of Psychedelics and Their Mediator Role in Psychedelic Therapy, Spirituality, and Creativity.	2018	<i>Frontiers In Neuroscience</i>	Neuroscience	Values and Personality, Spirituality and Worldview

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Heuschkel, K., & Kuypers, K.	Depression, Mindfulness, and Psilocybin: Possible Complementary Effects of Mindfulness Meditation and Psilocybin in the Treatment of Depression	2020	<i>Frontiers In Psychiatry</i>	Psychiatry	Values and Personality
Johnson, M., Hendricks, P., Barrett, F., & Griffiths, R.	Classic psychedelics: An integrative review of epidemiology, therapeutics, mystical experience, and brain network function	2019	<i>Pharmacology & Therapeutics</i>	Pharmacology	Values and Personality, Spirituality and Worldview
Jungaberle, H., Thal, S., Zeuch, A., Rougemont-Bücking, A., von Heyden, M., Aicher, H., & Scheidegger, M.	Positive psychology in the investigation of psychedelics and entactogens: A critical review.	2018	<i>Neuropharmacology</i>	Neuropharmacology	Values and personality, Connectedness, Spirituality and Worldview
Kettner, H., Gandy, S., Haijen, E., & Carhart-Harris, R.	From Egoism to Ecoism: Psychedelics Increase Nature Relatedness in a State-Mediated and Context-Dependent Manner.	2019	<i>International Journal Of Environmental Research And Public Health</i>	Environmental Research	Values and Personality, Connectedness
Lea, T., Amada, N., & Jungaberle, H.	Psychedelic Microdosing: A Subreddit Analysis.	2019	<i>Journal Of Psychoactive Drugs</i>	Psychedelic Science, Addiction & Prevention, Applied Sciences, Social Health	Values and Personality, Connectedness
Lea, T., Amada, N., Jungaberle, H., Schecke, H., & Klein, M.	Microdosing psychedelics: Motivations, subjective effects and harm reduction.	2020	<i>International Journal Of Drug Policy</i>	Psychiatry and Psychotherapy, Addiction and Prevention Research	Spirituality and Worldview, Connectedness
<i>Continues over page</i>					

Lebedev, A.V., Kaelen, M., Lövdén, M., Nilsson, J., Feilding, A., Nutt, D.J. & Carhart-Harris, R.L.	LSD-induced entropic brain activity predicts subsequent personality change.	2016	<i>Human Brain Mapping</i>	Neurobiology, Neuropsychopharmacology	Values and Personality
Luke, D.	Ecopsychology and the psychedelic experience.	2013	<i>European Journal Of Ecopsychology</i>	Ecopsychology	Spirituality and Worldview, Connectedness
Lyons, T., & Carhart-Harris, R.	Increased nature relatedness and decreased authoritarian political views after psilocybin for treatment-resistant depression.	2018	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Connectedness
Madsen, M., Fisher, P., Stenbæk, D., Kristiansen, S., Burmester, D., & Lehel, S. et al.	A single psilocybin dose is associated with long-term increased mindfulness, preceded by a proportional change in neocortical 5-HT _{2A} receptor binding.	2020	<i>European Neuropsychopharmacology</i>	Neuropsychopharmacology	Values and Personality, Spirituality and Worldview
MacLean, K., Johnson, M., & Griffiths, R.	Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness.	2011	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Spirituality and Worldview
Malone, T., Mennenga, S., Guss, J., Podrebarac, S., Owens, L., & Bossis, A. et al.	Individual Experiences in Four Cancer Patients Following Psilocybin-Assisted Psychotherapy	2018	<i>Frontiers In Pharmacology</i>	Pharmacology	Values and personality, Connectedness, Spirituality and Worldview
<i>Continues over page</i>					

Metzner, R.	Entheogenesis: Toward an Expanded Worldview for Our Time.	2017	<i>Journal Of Humanistic Psychology</i>	Psychology	Spirituality and Worldview
Millière, R., Carhart-Harris, R., Roseman, L., Trautwein, F., & Berkovich-Ohana, A.	Psychedelics, Meditation, and Self-Consciousness.	2018	<i>Frontiers In Psychology</i>	Psychology	Values and Personality, Connectedness
Murphy-Beiner, A., & Soar, K.	Ayahuasca's 'afterglow': improved mindfulness and cognitive flexibility in ayahuasca drinkers	2020	Psychopharmacology	Psychopharmacology	Values and Personality
Nicholas, C., Henriquez, K., Gassman, M., Cooper, K., Muller, D., & Hetzel, S. et al.	High dose psilocybin is associated with positive subjective effects in healthy volunteers.	2018	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality, Spirituality and Worldview
Nichols, D.	Dark Classics in Chemical Neuroscience: Lysergic Acid Diethylamide (LSD)	2018	<i>ACS Chemical Neuroscience</i>	Neuroscience	Values and Personality, Connectedness
Nour, M., Evans, L., & Carhart-Harris, R.	Psychedelics, Personality and Political Perspectives.	2017	<i>Journal Of Psychoactive Drugs</i>	Psychoactive Drugs	Values and personality, Connectedness, Spirituality and Worldview
Pittaway, D.	"To learn healing knowledge": Philosophy, psychedelic studies and transformation.	2018	<i>South African Journal Of Philosophy</i>	Philosophy	Spirituality and Worldview, Connectedness
Pokorny, T., Preller, K., Kometer, M., Dziobek, I., & Vollenweider, F.	Effect of Psilocybin on Empathy and Moral Decision-Making.	2017	<i>International Journal Of Neuropsychopharmacology</i>	Neuropsychopharmacology	Values and Personality, Connectedness
Preller, K., & Vollenweider, F.	Phenomenology, Structure, and Dynamic of Psychedelic States.	2016	<i>Behavioral Neurobiology Of Psychedelic Drugs</i>	Neurobiology	Values and Personality

Reiff, C., Richman, E., Nemeroff, C., Carpenter, L., Widge, A., & Rodriguez, C. et al.	Psychedelics and Psychedelic-Assisted Psychotherapy.	2020	<i>American Journal Of Psychiatry</i>	Psychiatry	Values and Personality, Spirituality and Worldview
Roseman, L., Hajjen, E., Idialu-Ikato, K., Kaelen, M., Watts, R., & Carhart-Harris, R.	Emotional breakthrough and psychedelics: Validation of the Emotional Breakthrough Inventory.	2019	<i>Journal of Psychopharmacology</i>	Psychopharmacology	Values and Personality
Sampedro, F., de la Fuente Revenga, M., Valle, M., Roberto, N., Domínguez-Clavé, E., & Elices, M. et al.	Assessing the Psychedelic “After-Glow” in Ayahuasca Users: Post-Acute Neurometabolic and Functional Connectivity Changes Are Associated with Enhanced Mindfulness Capacities.	2017	<i>International Journal Of Neuropsychopharmacology</i>	Neuropsychopharmacology	Values and Personality
Schmid, Y., & Liechti, M.	Long-lasting subjective effects of LSD in normal subjects.	2017	<i>Psychopharmacology</i>	Psychopharmacology	Spirituality and Worldview
Smigielski, L., Kometer, M., Scheidegger, M., Krähenmann, R., Huber, T., & Vollenweider, F.	Characterization and prediction of acute and sustained response to psychedelic psilocybin in a mindfulness group retreat.	2019	Scientific Reports	Neuropsychopharmacology and Brain Imaging, Department of Psychiatry, Psychotherapy and Psychosomatics	Values and Personality, Spirituality and Worldview
Soler, J., Elices, M., Dominguez-Clavé, E., Pascual, J., Feilding, A., & Navarro-Gil, M. et al.	Four Weekly Ayahuasca Sessions Lead to Increases in “Acceptance” Capacities: A Comparison Study With a Standard 8-Week Mindfulness Training Program.	2018	<i>Frontiers In Pharmacology</i>	Psychiatric University	Values and Personality

Soler, J., Elices, M., Franquesa, A., Barker, S., Friedlander, P., & Feilding, A. et al.	Exploring the therapeutic potential of Ayahuasca: acute intake increases mindfulness-related capacities	2015	<i>Psychopharmacology</i>	Psychopharmacology	Values and Personality
Sweat, N., Bates, L., & Hendricks, P.	The Associations of Naturalistic Classic Psychedelic Use, Mystical Experience, and Creative Problem Solving.	2016	<i>Journal Of Psychoactive Drugs,</i>	Health Behaviour	Values and Personality, Spirituality and Worldview
Tennison, M.	Moral Transhumanism: The Next Step.	2012	<i>Journal Of Medicine And Philosophy</i>	Medicine and Philosophy	Values and Personality, Connectedness
Uthaug, M., van Oorsouw, K., Kuypers, K., van Boxtel, M., Broers, N., & Mason, N. et al.	Sub- acute and long-term effects of ayahuasca on affect and cognitive thinking style and their association with ego dissolution.	2018	<i>Psychopharmacology</i>	Psychopharmacology	Values and Personality
Watts, R., & Luoma, J.	The use of the psychological flexibility model to support psychedelic assisted therapy.	2020	<i>Journal Of Contextual Behavioral Science</i>	Behavioural Science	Values and personality, Connectedness, Spirituality and Worldview
Watts, R., Day, C., Krzanowski, J., Nutt, D., & Carhart-Harris, R.	Patients' Accounts of Increased "Connectedness" and "Acceptance" After Psilocybin for Treatment-Resistant Depression.	2017	<i>Journal Of Humanistic Psychology</i>	Psychology	Values and personality, Connectedness, Spirituality and Worldview
Wolfson, P.	Psychedelics, the Spiritual and Consciousness - an Evolving Confluence in the Cultural Stream.	2018	<i>Tikkun</i>	Politics and Society	Values and personality, Connectedness, Spirituality and Worldview

Table 1. List of papers with author names and publication date, journal names, disciplines and themes listed.

Statements and Declarations

The authors did not receive support from any organisation for the submitted work. This research has no competing interests to declare. Since this study only involves literature analysis, an ethics approval has not been necessary.

We want to thank the two reviewers for their helpful comments.

Data availability statement

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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