

C6

## 6

## Psychedelic visuals in context

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C6S1

### 6.1 Introduction

C6P1

Amidst the recent bout of attention on subjective psychedelic phenomenology, *visual effects* have received relatively little attention, despite the fact that they ‘are the most frequent and robust features of the psychedelic experience’ (Vollenweider & Preller, 2020) for which these drugs are ‘famous’ (Kometer & Vollenweider, 2016; Letheby, 2021; Vollenweider & Preller, 2020). Rating-scale items that measure visual changes have consistent dose–response relative to other effects under lysergic acid diethylamide (LSD) (Holze et al., 2020, 2022; Liechti et al., 2017; Schmid et al., 2015), *N,N*-dimethyltryptamine (DMT) (Pallavicini et al., 2021; Strassman et al., 1994), and psilocybin (Carbonaro et al., 2020; Hasler et al., 2004; Hirschfeld & Schmidt, 2021; Holze et al., 2022; Studerus Kometer, et al., 2010).

C6P2

Considering their central place in psychedelic experiences, along with the central role that visual perception itself plays in everyday human mental function, understanding the visual effects of psychedelics should be central to understanding how psychedelics impact the mind. Yet visuals remain relatively under-examined in recent discussions. By contrast, visual effects continue to be central to the ritualistic use of psychedelics by indigenous cultures around the world, who place high value on the visual effects of DMT-containing ayahuasca, mescaline-containing cacti, and psilocybin-containing mushrooms (Carod-Artal, 2015; GebhartSayer, 1985; George et al., 2022; Schultes, 1969; Schultes et al., 2006). As Hartogsohn (2017) notes, ‘in such societies hallucinations are often cherished and regarded as potentially valuable for the individual and the culture’ (see also Wallace, 1959). Furthermore, in modern illicit markets, visual effects continue to be a subjective benchmark of the authenticity, quality, and potency of psychedelic drug material (see, for example, Weasel, 1994) and are among the top effects that account for human self-administration of classic psychedelics (Carbonaro et al., 2020).

- C6P3** Here, I address three knowledge gaps in our current understanding of psychedelic visuals. First, with a few notable exceptions (Aday et al., 2021; Klüver, 1928; Kometer & Vollenweider, 2016), analysis of psychedelic visuals is lacking relative to non-visual effects. Even where visuals are addressed, attention tends to focus on *closed-eye* visuals (CEVs)—visual imagery that occurs behind closed eyelids, in the ‘mind’s eye’, akin to imagination but with extra vivacity and force (Erowid, 1995; Swanson, 2018), which have been subdivided into ‘elementary’ and ‘complex’ (Dittrich, 1998; Kometer & Vollenweider, 2016; Stoll, 1947; Studerus, Gamma, & Vollenweider, 2010; Swanson, 2018). In comparison, there have been fewer analyses of *open-eye* visuals (OEVs)—psychedelic alterations of external visual perception. Here, I introduce a taxonomy to classify three distinct types of OEVs: (1) enhancements, (2) transformations, and (3) overlays. Following Klüver (1942), I demonstrate how examining OEV phenomenology offers insights into how psychedelics affect mental functions.
- C6P4** Second, relatively few accounts attempt to *explain why and how* psychedelics affect visual perception, as contrasted with, for example, the care that has gone into accounts aimed at explaining ego dissolution (Letheby & Gerrans, 2017; Millièrè, 2017). Existing accounts that *do* address visuals lack compelling explanations for the *particular* phenomenology of OEVs. For example, the thalamic gating model (Vollenweider & Smallridge, 2022) might account for ‘sensory overload’, but this notion falls short of explaining why OEVs have the particular phenomenology that they do. Similarly, predictive processing accounts that explain OEVs as resulting from disrupted Bayesian priors—‘decomposed predictions’ (Pink-Hashkes et al., 2017) or ‘relaxed beliefs’ (Carhart-Harris & Friston, 2019)—do not explain why OEVs involve only certain kinds of visual alterations: if psychedelics interrupted *all* visual ‘priors’ then we would expect complete perceptual chaos, which does not capture the phenomenology of OEVs.
- C6P5** The third knowledge gap I address here is our lack of understanding of how psychedelic visuals link, if at all, to therapeutic mechanisms. Are visuals entirely epiphenomenal to therapeutic mechanisms, or do they play a causal role in the therapeutic process? If they play no role, then why do drugs that cause OEVs also have therapeutic benefits?
- C6P6** Visual perception is perhaps the most well-characterized and extensively studied mental function in psychology and neuroscience. Moreover, visual experiences dominate debates in philosophy compared to other sense modalities. Our efforts to understand psychedelic drugs can advantageously leverage this

foundation of knowledge. Psychedelic OEVs can serve as specimens of the way in which psychedelics affect this important aspect of the mind. We can analyse psychedelic visual phenomenology from the platform of existing knowledge about everyday visual perception. Conversely, psychedelics offer pharmacological probes for understanding everyday visual perception (Bayne & Carter, 2018; Carter et al., 2005). Visual effects are thus ‘low-hanging fruit’ waiting to be harvested in service of improving our understanding of how psychedelic drugs affect our minds.

**C6P7** In this chapter, I situate psychedelic visual phenomenology within the context of what we know about everyday perceptual and cognitive functions. I think of this approach as a phenomenological–functional analysis. Starting with an informal taxonomic classification of some common OEV phenomenology, I describe a canonical principle that, I argue, captures the essence of many types of psychedelic visuals, which I call *hypercontextual modulation* (HCM). OEVs, I maintain, are ordinary, everyday visual context effects ‘on drugs’—drugs that cause hypersensitivity to sensory contextual cues even at the lowest levels of visual processing. Finally, I apply the notion of HCM to arrive at some practical implications for psychedelic therapy, cognitive neuroscience, and philosophy.

C6S2

## 6.2 What it’s like to see open-eye visuals

**C6P8** Here, I introduce a general taxonomy that distinguishes three kinds of OEV phenomenology commonly reported under classic psychedelics. Importantly, my analysis is restricted to what are conventionally known as ‘classic’ psychedelic molecules: LSD, DMT, mescaline, and psilocybin. The following OEVs are reliably induced by these drugs.

C6S3

### 6.2.1 Enhancements

**C6P9** Even at low doses, the first detectable visual changes are often subtle ‘enhancements’ in the ordinary visual field; for example, edges appear sharper, textures more pronounced, hues intensified. These changes are what I call *enhancement* OEVs. They are commonly measured by rating-scale items such as ‘Change in visual distinctiveness’ and ‘Change in brightness of objects in room’ (Carbonaro et al., 2018; Strassman et al., 1994). Visual enhancements

were noted in a 1914 issue of *Science* magazine in a report from a botanist who inadvertently consumed a psilocybin-containing mushroom species.

- C6P10** ... objects took on peculiar bright colors ... Real objects at this time appeared in their true forms, but if colored they assumed far more intense or vivid colors than natural; dull red becoming brilliant red, etc. (Verrill, 1914, p. 409)
- C6P11** In 1925, neuroscientist Heinrich Klüver ingested peyote at the Psychological Laboratory at the University of Minnesota and noted that ‘there was a general increase in brightness; most colours seemed to be more deeply saturated’ (Klüver, 1926) and he subsequently collected numerous descriptions of enhancement OEVs from the literature of the time.
- C6P12** With respect to colors, there are frequently changes in brightness and saturation ... the objects appear more solid than ever, the surface colors are more sharply defined .... Small differences in hue and brightness of real objects are often noticed. ... An enhancement of contrast phenomena seems to be the rule. Very pronounced simultaneous contrast is found; the contours of the objects become sharp and well-defined. ... Objects normally seen in two dimensions may appear tridimensional in the mescal state. Tridimensional objects may seem still more voluminous than usual. ... Human faces seem to undergo certain changes ... the features become more sharply defined (Klüver, 1928).
- C6P13** Díaz (2010) refers to these phenomena as *dishabituation of perception*: ‘The ordinary visual scene looks new, and everything seems as if seen for the first time. Textures or colors are fascinating and are perceived as much more intense.’ Huxley (1954) describes how the ordinary textures looked to his eyes under mescaline.<sup>1</sup> ‘Those folds in the trousers—what a labyrinth of endlessly significant complexity! And the texture of the gray flannel—how rich, how deeply, mysteriously sumptuous!’
- C6P14** Enhancement OEVs persist through the duration of the drug effects, often outlasting other effects (Díaz, 2010; Dittrich, 1998; Kometer & Vollenweider, 2016; Preller & Vollenweider, 2018). ‘The following day ... after a period of sleep, there was still a great sensitivity to colors, but visions could not be detected with closed or open eyes’ (Klüver, 1926). Albert Hofmann, the inventor of LSD, noted that enhancement OEVs remained the morning after taking LSD at 16:20 in the afternoon the day before.

<sup>1</sup> Check out Letheby (2021) for more fun with this quote.

**C6P15** When I later walked out into the garden, in which the sun shone now after a spring rain, everything glistened and sparkled in a fresh light. The world was as if newly created. All my senses vibrated in a condition of highest sensitivity, which persisted for the entire day. (Hofmann, 1980)

#### C6S4 6.2.2 Transformations

**C6P16** What I call *transformation*<sup>2</sup> OEVs involve changes to the spatial properties or *form* of objects—that is, their perceived shape, size, and distance. Rating scales measure this type of OEV with items such as ‘Room looks different’, ‘My sense of size and space was distorted’, ‘Things in my surroundings appeared smaller or larger’, ‘Edges appeared warped’, ‘I saw movement in things that weren’t actually moving’, and ‘With eyes open visual field vibrating or jiggling’ (Carbonaro et al., 2018; Dittrich, 1998; Hirschfeld & Schmidt, 2021; Holze et al., 2022; Lawrence et al., 2022; Muthukumaraswamy et al., 2013; Strassman et al., 1994; Studerus Gamma, & Vollenweider, 2010).

**C6P17** Regarding size transformations, objects can appear either larger (macropsia) or smaller (micropsia) than normal (Kometer & Vollenweider, 2016).

**C6P18** The changes in the apparent size of real objects require special consideration. To illustrate [from documented cases of mescaline experiences]: ‘When I moved my hand towards me, it got enormous and bulky forms’ ... ‘I looked out of the window and was particularly surprised at the changes in the size of the houses ... they seemed to have grown’ ... ‘The branches [of a tree] became longer and shorter’ (Klüver, 1928).

**C6P19** Relatedly, Klüver reports from his own peyote experience how ‘Standing near a corner of the room, the walls ... seemed to move towards me’ (Klüver, 1926). Similarly, Huxley remarks that under mescaline ‘the perspective looked rather odd, and the walls of the room no longer seemed to meet in right angles’ (Huxley, 1954). These reports highlight how transformation OEVs involve visual shifts in apparent distance and perspective.

**C6P20** Huxley, describing a staple transformation OEV, notes that he looked at flowers in a vase and ‘seemed to detect the qualitative equivalent of breathing’

<sup>2</sup> My term ‘transformation OEVs’ follows Klüver’s (1928, p. 34) remark that such effects are ‘what may be called a ‘visionary transformation’ of the object’. I prefer this term to terms ‘pseudohallucination’, ‘distortions’, or ‘illusions’ used elsewhere to describe the phenomena (Dittrich, 1998; Hofmann, 1980; Kometer & Vollenweider, 2016; Preller & Vollenweider, 2018; Vollenweider & Preller, 2020).

(Huxley, 1954). Note that visually ‘breathing’ involves both movement *and* change of shape (take a deep breath now, observe your chest, and it will both move and change shape). Klüver characterized these as ‘the apparent movement of stationary objects,’ but also used descriptions that entail changes in object shape—‘undulating movements ... movements which change the contours and dimensions of the object’ (Klüver, 1928, p. 41). ‘Looking at the radiator in the room, its divisions seemed to move rhythmically’ (Klüver, 1926). Hofmann (under LSD) reported seeing both ‘continuous motion’ and changes in the shape of the inanimate objects he looked at.

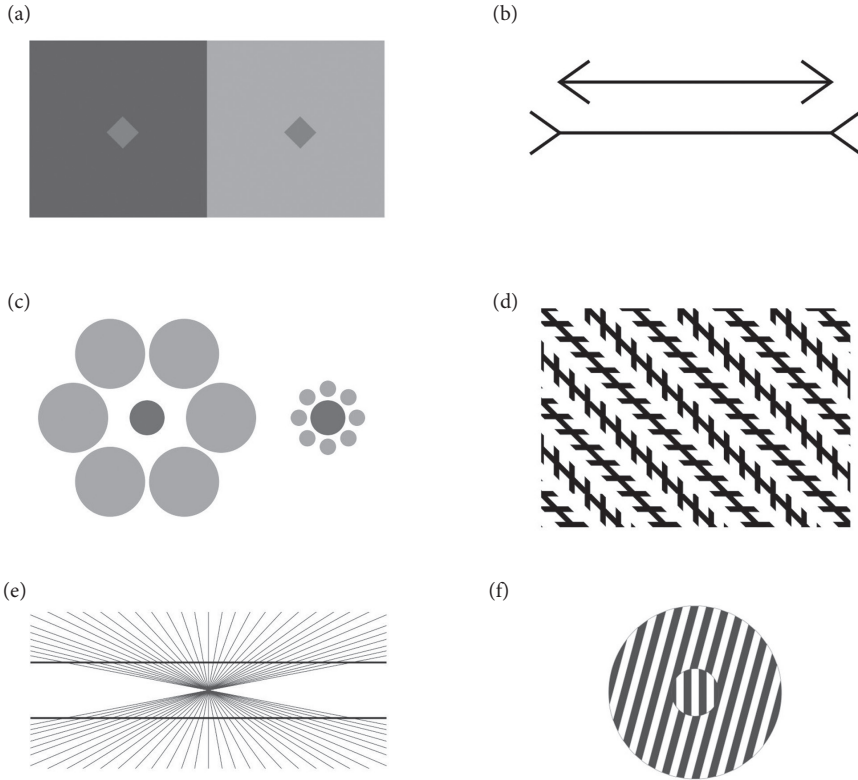
- C6P21** Everything in my field of vision wavered and was *distorted as if seen in a curved mirror*. ... My surroundings had now *transformed* themselves ... the familiar objects and pieces of furniture ... were in continuous motion, animated, as if driven by an inner restlessness (Hofmann, 1980, emphasis mine).
- C6P22** Similar phenomenology has been noted under psilocybin, an early example being again from the 1914 *Science* magazine.
- C6P23** I noticed that the irregular figures on the wall-paper seemed to have creepy and crawling motions, contracting and expanding continually, though not changing their forms; finally they began to project from the wall and grew out toward me from it with uncanny motions (Verrill, 1914, p. 409).
- C6S5** 6.2.3 Overlays
- C6P24** The final species of OEV phenomena I taxonomize here are what I call *overlays*: geometric patterns that infuse the external visual scene. Often compared to decorative patterns found on rugs, tapestries, and wallpaper, overlay OEVs appear as a layer, on top of, or ‘covering’ ordinary objects. Rating scales capture overlay OEVs quite explicitly: ‘Room overlaid with visual patterns’ (Carbonaro et al., 2018; Strassman et al., 1994). Klüver observed OEV overlays when he looked at the walls of the room under peyote.
- C6P25** (Eyes open): the walls covered with squares (about 2 × 2 cm): shadowy dark contours. The corners of the squares: red jewels (three-dimensional). This design followed by similar mostly more complicated designs in various colors. Sometimes not sure whether the phenomena are localized at the distance of the walls (Klüver, 1926).

- C6P26** As the effects climaxed, the overlays intensified. '(Eyes open): impossible to look at the walls without seeing them *covered* with visionary phenomena. Various designs ... visionary phenomena on the walls' (Klüver, 1926, emphasis mine). Klüver (1928) later compiled descriptions from other subjects:
- C6P27** 'transparent oriental rugs, but infinitely small' seen for example on the surface of the soup at lunch time ... 'wallpaper designs' ... 'countless rugs with such magnificent hues and such singular brilliancy' ... localized on the walls, on the floor or *wherever the subject happens to look* (Klüver, 1928 emphasis mine).
- C6P28** Klüver notes that 'The visionary phenomena ... lasted until retiring and could always be seen in the dark room with open eyes' (Klüver, 1926). After spending time staring at his overlay-covered walls, Klüver went on to develop a taxonomy of OEV overlay phenomenology that identifies four fundamental types of patterns that he called 'form constants'; namely, (1) lattices (checkerboards, honeycombs, and triangles), (2) tunnels, (3) spirals, and (4) cobwebs (Klüver, 1928).
- C6P29** Overlay OEVs are common with all classic psychedelics. The following description of viewing the night sky under psilocybin uses the term 'overlay' as well as 'enhancement':
- C6P30** Visual acuity is enhanced to the point where the sky becomes three-dimensional. ... Electromagnetic fields ebb and flow, much like a hyperactive *aurora borealis*. ... Overlaying this display of splendor are colorful, dancing, geometrical fractals of infinite complexity (Stamets, 1996).

### **C6S6** 6.3 Hypercontextual modulation in psychedelic vision

- C6P31** Everyday visual perception involves cascades of *contextual modulation*: each perceived element of a visual scene is shaped by the spatial context (the other visual elements) in which it is situated. Spatial *context effects* occur when the perceived properties of a target element change based on the properties of neighbouring elements (Schwartz et al., 2007). Visual illusions demonstrate how perceived visual properties can be altered simply by changing *contextual cues*, without changing the physical attributes of the target stimulus. Consider the classic context effects presented in Figure 6.1. In such cases, 'the origin of the illusory effects is not based on physical distal or physical

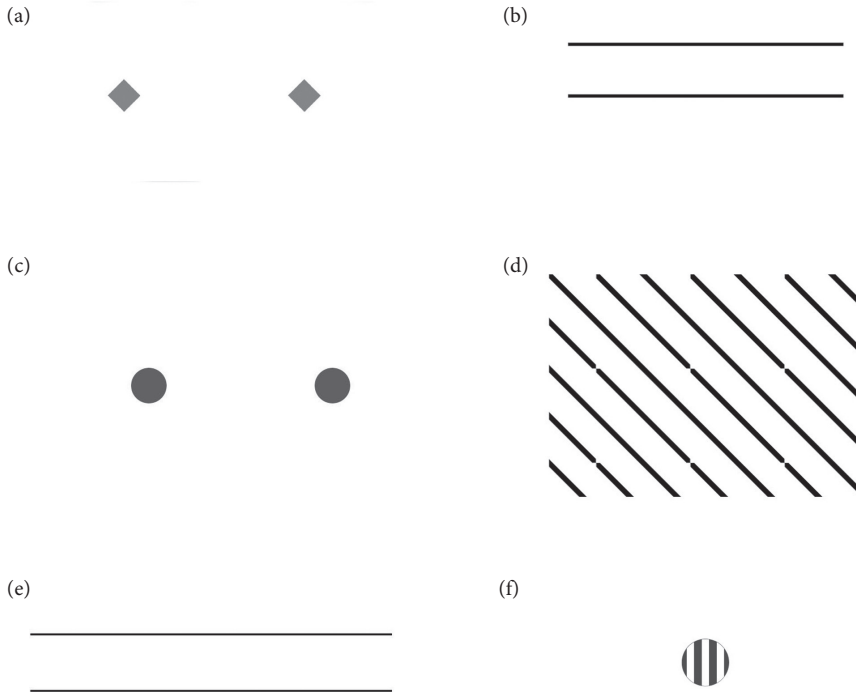
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C6F1

**Figure 6.1** Examples of (spatial) visual context effects. (A) The two diamonds have the same shade of grey, but appear to have different shades (Chevreul, 1860). (B) The top and bottom horizontal lines are the same length, but the bottom line appears longer (Müller-Lyer, 1889). (C) The two (orange) central circles are the same size, but the right one looks larger (Ebbinghaus, 1902; Titchener, 1905). (D) All strips have the same orientation, but appear slanted in different directions (Zöllner, 1860). (E) The two horizontal (red) lines are straight, but appear slightly curved (Hering, 1861). (F) The stripes in the centre circle are completely vertical, but appear slightly tilted (Gibson & Radner, 1937). Figure 6.2 shows the same target stimuli without the contextual cues.

proximal differences of target objects, but on the differences in their contexts' (Todorović, 2020). Indeed, more than a century of psychophysical studies has established that 'the perception of, and neurophysiological responses to, a target input depend strongly on both its spatial context (what surrounds a given object or feature) and its temporal context (what has been observed in the recent past)' (Schwartz et al., 2007). Figure 6.2 presents the exact same



C6F2

**Figure 6.2** The exact same target stimuli from Figure 6.1 but without the contextual cues. (A) The two diamonds have the same shade of grey. (B) The top and bottom horizontal lines are the same length. (C) The two (orange) central circles are the same size. (D) All strips have the same orientation. (E) The two horizontal (red) lines are straight. (F) The stripes in the centre circle are completely vertical. Figure 6.1 shows how contextual cues can alter the appearance of these stimuli.

Figures 6.1A and 6.2A are adapted from Todorović (2020).

Figures 6.1B and 6.2B are adapted from Wikimedia commons. [https://commons.wikimedia.org/wiki/File:M%C3%BCller-Lyer\\_illusion.svg](https://commons.wikimedia.org/wiki/File:M%C3%BCller-Lyer_illusion.svg) (licensed under Creative Commons CC BY-SA 3.0).

Figures 6.1C and 6.2C are adapted from Wikimedia. commons <https://commons.wikimedia.org/wiki/File:Mond-vergleich.svg> (Public Domain).

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Figures 6.1E and 6.2E are adapted from Wikimedia commons. [https://commons.wikimedia.org/wiki/File:Hering\\_illusion.svg](https://commons.wikimedia.org/wiki/File:Hering_illusion.svg) (licensed under Creative Commons CC BY-SA 3.0).

Figures 6.1F and 6.2F are adapted from Schwartz et al. (2007).

target stimuli used in Figure 6.1 without the contextual cues. The term *contextual modulation* refers to the processes by which contextual stimulus cues influence the perceived properties of a target stimulus. For our purposes here, the specific neural mechanisms of contextual modulation are irrelevant. All

that is required is that contextual modulation *occurs in perception*, as demonstrated in Figures 6.1 and 6.2.

**C6P32** The key insight of this section is that psychedelics might produce OEVs *by inducing hypersensitive contextual modulation*. I motivate this analytically with a thought experiment, followed by phenomenological and psychophysical evidence.

**C6S7**

### 3.1 Thought experiment

**C6P33** Imagine that some fictional drug could selectively enhance contextual modulation. Under this drug, the apparent contrast of the diamonds in Figure 6.1A would diverge even *more*—that is, the background shades (contextual cues) would have a *greater* effect on the perceived shades of the diamonds (target stimulus). By inducing *hypercontextual* modulation—amplified modulatory effects of contextual cues—the drug would exaggerate perceived differences in line length (B), circle size (C), line orientation (D, F), and curvature (E). Importantly, under this fictional drug, only the *magnitude of influence of contextual cues* is impacted—that is, without the contextual cues (Figure 6.2) the drug would have less influence on percepts of the target stimuli.

**C6P34** Now, imagine further that the *strength* of these drug-amplified contextual modulations *varied from one frame to the next*, perhaps due to its pharmacokinetics, causing a ‘rubber-banding’ effect, where each moment the contextual modulation was stronger, then weaker, then stronger, relative to the previous moment. The net phenomenology, I argue, would be exactly the kind of ‘breathing’ (Huxley, 1954), ‘wavering’ (Hofmann, 1980), ‘undulating movements’ (Klüver, 1926) seen in transformation OEVs. Our fictional drug would be able to produce transformation OEVs solely by enhancing the contextual modulation that occurs when you look at Figure 6.1. Furthermore, your overall visual field would have *richer variations* among its elements, akin to enhancement OEVs, just as the target stimuli in Figure 6.1 have more variation than they do in Figure 6.2.

**C6P35** I argue that common psychedelic OEVs can be accounted for by what I call *hypercontextual modulation* (HCM) in visual perception. The central notion is that psychedelics could cause OEVs by amplifying the visual processes by which perception of the target stimuli in Figure 6.2 are transformed by the contextual cues as in Figure 6.1.

C6S8

### 6.3.2 Open-eye visual phenomenology as hypercontextual modulation

- C6P36** Consider that psychedelics increase scores on the rating scale-item ‘Things in my surroundings appeared smaller or larger’, phenomena known as micropsia and macropsia (Kometer & Vollenweider, 2016). In normal vision, the apparent sizes of objects are perceived *in relation to the spatial context of the visual scene*—an effect illustrated by the moon illusion (Berkeley, 1709; Hershenson, 2013), in which the apparent size of the moon changes depending on its position in the sky. Thus, if psychedelics caused HCM—that is disproportionate modulatory responses to contextual cues that ordinarily determine perceived size and shape—we would expect shifts in the apparent size of objects, as seen in transformation OEVs. Interestingly, transformation OEVs are often restricted to only some objects in the visual scene—for example, some objects might appear to move or ‘breathe’, while others simultaneously remain static and appear normal, consistent with my claim that OEVs stem from a selective impact on contextual modulation processes rather than whole-scale distortions of the entire visual stream.
- C6P37** It is theoretically interesting that the occurrence of apparent movements in the mescal state depends to a certain extent on the nature of the stimuli. . . . objects which together with their surroundings form an optical ‘whole’ and which are so to speak definitely anchored in optical respects are less likely to move than those which seem to be detached from their backgrounds; objects the contours of which ‘suggest’ movement are more likely to move than those with definite, well-marked contours (Klüver, 1928, pp. 42–43)
- C6P38** The context effects in Figure 6.1 match well to transformation OEVs. In a state of HCM, a greater-than-usual effect of cues seen in Figure 6.1B/C could lead to ‘The branches [of a tree] became longer and shorter’ (Klüver, 1928). Hypersensitivity to cues that modulate line orientation (panels D/F) could lead to ‘the walls of the room no longer seemed to meet in right angles’ (Huxley, 1954). Amplification of the modulation seen in panel Figure 6.1E could lead to ‘my field of vision wavered and was distorted as if seen in a curved mirror’ (Hofmann, 1980).
- C6P39** The same logic applies to enhancement OEVs. As seen in Figure 6.1A, amplified contextual modulation could produce intensification of colours, heightened vivacity, and finer detail by increasing simultaneous contrast effects. In

everyday perception, contextual cues modulate many low-level visual features, including perceived luminance (Adelson, 2000; Anderson & Winawer, 2005), contrast (Cannon & Fullenkamp, 1991; Chubb et al., 1989; Ejima & Takahashi, 1985; Snowden & Hammett, 1998), and orientation (Clifford, 2014; Fraser, 1908; Goddard et al., 2008; Qiu et al., 2013; Zöllner, 1860), which underpin the perception of textures.

**C6P40** What about overlay OEVs? Bressloff et al. (2002) build on Klüver's idea of 'form constants' to suggest that the 'mechanisms that generate geometric visual hallucinations are closely related to those used to process edges, contours, surfaces, and textures.' Speculatively, the geometric patterns seen in overlay OEVs are proto-elements of these higher-level visual features, which might become 'orphaned' or 'detached' from any objects. In a state of HCM, low-level visual processes might generate *extra* proto-elements of edges, contours, surfaces, and textures in (hyper)response to various (low-level) contextual cues, resulting in overlay OEVs. Indeed, there is evidence that the earliest/lowest visual areas generate proto-elements of naturalistic textures (Freeman et al., 2013; Ziemba et al., 2016). Thus, it is plausible that overlay OEVs result from hyper-recruitment of the response patterns in these early visual areas, causing them to produce an overabundance of textures like those found in the natural world.<sup>3</sup>

**C6P41** In summary, I propose that HCM is critically involved in all major types of OEVs induced by classic psychedelics. The defining phenomenological features of enhancement OEVs, transformation OEVs, and overlay OEVs are exactly the kinds of perceptual consequences we might expect to see if the visual system became hypersensitive to contextual cues at multiple levels. So far, I have provided a phenomenological–functional analysis supporting HCM as the cause of OEVs. I next present supporting empirical evidence from studies that asked participants to complete psychophysical tasks under psychedelics.

**C6S9**

### 6.3.3 Psychedelic psychophysics

**C6P42** Evidence indicates that visual performance is largely preserved under psychedelic drugs, *unless the stimuli are designed to elicit strong contextual modulation*. For instance, Barrett et al. (2018) found no significant differences in performance on the Penn Line Orientation Test (Moore et al., 2015) under

<sup>3</sup> Thanks to Michael-Paul Schallmo for providing the extra neuroscience references on this point.

psilocybin, a task that does not trigger significant contextual modulation at the level of perception that it measures (Moore et al., 2015).

**C6P43** Further evidence can be found in Carter et al. (2004), who designed two motion-detection tasks—one ‘local motion’ task, and one ‘global motion’ task—and compared task performance under psilocybin versus placebo. Psilocybin had no impact on the local motion task, but significantly impacted the global motion task. Importantly, *contextual cues remained fixed across trials* on the local motion task. The global motion task, by contrast, presented contextual cues in the form of randomly moving (non-target) dots intermixed with the target dots, so that the visual context varied across trials. Psilocybin significantly impacted performance on this task. Furthermore, ‘a number of subjects commented that subjectively the global motion task became harder [under psilocybin] *due to an increased salience of the randomly moving dots*’ (Carter et al., 2004, emphasis mine). In a different study that measured the influence of contextual cues on visual attention, Gouzoulis-Mayfrank et al. (2002) found that psilocybin significantly increased the influence that visual cues had on performance on the Covert Orienting of Visuospatial Attention Task (COVAT), consistent with the notion of HCM.

**C6P44** Taken together, these studies support HCM because they indicate that task performance is largely preserved under psilocybin on tasks (and on ‘catch trials’) that do not invoke or measure context effects, while performance is significantly impacted on tasks that induce contextual modulation.

**C6S10**

## 6.4 Practical implications

**C6P45** In this section, I describe key takeaways whereby HCM might inform current debates and philosophical questions about the therapeutic use of psychedelics.

**C6S11**

### 6.4.1 Hallucination and HCM

**C6P46** Do psychedelic visuals count as hallucinations? Through the lens of HCM, psychedelic visuals are perceptual consequences of hypersensitivity to contextual cues—*normal* contextual modulation processes are augmented to produce *exaggerated* visual responses. Since we generally don’t say that you are hallucinating when you view Figure 6.1, hypercontextual modulations of perception might be more appropriately considered as illusions (Todorović, 2020), not hallucinations. Importantly, our concepts of illusion

and hallucination are not synonymous, as the two concepts differ with regard to the epistemic status or veridicality of the experiences. Macpherson & Batty (2016), for example, argue that common features of everyday perception have mixed veridicality. If I am right that psychedelic visuals stem from HCM, then we might hold their epistemic status akin to how we regard perceptual context effects: illusory, in a sense, but part of the normal way that everyday perception functions (Macpherson & Batty, 2016; Schwartz et al., 2007; Todorović, 2020)—just exaggerated.

**C6P47** The epistemic status of psychedelic visuals is thus improved by disentangling them from the poor epistemic reputation of hallucinations, seeing their status instead as roughly on par with garden variety illusions, which brings them much closer to the epistemic status of everyday perception, which, of course, is infused with ‘illusory’ elements at every turn (Klüver, 1966; Macpherson & Batty, 2016; Purves et al., 2015). Thus, psychedelic visuals are nothing to fear, epistemically speaking.

**C6S12**

#### 6.4.2 New context for old cues

**C6P48** Letheby (2021) provides an argument for what he sees as a chief epistemic virtue of psychedelics:

- C6P49** 1. Psychedelics often facilitate the apprehension of already known facts under new and distinctive modes of presentation.
- C6P50** 2. If one apprehends an already known fact under a new and distinctive mode of presentation, then one thereby acquires new knowledge of an old fact.
- C6P51** 3. Therefore, psychedelics often facilitate the acquisition of new knowledge of old facts (Letheby, 2021).

**C6P52** In terms of HCM, we might say that psychedelics allow old cues to trigger new contextual modulations. Furthermore, HCM offers a new way to describe and understand the old fact that psychedelics can cause people to see things anew, adding greater specificity to the claim that ‘psychedelics facilitate the representation of old facts in new modes by disrupting the brain’s functional architecture’ (Letheby, 2021). Many classes of drugs (among other things) can disrupt the brain’s functional architecture. Psychedelics are uniquely valuable, I argue, because they cause hypersensitivity to contextual cues, allowing the brain to modulate itself in new ways.

**C6P53** Another epistemic benefit highlighted by Letheby (2021) is that psychedelics might engender *knowledge by acquaintance* (Russell, 1910); namely, acquaintance with the fact that our minds have ‘vast, normally unrealized potential’ (Letheby, 2021, p. 184). Here, I argue that the potential we are acquainted with is the mind’s capacity for nearly limitless *contextual modulation*—to combine cues in infinite different ways producing infinite varieties of percepts and thoughts—and that psychedelics grant direct acquaintance with this at multiple levels of mental function. HCM also offers a framework for understanding how psychedelics facilitate epistemic gains that take the form of *knowledge how* and *knowledge that* (Letheby, 2021). Within a new ‘*context of discovery*’ (Letheby, 2021), new insights are made available (*knowledge that*). Insofar as learning new (psychological and emotional) skills arises from enhanced contextual modulation, *knowledge how* might also be gained via HCM.

C6S13

### 6.4.3 HCM and psychedelic therapy

**C6P54** HCM can be applied in pursuit of a naturalistic, neurocognitive understanding (Letheby, 2021; Shanon, 2002) of why psychedelics can have therapeutic benefits. Consider that patients with major depressive disorder (MDD) show reduced (*hyposensitive*) contextual modulation in the processing of visual (Golomb et al., 2009; Salmela et al., 2021; Song et al., 2021), and emotional (Rottenberg et al., 2005) stimuli. Relatedly, a common symptom of MDD is physical anhedonia (Chapman et al., 1976), the reduction of interest and enjoyment in sensory stimuli (Sagud et al., 2020; Shankman et al., 2010). Furthermore, MDD patients show blunted responses to everyday stimuli that convey contextual emotional cues, including body movements (Kaletsch et al., 2014), speech (Pang et al., 2014), music (Nasari et al., 2021), and faces (Bourke et al., 2010; Krause et al., 2021). Conversely, psychedelics appear to do exactly the opposite. Responses to music, as described above, are enhanced (Bonny & Pahnke, 1972; Kaelen et al., 2015; Preller et al., 2017). There is substantial evidence that psilocybin ‘revives emotional responsiveness [to faces] on a neural and psychological level’ (Mertens et al., 2020) in MDD patients (Gill et al., 2022; Mertens et al., 2020; Roseman et al., 2018; Stroud et al., 2017) as well as healthy volunteers (Grimm et al., 2018). Altered visual perception of faces under mescaline was reported early on by Klüver (1928): ‘Human faces seem to undergo certain changes . . . the features become more sharply defined.’ HCM might thus provide a key insight into the general trajectory by which psychedelics move patients out of depression; namely, that MDD involves

*hyposensitive* contextual modulation, while psychedelics perhaps counteract this by inducing *hypersensitive* contextual modulation.

**C6P55** As argued above, this neurocognitive understanding has the potential to free psychedelic therapy from the poor epistemic reputation of hallucinations. It might also defuse what Letheby (2021) calls the ‘Comforting Delusion Objection’, which holds that therapeutic benefits derive from false beliefs. HCM offers a naturalistic account of therapeutic benefits that does not rest on the induction of non-naturalistic beliefs.

#### **C6S14** 6.4.4 Vision(s), symbols, and insight

**C6P56** As Letheby (2021) points out, testimonies from patients suggest that psychological insights and emotional shifts often occur concomitantly with unusual visual experiences, sometimes taking the form of symbolic imagery or ‘visual parables’: ‘Visual parables and metaphors constitute an alteration to perceptual experience, but also an experience of apparent *insight* ... they engender novel understanding or comprehension, or at least feelings thereof’ (Letheby, 2021, p. 43). Relatedly, the most significant increases in symbolic thought measured by Wiessner et al. (2022) under LSD came in response to tasks that used *abstract prompts with visual stimuli*, which the authors explicitly link to the therapeutic role of symbolic visions reported by early psychedelic therapists.

**C6P57** There is wide agreement that music listening is critical to psychedelic therapy (Barrett et al., 2018; Bonny & Pahnke, 1972; Kaelen et al., 2018). Moreover, indigenous cultures continue to use sound and music—often simple, repetitive motifs and rhythms—to drive and optimize visual effects and concomitant revelations (Carod-Artal, 2015; George et al., 2022; Schultes, 1969; Schultes et al., 2006). Less discussed in the literature, but relevant to our concerns here, is the role of external *visual* stimuli.<sup>4</sup> Furnishings and decorations in the treatment room are standard ‘setting’ protocol in virtually all recent clinical trials (Johnson et al., 2008).<sup>5</sup> In many protocols, ‘the environment in which the treatment is conducted commonly includes mystical themes, use of psychedelic imagery such as mandalas’ (Hosanagar et al., 2021). Interestingly, mandalas were prescribed by Metzner and Leary (1967) to visually drive psychological insight

<sup>4</sup> I thank Dr Kathryn Swanson for pointing out the importance of physical objects in shaping psychedelic experience.

<sup>5</sup> Note that these protocols also encourage the use of eyeshades. This confounds analyses such as Roseman et al. (2017), which examine the degree to which visual alterations correlate with positive clinical outcomes.

under psychedelics. ‘The various symbolic figures on the mandala, with letters, colors etc., serve as additional *anchoring points of associations*. The idea is to get as much of the mental contents on to the two-dimensional surface . . .’ (Metzner & Leary, 1967, emphasis mine). Moreover, indigenous psychedelic rituals place ‘sacred objects’ within the ritual space, often arranged as shrines; peyote rituals, for example, use an altar ‘over which thoughts and visions understood travel to and from God’ (Stewart, 1961), while ayahuasca rituals are often held in spaces with intentional geometric layouts and filled with ‘visually pleasing objects such as flowers, colorful icons, crystals, and glowing candles, but also by the calculated use of symbology’ (Hartogsohn, 2021).

**C6P58** Letheby (2021) characterizes perceptual effects as ‘vehicles’, the importance of which, he argues, is ‘derivative’ from the insights they can deliver. However, if the insights are important, then understanding the vehicles that deliver them would be *even more important*. This calls into question the recent tendency to downplay the importance of psychedelic visuals. It also casts doubt on what Letheby (2021) terms ‘Pure Neuroplasticity Theory’, which hopes that *all* acute subjective psychedelic effects are epiphenomenal to what are putatively purely neurobiological therapeutic mechanisms (Berg et al., 2022; Hesselgrave et al., 2021; McClure-Begley & Roth, 2022). If therapeutically beneficial experiences come from HCM, then the visuals might come with the territory. At the very least, visuals are a *perceptual marker* that the mind has entered the therapeutically beneficial mode of functioning.

**C6P59** Metzner and Leary (1967) stated that ‘A psychedelic experience is a period of intensely heightened reactivity to sensory stimuli from within and without.’ This perspective appears to have faded, as the role of visual stimuli, external objects, and visual imagery in psychedelic therapy continues to be downplayed. HCM offers an antidote to the professional blind eye<sup>6</sup> that has been turned to psychedelic visuals, because it is a naturalistic, neurocognitive explanation capable of linking visuals to therapeutic benefits.

**C6S15**

## 6.5 Conclusion

**C6P60** Visual perception is a central element of human mental function. We routinely speak about our mental operations using visual metaphors. Psychedelic OEVs thus offer an important clue to how psychedelics impact the mind. I have argued that the phenomenology of OEVs suggests that psychedelic drugs impact

<sup>6</sup> Pun intended (wink).

contextual modulation such that percepts are hypermodulated in response to the usual contextual cues.

- C6P61** The implications of the HCM understanding of psychedelics are three-fold. First, HCM suggests that psychedelic effects on visual perception are congruent with effects on cognition, since the cognitive effects (increased symbolic thinking and semantic activation, the influence of set and setting, the phenomenon of ‘bad’ trips) all seem to involve hypersensitivity to contextual cues. Second, understanding psychedelics in terms of HCM can serve as a basis for a neurocognitive account of psychedelic therapy, whereby psychological insights are more likely to arise from a sea of exaggerated responses to external and internal cues. Third, HCM might relieve the epistemic stigma associated with visual effects, as both visual and non-visual psychedelic effects can be understood within a unified, naturalistic, neurocognitive framework.
- C6P62** HCM also sketches an empirical research programme, with OEVs as the phenomena of interest, in which the fundamentals of psychedelic effects on low-level perceptual processes could be studied using classic paradigms to understand how psychedelics alter vision and other mental functions.
- C6P63** There is much to be gained by seeing psychedelic visuals in context.

C6S16

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