Some Hallucination is Experience of the Past*

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Abstract

A sensory experience is an hallucination only if the subject is not in the normal sort of concurrent causal interaction with the object of experience. It's standardly further inferred that the object of hallucination doesn't actually exist. But this inference does not follow. The lack of normal concurrent causal interaction does not imply that there does not exist a thing that is hallucinated. It might be a past-perceived object. In this paper I argue this claim holds for at least some interesting cases of hallucination. Hallucinations generated by misleading cues (e.g., seeing subjective contours), hallucinations of Charles Bonnet Syndrome patients, and dreams are experience of past-perceived bits of the world. The crux of my argument turns on the idea that hallucinations in these cases are generated by sensory activities facilitated by the same sort of neural pattern completion which enables episodic memory.

1 Introduction

If I visually hallucinate a pencil, the hallucinated pencil is not "really there". The standard view infers that there does not exist a physical item which is hallucinated (e.g., Macpherson 2013). In other words, there is nothing out in the world with which I am in sensory contact as I hallucinate. But

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while the hallucinated pencil isn't something now in front of me with which I concurrently interact visually in the normal way, it doesn't follow that there does not exist a particular pencil I'm visually experiencing. I might still be making sensory contact with the world. For example, it might be that the hallucinated pencil is an item in the past—a past-viewed pencil.

In this paper I argue that this holds for at least some cases. The argument goes as follows:

P1: At least some hallucinations are generated by sensory activities which are (in part) interactions with past-perceived bits of the world.
P2: If a sensory experience is generated by a sensory interaction with some bit of the world, then it's an experience of that thing.
Conclusion: At least some hallucinations are experiences of past-perceived bits of the world.

P1 is supported by additional premises:

P3: A sensory activity is an interaction with a thing if (1) that thing is a causal antecedent of the neural signals mediating the activity, and (2) the use to which the organism puts those signals involves that thing in the right way.
P4: At least some hallucinations are generated (in part) by sensory activities which are mediated by neural signals which have past-perceived bits of the world as causal antecedents.
P5: In at least some of these hallucinations, the generating sensory activities involve those past-perceived bits of the world in the right sort of way.
Conclusion (P1): At least some hallucinations are generated by sensory activities which are (in part) interactions with past-perceived bits of the world.

The experiences of a fully envatted brain which has only ever been fed input from virtual models are *not* among those at issue in P1. Instead, the kind of hallucinations falling under P1—and so which are experience of the past—include those induced by misleading cues (such as seeing subjective contours of Kanizsa triangles), dream experiences, and the clinical case of Charles Bonnet Syndrome (CBS).

When I say that these cases of hallucination involve experience of the past, what I mean is that there exists a bit of the physical world of which the hallucinating subject is aware. These hallucinations involve sensory contact with the world. This existing hallucinated item is some bit of the world from the past.

2 Sensory Interaction and Experience

Consider first P2:

P2: If a sensory experience is generated by a sensory interaction with some bit of the world, then it's an experience of that thing.

Sensory interactions are interactions with a distal stimulus facilitated by your sensory systems. For example, looking over an apple you're holding, identifying the location of a seen ball or a felt touch, tracking a constant sound through changing proximal stimulation, or discriminating a moth from tree bark are all paradigmatic sensory interactions.[1]

The idea behind P2, going back to causal sense-datum theories of perception (Russell 1912; Price 1932; Grice 1961), is that the underlying causal structure behind the event generating a sensory experience fixes the object of the experience. Sensory interaction between an organism and a distal bit of the world is the ideal case in which causal structure lines up in the right way (whatever that way is) for grounding sensory experience of that distal thing.

This idea fits many mainstream approaches to perception. Consider externalist representationalism, which holds that what's experienced is what a given experience represents, which itself is determined by causal interactions with the world (Tye 1995; Lycan 2001; Dretske 2003). Dretske (2003, 68), for example, says that "Following fairly standard causal thinking, I take the object(s) of a representation [like a sensory experience] to be the object(s) that stand(s) in the right causal relation to it."

Consider also the popular view that sensory experiences have demonstrative (Burge 2005; Matthen 2005) or gappy (Schellenberg 2010) content. Demonstrative and gappy contents are context sensitive, so that the object of the representation is determined by the situation in which the representation (the sensory experience) is tokened. Assume that a sensory experience is generated by a sensory interaction with some bit of the world. It's hard

[1] These examples are taken from (Matthen 2005, 2014; Siegel 2006; Burge 2010; Schellenberg 2019), although these authors typically raise the examples in the context of discussing what it takes to perceive a given distal stimulus.

to see how it wouldn't follow that that bit of the world isn't the contextually determined referent of the experience, on these views. So again, on this variety of representationalism, we get premise 2.

Most representationalits accept that we experience particular objects and explain that particularity by appeal to representations of those particulars. *Some* story will have to be told about how perceptual states come to represent the particular objects perceived, and it's hard to imagine any way of telling the story which doesn't ground that particular content in sensory interactions. Matthen, for example, explicitly grounds the particular content of visual experience in the sensory activity of locating objects in egocentric space (see Matthen 2005, 300–305). Even representationalists who deny that sensory experience has particular content (Tye 1995; Pautz 2009) appeal to a causal story about how experiences get their particularity (Pautz 2009, 499, 2010, 286). But a causal explanation of the particularity of experience will also bring us back to premise 2.

Naïve realists (e.g. Campbell 2002; Martin 2004; Fish 2009), who believe that experiences are relations, should be amenable to P2 as well. A common approach is to say that the experience-constituting relation is perception, or sensory-based Russellian acquaintance (e.g., see Fish 2009, 15; Logue 2012, 221). It's fair to assume that sensory interaction with an object suffices for both perception and sensory-based acquaintance, so if this is the naïve realist's view, premise 2 holds.

3 Plasticity, Pattern Completion, and Recall

The argument for P1 starts by giving two jointly sufficient conditions for sensory interaction:

P3: A sensory activity is an interaction with a thing if (1) that thing is a causal antecedent of the neural signals mediating the activity, and (2) the use to which the organism puts those signals involves that thing in the right way.

In support of P3, it's at least suggestive that paradigm examples of sensory interactions involve both conditions. For example, as you look over an apple you're holding, the apple is a causal antecedent of the neural signals facilitating your visual exploration and you put those signals to use to guide your approach to the apple, to enable your grasp of it, and to assess its various qualities like ripeness and color. In sensory exploration you are concerned with and act towards an object in a way that's facilitated by neural (information-carrying) signals caused by that object.

More importantly, all that matters for P3 is that the two conditions given suffice for the sort of sensory interaction at issue in P2, and they do. If a sensory activity meets these two conditions and generates a sensory experience, then the resulting experience is an experience of the relevant causal antecedent. In other words, conditions (1) and (2) in P3 jointly imply the consequent of P2, which is all we need to make the logic of the overall argument work.

Let's consider P4.

P4: At least some hallucinations are generated (in part) by sensory activities which are mediated by neural signals which have past-perceived bits of the world as causal antecedents.

The basic considerations in favor of this premise run as follows. The neural activity mediating normal sensory activities—whether resulting in hallucinatory or perceptual experience—is prompted by changes in the membrane potential of sensory receptors due to stimulus energy. But the exact shape of this mediating neural activity (e.g., spike-rate frequency and the spatial pattern of spike-rate frequency changes across patches of cortex) is determined not just by the stimulus-driven changes in receptor membrane potential, but also by the weights of the synapses connecting the neurons in the relevant circuits. These synapses exhibit *plasticity*. Their weights are (in turn) shaped by past activity of the system.[2] In the normal case, at least some of that past activity was (of course) driven by past sensory interactions, interactions with

[2]How this tuning of synaptic weight works depends on things like neurotransmitter levels, cell type, structural position within a circuit, and type and position of the synapse relative to the neuron itself (Feldman 2012, 557–62). As proposed by Hebb (1949), one way some synapses get tuned, some of the time, is through correlated spiking between two connected neurons which strengthens the synapses between them (Feldman 2012, 556). High (>30Hz) and low spike rates (<10Hz), spike timing (e.g., one neuron firing within about 20ms of another), and coordinated spiking (e.g., multiple presynaptic neurons spiking synchronously) all also shape synaptic weights (Feldman 2012, 558). Depending on these factors spike propagation tunes synapses: strengthening some (long-term potentiation) and weakening others (long-term depression). Evidence suggests that this activity-dependent plasticity shapes neural circuits involved in sensory processing, including both low-level feature extraction and high-level object recognition in animal (including human) vision (Albright 2012, 230; Feldman 2012, 564).

past-perceived bits of the world. So past-perceived bits of the world causally affect the neural activity mediating current sensory activities via the past neural activity they prompted and effects that past neural activity had on synaptic weights. This reasoning won't go through for the case of a fully envatted brain which has only been fed input based on artificial computer simulations. But it will go through for the hallucinations of a subject who usually is in normal perceptual contact with the physical world.

Even common sensory interactions leading to normal perceptual experiences have the sort of past-pointing causal connections highlighted by P4. But these are not interactions with those past causal antecedents; they are interactions with the concurrent causal antecedents affecting sensory receptors. This is presumably to be explained by the use to which the organism is putting the mediating neural signals in the sensory activity. Looking over an apple (for example) is an interaction with the present object (and not any past causal antecedent) because the purpose of the exploration is present-focused. You are sensitive to the present object, orient your exploratory behavior with respect to it, and your activity functions to gather information about what's here now.

So if the sensory activities which generate hallucinations are interactions with past causal antecedents, it is because the generating activities are past-focused. This brings us to P5:

P5: In at least some of these hallucinations (generated by sensory activities mediated by neural signals with past-perceived bits of the world as causal antecedents), the generating sensory activities involve those past-perceived bits of the world in the right sort of way.

What it is for a sensory activity to "involve" some bit of the world "in the right sort of way" is imprecise, but the above discussion should already indicate some of what's meant. There's at least one sensory activity which clearly involves past-perceived items in the right sort of way: recall.

The best example of recall is episodic memory (see Tulving 1983; 2002). In episodic memory one not only recalls some bit of information, but "relives" or re-experiences a previous sensory experience via mental imagery. This recall is *past-pointing* and engages with particular past-perceived items. For example, the recall I'm doing right now as I remember eating breakfast this morning is a sensory interaction with the food I ate.

My suggestion is that in at least some cases of hallucinations the generating sensory activities involve recall. Since recall is past-pointing in the right sort of way, P5 will follow immediately. This suggestion turns on the following premise:

Recall Premise: If a given sensory activity is facilitated in part by neural pattern completion, then that activity involves a form of recall.

The standard account of episodic memory provides an introduction to neural pattern completion.

The net effect of synaptic tuning varies (see Feldman 2012), but often the result is that a pattern of activity primes a neural circuit to repeat that pattern when provided part of it as input (Jackson 2013; Zylberberg and Strowbridge 2017, 605). The standard view is that this pattern completion is what facilitates episodic memory: episodic memories are recalled by repeating the patterns of neural activity which facilitated the original (recalled) sensory interactions (Brogaard and Gatzia 2017, 9). The idea is that the original pattern of activity tunes the synaptic weights in relevant memory-storing areas, leaving behind a memory "trace" or "engram" in the circuit (Liu et al. 2014, 59). These memory traces are the effects of the original pattern—presumably the tuned synaptic weights—which allow the organism to repeat that pattern by inputting a part of it.[3]

If pattern completion facilitates recall in the case of episodic memory, perhaps it's facilitating recall in other cases as well—hence, the recall premise. The sensory activity generating some hallucinations is facilitated by pattern completion. Hallucinations generated by misleading visual cues provide a good case. A well-known example is seeing subjective contours, as in Kanizsa's triangles (see Kanizsa 1976). In these cases while viewing an image you visually experience contours, or edges, of some shape which aren't

[3]Something like P4 obviously holds for episodic memory: episodic memories are generated in part by sensory activities which are mediated by neural signals with past-perceived bits of the world as causal antecedents, thanks to this pattern completion. So we get the conclusion that episodic-memory recall is a sensory interaction with the past. Byrne (2010, 21) makes a similar point when he suggests that episodic memory preserves "cognitive contact" with past-perceived things. By this he's following Campbell (2002) and is referring to whatever link perception provides which affords us the ability to talk and think demonstratively about objects, but the spirit is in line with what I'm arguing for here. Similarly, Debus (2008) has proposed a relational account of memory, akin to naïve realist accounts of perceptual experience. Again there's an obvious parallel between Debus's relational account of memory—at least, her claim that episodic recollection is a relation (2008, 406)—and this implication that episodic memory recall is a sensory interaction with the past.

really there. It should be immediately plausible that some sort of pattern competition is behind the hallucinatory experience.

As suggested by Thomas Albright's account of visual processing (2012), pattern-completion generated hallucinations might be the norm. Albright suggests that overall activity in visual processing results from a mix of bottom-up and top-down input. This top-down input originates (on Albright's view) in the inferior temporal (IT) cortex, which he suggests serves in part as a "long-term repository of visual memories", with the medial temporal lobe and hippocampus serving a role in the formation of these memories (2012, 229). Crucially, the top-down input from IT cortex seems to be a form of pattern competition similar to that facilitating episodic memory recall: repeated exposure to concurrent stimulus items strengthens connections in IT cortex so that exposure to one item prompts top-down signals which trigger activity normally associated with the missing item. On Albright's view, the neural circuits facilitating this top-down generation of visual activity are the same ones involved in mental imagery tasks. The extent to which bottom-up or top-down input dominates overall visual activity depends on the quality of the bottom-up signal; when input from sensory receptors is incomplete, noisy, ambiguous, or otherwise defective, input from this top-down imagery system fills in the gaps (see also Tang et al. 2018).[4] How we fill in missing information during perception isn't different from what we do when we generate mental images of past-viewed objects based on episodic memory traces (Albright 2012, 237–39).

The misleading visual cues which prompt hallucinations (as when viewing Kanizsa's triangles) are examples of ambiguous or incomplete input which the visual system might fill-in via pattern completion. The visual cues now prompting your hallucination of edges were in the past associated with certain shapes. That association prompted activity which left visual memory traces which are reactivated when viewing the cues.

Albright provides a second example of an hallucination generated by top-down completion:

> Consider, for example, the "vanishing ball illusion": in this simple yet compelling trick, the magician repeatedly tosses a ball

[4]As is well-known, sensory stimulation almost always, if not always, underdetermines its distal source (e.g., Fodor and Pylyshyn 1981, 173). But as noted by Albright (and also Tang et al. 2018), not every bit of receptor input requires completion by top-down processing.

> into the air. On the final toss, the ball vanishes in mid flight (...). In reality, the ball never leaves the hand. The illusion is effected by the use of learned cues that are visible to the observer, including the magician's hand and arm movements previously associated with a ball toss, and the magician's gaze directed along the usual path of the ball. The observer's inferences about environmental properties and events are probabilistically determined (from the associated cues) but the inferences are incorrect. According to the implicit imagery hypothesis, these flawed inferences are nonetheless manifested as imagery of motion along the expected path. Moreover, this imaginal contribution to perceptual experience is likely to be mediated by top-down activation of directionally selective MT neurons, in a manner analogous to the effects [observed in Rhesus monkeys]. (Albright 2012, 238, reference omitted.)[5]

In the case of the vanishing ball illusion, on the illusory toss the observer has a visual experience of a ball leaving the magician's hand, but there is no such ball. This hallucinatory experience (of a ball which isn't there) is generated (at least in part) by the cued reproduction of visual activity that was previously elicited by the prior real tosses.

So Kanizsa's triangles and the vanishing ball illusion plausibly provide two cases of hallucinations generated by sensory activities facilitated by pattern completion.[6] Two other cases of hallucination are plausibly generated by

[5] Albright is at the end referring to an experiment he completed (see Schlack and Albright 2007) using Rhesus monkeys which shows that motion-sensitive neurons in visual cortical area MT can be trained via association to respond to (artificial) cues for motion, such as arrows (Albright 2012, 230–31). As Albright describes the results, "evidence indicates that the learning-dependent responses to arrows in area MT are ... a cued top-down reproduction of the activity pattern that would be elicited in MT by a moving stimulus projected upon the retina" (Albright 2012, 232).

[6] It might be objected that the recall premise is false: pattern completion need not be facilitating recall. For example, one proposal is that the neural circuits which facilitate episodic memory also enable prospection (planing for and imagining the future) and taking others' viewpoints (Addis et al. 2007; Buckner and Carroll 2007); in these cases, pattern completion presumably facilitates what Buckner and Carroll call *simulation*, or the "construction of an imagined alternative perspective" (2007, 49). But this is compatible with my proposal, as it might be that pattern completion facilitates simulation *by providing recalled pieces out of which the simulation is built*. Although they say that what the relevant neural circuits are doing in these cases is simulation, it's simulation

sensory activities involving recall, and so satisfy P5 and provide examples of experience of the past.

The first is Charles Bonnet Syndrome (CBS). CBS is a condition in which those with vision loss due to retinal or optic-nerve damage suffer visual hallucinations in the period immediately after the onset of the loss (see ffytche 2013). Albright (2012, 239) suggests that CBS hallucinations result from the same top-down image generation which completes defective input in cases of misleading-cues. Assuming the recall premise, if Albright is correct then CBS hallucinations are generated by recall.[7]

Dreams are the second case. It is perhaps obvious that dreams often involve memories. For example, in dreams you find yourself in a familiar place, or seeing familiar people. This imagery is often specific: it is what Freud called "day-residue", or "elements that [connect] with experiences of the previous day" (Nielsen and Stenstrom 2005, 1286). As Nielsen and Stenstrom note in their review of dreams and memory (2005, 1286), "When psychophysiological methods were introduced into the study of dreaming, ... Results confirmed the robustness of day-residue memory elements and largely attributed these elements to the fragmentation and transformation of episodic memories." So the idea is that the hallucinatory sensory experiences composing dreams are often made up of rearranged parts of past sensory experiences, via the fragmentation and transformation of episodic memories (see also Windt 2015, 546–49). For example, in one study 65% of dream reports were found to include day-residue, with 1-2% of reports including complete episodic memories (Fosse et al. 2003; cited in Windt 2015, 604).[8] It's plau-

"based on our past experiences" which relies "on autobiographical information" (2007, 49). They suggest (2007, 52) that "Simulations of others' perspectives, and of ourselves in another time, might be built on specific past instances, as captured through medial temporal processing." Responding to the same findings regarding the overlap of episodic memory and prospection, De Brigard similarly suggests that the cognitive system behind episodic memory actually functions to recombine "encoded traces into representations of possible past events that might or might not have occurred, presumably in the service of constructing mental simulations of possible future events" (2014, 158). So the point that pattern completion facilitates prospection and other non-past oriented perspective shifts is not a challenge to the recall premise, as it might allow for these activities by first enabling recall (of past-perceived items that are recombined into the prospected scene).

[7]Whether Albright is correct is a point of dispute. On the basis of his earlier, seminal fMRI work (ffytche et al. 1998), ffytche argues (2013, 53–4) that CBS hallucinations do not originate from the same top-down neural circuits which facilitate mental image generation. There is no room here to discuss the dispute.

[8]For an overview of the empirical evidence supporting this interpretation of dreams as

sible that dreams involving repackaged episodic memories are generated by recall.

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