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**Is Virtual Reality Experience Veridical, Illusory or Hallucinatory?
A Complex Answer Based on a New Theory of Illusion and Hallucination and the
Nature of the Technology Used to Create Virtual Reality**

Fiona Macpherson

Abstract: Does virtual reality involve illusory or hallucinatory experience of things that are not present, or does it involve veridical perceptual experience of virtual objects? Philosophers have defended one or other of these options in recent debate. I answer this question by outlining and extending a new theory of illusion and hallucination, first articulated in Macpherson and Batty (2016), and applying it to virtual reality experience. In so doing, I pay attention to a feature of virtual reality experience unduly neglected in the philosophical literature: how it is actually produced. The result is a new account of the nature of virtual reality experience that shows that it is far more complex than extant accounts envision. Extant accounts assume a false dichotomy: that the experience is either wholly illusory or hallucinatory, on the one hand, or that it is wholly veridical, on the other. I show, instead, that it involves multiple veridical, illusory, and hallucinatory elements related in a multifaceted fashion. Developing this account of the experience had in virtual reality reveals important insights into the nature of indirect perception and reveals new forms of illusion and hallucination heretofore unthought of.

1. Introduction

When one puts a virtual reality headset on over one's eyes, one seems to be immersed in a three-dimensional world (typically) different to the one that one is actually in, occupying an ego-centric perspective from which one can look around and visually experience the world in the way that one would do in the real world. What is the nature of this powerful experience? In this paper, I address this question by taking a new theory of illusion and hallucination, put forward by Macpherson and Batty (2016), and applying it to virtual reality experience. In so doing, I pay particular attention to the way that virtual reality technology works.

It is important to have a good understanding of virtual reality experience in order that we understand what virtual reality can do, and the way in which it does it, especially as virtual reality experience becomes ubiquitous. An important by-product of this understanding is a better comprehension of the nature of perception more generally.

The paper will unfold as follows. In section two, I outline the traditional conception of illusion and hallucination. In section three, I argue that this conception is metaphysically parochial, drawing on the theory of Macpherson and Batty (2016). I recount and further develop that theory, identifying a wide range of mixed veridical, illusory and hallucinatory experiences, that become germane when we turn our attention to virtual reality experience.

In section four, I briefly outline the two extant accounts of virtual reality experience. According to one, virtual reality experience is wholly illusory or hallucinatory. According to

the second account, virtual reality experience is veridical experience of virtual or computational objects. I argue that neither of these accounts captures the complete nature of virtual reality experience. First, neither takes account of the way the experience is created. In explicating the oft neglected technology producing virtual reality, I pay particular attention to the stereoscopic display. It shares similarities with a normal two-dimensional screen that we should take note of. We should also take careful note of the way in which it allows us to have a three-dimensional experience. Both these features help determine the nature of virtual reality experience. Second, neither of the extant accounts adopts my new theory of illusion and hallucination—thus they are limited in their conception of the forms of illusion and hallucination possible. I apply the new account of illusion and hallucination outlined in section one, to virtual reality experience to show that it is highly complex and multifarious, involving many veridical, illusory and hallucinatory elements conjoined in a plethora of ways. This beautiful intricacy is what we should expect given the many technological elements required to create virtual reality experience.

2. The Traditional Theory of Illusion and Hallucination and the Framework For Discussion

After first outlining the traditional account of illusion and hallucination, in this section, I will recount, and further develop, my new theory of illusion and hallucination, first outlined in Macpherson and Batty (2016), in the next, before applying it to virtual reality experience in section four. In so doing, I will discuss numerous types of illusion and hallucination that may, on first encounter, appear *recherché*. I beg the reader's indulgence in discussing such cases for, as will eventually become clear, these cases are not simply discussed to illustrate the wide array of types of illusion and hallucination that my new theory of illusion and hallucination brings to light. These cases are also discussed because they turn out, perhaps surprisingly, to be highly instructive when examining the nature of virtual reality experience.

To begin, when I talk of “worldly” objects, properties, events, relations, and so on, I mean to refer to things external to the minds of the perceivers of those things, such as tables and chairs, roundness and squareness, bangings and clatterings, being to the left of and being the sister of, and so on. Thus, “worldly” things are to be contrasted with mere mental entities, such as sense-data, which some philosophers have, controversially, proposed exist in the mind when we have perceptual experience.¹

Of course, which of the objects, properties, events and relations that we frequently discuss are really “worldly” is often a matter of considerable philosophical dispute. The colours provide a good example. Whether redness and blueness exist outside of the minds of perceivers, exist as properties of worldly objects rather than mental objects or mental experiences, is matter of sustained debate.² However, for the purposes of this paper, I will take it that all these everyday things, including the colours, are worldly things, both for ease of exposition and for ease of finding easily graspable examples. If any of these things are not worldly things, or if you take them not to be worldly things, then no damage is done to my

¹ Sense-data are defined as mind-dependent, mental objects that are always as they appear to be and that explain why things perceptually seem a certain way to us: we are aware of mental entities that are that way whether or not there are non-mental, “worldly” entities—typically physical objects and properties—in front of us that we accurately see. See Huemer (2019) for an overview of sense-data.

² See, for example, Brown and Macpherson (2021)

account of illusion and hallucination. It is merely that the examples used to illustrate the account would have to be modified.

I will also make two simplifying assumptions: first that our experiences represent the world and have correctness conditions³; and second, that our experiences represent that there are objects in front of us, and that they have certain properties. Whether those objects should be thought of as existentially quantified objects (so that the experience represents that there exists an object which has such and such properties) or whether those objects should be thought of as particular objects (such as Nicola Sturgeon or Jacinda Arden), I leave open. My theory can accommodate both.⁴ I also leave open whether in representing objects as having properties we should think that what is represented are that universals are instantiated, or that tropes (the particular properties of individuals) exist. I will be liberal about the sorts of properties that can be represented in experience—such as ego-centric properties, and high-level properties (such as natural kind properties). No doubt, experience can have many other forms of content. It can represent events and relations (perhaps in virtue of representing properties, perhaps not). Some forms may only represent properties—as may be the case in olfactory experience, which I explored in Macpherson and Batty (2016). It may be that some experience represents demonstratively, or in other ways. I believe that these different contents present no challenge to my theory. The theory can be adapted to suit any form of metaphysical category that you care to think our experience represents. However, as previously stated, for ease of exposition, I illustrate it in this paper only for experiences representing objects having properties.

I take as my starting point in thinking about illusions and hallucinations a thought that is common to all philosophical accounts of those phenomena, and which, to my mind, forms the core conception of these notions: that in illusion we see a worldly thing, but we see it defectively, always, or at least typically, in some non-veridical manner; and that in hallucination we do not see a worldly thing, although we undergo a perceptual experience which makes it seem to us as if we are. Typically, hallucination is non-veridical. (I will come back to discuss why I qualify these statements with, “typically”, shortly.)

Illusion and hallucination are contrasted with veridical perceptual experience. In veridical perceptual experience we see a worldly thing (an object, property, event or relation) in a non-defective manner, and so we see it accurately—as indeed it is. It can then be seen that illusory experience of a worldly something shares something in common with veridical perceptual experience of a worldly something—both are perception of that worldly something—it is just that in illusion it is defective perception, typically not veridical, while in veridical perceptual experience, it is not defective perception, and the experience is accurate. Hallucinatory experience of a worldly something differs from veridical perceptual experience and illusory perceptual experiences in being a failure of perception with regard to that worldly thing. Yet hallucinatory and illusory experience share something in common—they are, typically, not veridical.

³ There are some philosophers who hold that in an important sense perceptual experiences do not represent the world, and do not have correctness conditions, but, rather, present it to be a certain way. Those philosophers hold that while such experiences can have counterpart hallucinations that are subjectively indistinguishable from them, there is not a common content to the experiences and their counterpart hallucinations. I believe that I could restate all of this paper within such a framework without loss, and therefore that nothing essential turns on my use of the representational framework.

⁴ However, later in the paper I will explicitly make one specific commitment on these matters.

Both the traditional account of illusion and hallucination, and my own account of these phenomena, accept these core conceptions of them. The need to replace the traditional account by my new theory of illusion and hallucination is revealed by a series of cases that show that the traditional account elides cases of illusion and hallucination, that our intuition tells us should be distinguished. The traditional account also fails to classify at all certain cases, as it simply lacks the resources to deal with them—cases which our intuition clearly tells us are either illusion or hallucination. Moreover, our intuitions about these cases are backed up by the causal theory of perception—the standard account of perception in analytic philosophy today. (The alternative—naïve realism—is not a reductive theory and so does not offer tools to determine whether a case is one of veridical perception, illusion or hallucination. Those who hold that theory simply have intuition to work with.)

In light of these shortcomings, I will come to the conclusion that the traditional theory of illusion and hallucination is metaphysically parochial. It rules out there being cases of illusion and hallucination with respect to entities in certain metaphysical categories in an unmotivated, blinkered way. In contrast, my new theory of illusion and hallucination accounts for our intuitions on all cases. In addition, it falls in line with the pronouncements about the nature of cases that the causal theory of perception makes. Importantly, it also shows us a wealth of new cases of illusion and hallucination heretofore unthought of, or when some have been thought of, their nature has not been explored in light of the traditional theory of these phenomena. Moreover, my new theory provides us with a way of systematically laying out all the forms of illusion and hallucination that there are.

To see all this, consider the traditional accounts of illusion and hallucination:

Traditional Illusion: you perceive a worldly object but you misperceive it in the sense that you incorrectly attribute to it a worldly property that it lacks.

For example, suppose that you are standing on the top of a cliff looking out to sea. Further, suppose that you see a boat, and you see its size and position accurately, but you do not experience its colour accurately. You experience it as being dark red, when in fact it is light red. According to the traditional account, this is an illusion. You see the boat, but you misperceive one or more of its properties—in this case its colour. As A.D. Smith (2002: 23) elaborates the traditional account, illusion is “any perceptual situation in which a physical object is actually perceived, but in which that object perceptually appears other than it really is”.

Traditional Hallucination: you have an experience as of an object and its properties but there is no worldly object and there are no worldly properties that you perceive in virtue of having that experience.

For example, suppose that you have an experience as of being inside a grand castle, with dripping chandeliers and glorious tapestries. But suppose that in virtue of having this experience you see nothing. You are merely hallucinating. This kind of “total” hallucination in which one’s whole visual experience is a hallucination, is the sort mostly conceived of by philosophers—one in which one hallucinates the entire scene before one’s eyes. However, most actual cases of hallucination occur when one is seeing one’s environment, but one hallucinates an object to be in that environment which is not there. (See Macpherson (2013).) For example, suppose that you are standing on the top of a cliff looking out to sea. You have an experience of the sea and the sky, which amount to accurately seeing the sea and the sky.

Further, suppose that you also have a visual experience as of a dark red boat, but in virtue of having that experience as of a dark red boat, you are not seeing a dark red boat or any other worldly object (although of course in virtue of, at the same time, having the experience of the sea and the sky you are seeing those things). In virtue of having that experience as of the dark red boat you see nothing—you merely have a visual experience as of a boat.

It is worth noting that there can be cases of veridical hallucination. It is possible to hallucinate a dark red boat when there just happens to be a dark red boat present that matches the boat that you merely seem to see. Or it is possible to hallucinate that Kamala Harris is standing in front of one, when she just happens to be so standing. (See Lewis 1980.) This is why, when outlining the core conception of hallucination, I said that it is typically, rather than always, non-veridical. In contrast, according to the traditional conception of illusion, there could not be veridical illusion. This is because on the traditional notion of illusion it is definitional that there is a lack of veridicality with respect to one or more properties. However, as I will explain below, my conception of illusion does allow for there to be *non-typical* cases of veridical illusion, which, I hold, introduces a pleasing symmetry with the case of hallucination.

Before going on to outline cases of illusion and hallucination that, I will argue, the traditional account of illusion and hallucination cannot accommodate, I now outline the standard causal theory of perception. The reason for doing so is because, as I will demonstrate, the causal theory can be used to back up our intuitions about what cases are cases of veridical perception, cases of illusion, and cases of hallucination. The causal theory is a reductive theory of perception. As such, it analyses cases of perception in terms other than perception. This allows us to use those other terms to determine whether a case is a case of perception or not—and hence to justify and back up our intuitions. Please note that I am not here arguing that the causal theory of perception is correct, simply, that it backs up intuitions of mine about certain cases, that I hope that you will share. Thus, if you are inclined to accept the causal theory you have further reason to accept my verdict on certain cases.

According to a standard version of the causal theory of perception, a necessary and sufficient condition for perception is that one has an experience that ‘closely matches’ the scene in front of one, and that the experience is caused in the right way by that scene.⁵ In the representationalist framework, a matching experience is one that’s content is correct. This formulation of the causal theory does not recognise the possibility of unconscious perception, thus might want to alter it to account for such cases. However, as I will consider only conscious perception I will work with the claim as it stands.

Why, according to the causal theory of perception, does the experience have to be caused in the right way by the scene in front of one? The idea is that simply having a matching experience is not enough for perception, due to cases of veridical hallucination that I discussed above. You might hallucinate a scene, and just by chance the scene before you might match your experience, even though you are not seeing it. It seems that we need a causal relation between the scene and the experience to rule out such cases. Moreover, it seems that we need a causal connection of the right sort to rule out cases of “deviant” causal chains. For example, suppose that a neuroscientist had attached a device to my brain that when switched on reliably gave me an experience of a dog in front of me. Suppose that the scientist left the on switch on the floor and a dog, that just so happened to match the dog that I hallucinate when

⁵ See, for example, Grice (1961), Lewis (1980) and Lowe (2000:139)

the machine is switched on, stands on the switch turning on the machine and giving me an experience as of a dog matching the one in front of me. We would not think that this case amounted to perception of the dog because it the causal chain isn't of the right sort. The way that my experience is caused doesn't render me sensitive to the presence and absence of dogs, or that particular dog. It simply causes me to have a dog experience whenever anything turns on the machine irrespective of the presence of a dog or that particular dog.

So, what is it for experience to be caused in the right way? There are lots of different theories of this put forward by philosophers, and it is unclear what exactly is the best one that really captures all and only the cases of causation that we would deem appropriate. However, most agree that the causal connection must be of a kind so as to allow you to track the objects and properties you are experiencing across a fairly wide variety of situations and in order to avoid luck making your experience a close match.⁶ Thus whether a case counts as a case of perception depends on whether your causal link to the world supports a sensitivity to what you are experiencing not just in the actual situation that you are in but in other situations also. I don't here proffer a detailed account of what it is for experiences to be caused in the right way. I defer to the best attempts that others have made in this direction.

The main alternative to a causal theory of perception is a disjunctive, naïve realist account of perception. According to this theory one perceives something when one stands in a *sui generis*, primitive, perceptual relation to it. As this theory is not a reductive theory of perception that spells out what it is to stand in the perceptual relation to something in other terms, this theory gives us no further materials with which to work to determine whether a case is one of veridical perception, illusion or hallucination. Of course, a naïve realist could agree to the differences in the kinds of cases that I will discuss. It is just that their justification will appeal only to intuition.

3. The New Theory of Illusion and Hallucination

Why think that the traditional account of illusion and hallucination is not correct? To begin to see the weaknesses of the traditional account of illusion and perception, I first want to draw a distinction between two sorts of cases in both of which we see the object in question. These are cases that I call cases of property illusion and property hallucination, respectively. The distinction between these cases is not a distinction that the traditional account of illusion and hallucination does not allow. It would treat both cases as being cases of illusion.

The first case—the property illusion case—is one in which you see an object and in which you are sensitive to a particular property of the object so that you count as seeing that property, but imperfectly so, so that, typically, the experience of the property is not veridical (and if it is veridical, it is so by sheer luck). For example, suppose that because you are wearing dark glasses, you experience objects and all of their visible properties accurately

⁶ See, for example, Lewis (1980). He claims that one's experience bears appropriate causal relations to the scene experienced if that experience bears a suitable pattern of non-backtracking counterfactual relations to that scene. He explains that what it is for there to be a suitable pattern is that "[t]here is a large class of alternative possible scenes before the subject's eyes, and there are many mutually exclusive and jointly exhaustive subclasses thereof, such that (1) any scene in the large class would cause visual experience closely matching that scene, and (2) any two scenes in different subclasses would cause different visual experience" (1980: 246).

except for their colour which you experience as systematically skewed.⁷ You experience objects to be slightly darker than they really are. Suppose you look at a red ship and experience it to be a darker shade of red than it really is. Intuitively, this is a case of perception—but a case of misperception, and hence illusion. The dark glasses do not stop you seeing the colour of the ship or being sensitive to the colours of things more generally, they simply systematically skew your experience of the colours.

Moreover, the necessary and sufficient conditions of the causal theory of perception discussed above are fulfilled in these perceptual conditions in which you are wearing dark glasses: you are having a closely matching experience of a slightly darker red ship than is in front of you and the causal connection between the colour and your experience will allow you to track that and other colours in a wide variety of situations avoiding luck making your experience a close match. Thus, the causal theory of perception would yield the verdict that you are perceiving the colour, albeit misperceiving it—having an illusory experience of the colour.

The second is a case that I call property hallucination in which you experience an object having a property, but your experience of that property is not sensitive to a property of the object that, so that in having that experience you don't count as seeing that property at all. Typically, in such a situation, you would experience the object to have a property that it does not have (and if you did experience the object to have a property that it did, this would be by sheer luck). For example, let's suppose that an evil scientist has wired up a machine to the V4 area of your visual cortex, stimulation of which determines your colour experience. And let's suppose that the scientist constantly stimulates this area at random causing you to have colour experiences that are not responsive to the colours of the objects that are before you in the world. Let us suppose that in this situation you look at a ship and you see it as orange, when it is in fact yellow. In this case, your experience is not tracking and sensitive to the colours of things in the world, although you are tracking all objects and their other properties that are standardly visible. So, in accordance with the causal theory of perception, this is a case of object perception combined with property hallucination.

So, the interim conclusion here is that there is an intuitive distinction between property illusion and property hallucination (both occurring in cases where there is perception of an object). And we can back up this intuition using material from a standard causal theory of perception. This is a distinction that the traditional account of illusion and hallucination elides as it would count all such cases of seeing an object but in accurately experiencing one of its properties as cases of illusion.

As I mentioned previously, unlike the traditional conception of illusion as a case in which you see an illusion and represent one of its properties incorrectly, the conception of illusion that I have just outlined allows that there could be cases of veridical illusion. To see this, note that some illusions occur because of a juxtaposition of elements in the world. For example, some colours look lighter than they really are when placed next to other darker colours. A summary of such effects can be found in Adelson (2000). Suppose that you were undergoing a lightness illusion because you were looking at a surface that looked lighter than it really was because it was next to a darker surface. Now suppose that you put on dark glasses. It could be the case that because everything now looks a little darker with the glasses on, that

⁷ I set aside the complication that, as a matter of fact, when one wears dark glasses for a period of time, one's eyes adjust to some degree and things don't look quite as dark as when you first put on dark glasses.

when you looked at the surface that looked lighter than it really was when you were not wearing the glasses, it would now look just as light as it actually is. However, in the perceptual conditions that you are in—wearing dark glasses—it is by chance that you see this surface as having the lightness that it does. It is by chance that the stimulus you are seeing causes a lightness illusion that is perfectly off-set by the dark glasses. You are not in perceptual conditions that make you systematically accurately sensitive to the lightness of objects. You are in conditions that make you typically systematically inaccurate about the lightness of objects, thus this is a case of illusion—albeit a rare instance of veridical illusion.

At this point in the dialectic, a worry might have occurred to the reader. What is the criterion at play for saying that there is an experience closely matching one's environment? While I defined an exactly matching experience as one whose content is correct, I did not specify what it was for there to be a closely matching experience. Moreover, when I was discussing the case of property illusion I took as my example misperceiving the colour of something by experiencing it as a little bit darker than it really was. This intuitively satisfies the criterion of being a closely matching experience. But how different might an experienced property be from the actual property and still count as a case of perception?

A first point to make is that the answer is not provided by the standard version of the causal theory of perception. And many supporters of the causal theory comment little on this question. For example, Lowe (2000: 140) states only that, “we should not be too liberal in our interpretation of what is ‘suitable’ [or close] in this context. Clearly, John cannot be said to be seeing the green apple in front of him if his visual experience is one of seeing a red double-decker bus”.

I suspect that some defenders of the causal theory suppose that the problem is not too difficult for them. This is because, I suspect that that we they think of illusion on the traditional model, where an illusion consists of perception of an object and misattribution of a property to the object, they think that they can use the fact of the perception of the object, as a way of guaranteeing close matching. For what would it be to see the object, if not to accurately detect some of its properties? Arstila and Pihlainen (2009) explicitly endorse this thought. So the idea is that so long as we accurately see some of the properties of the object then that guarantees enough close matching of the experience for the experience to count as one of illusion and not hallucination. Some theorists might insist on accurate perception of a certain class of properties. For example, Nöe (2003) holds that perspectival, movement and location properties are most important. Others, such as Arstila and Pihlainen (2009) require only that some properties or other match. They say, “in accordance with the definition of an illusion, if some part of the experience matches the world, but not all, then it is a case of an illusion. We might have an experience of, say, a red ball, but this experience matches only the existence of a ball—its colour is not red.”

However, this proposed solution is not a good one. First, it seems perfectly possible for us to see an object and have an illusion with respect to all of its properties. Suppose that you are looking at a red cube, and you are wearing glasses that distort how it looks to you. They distort its colour, by making it look somewhat darker than it is. They distort its location, by making it look, say, further away and more to the left than it really is, and they distort its shape by elongating it, or in some other more complex way. I would not be tempted to think that I wasn't seeing the red cube in this situation, despite there being no property of the cube that was accurately seen.

I think that we need to look for an answer about the close matching of the experience that focuses in on whether the thing that we are saying is illusory is a close match. For example, in the case of wearing dark glasses in which I am claiming is a case of a property illusion with respect to the colour of what is seen, we need to focus in on what it is for the colour experienced to be a close match to the actual colour of the object.

One answer that might be put forward by someone, but a bad answer, is that what matters is that the illusory experience of colour has to be phenomenally quite similar to what the veridical experience of the colour would be. That is a bad answer for two reasons. First, it does not answer the question about what degree of phenomenal similarity is required for illusion. For example, if I see a red object as a little bit darker in shade than it really is, that will seem to count as quite similar. But what about darker, and darker still? What if I experience it as so dark that it looks black? What if I see the shade as a wee bit more orangey than the shade in question is? What about a lot more orangey? What if I experience it as orange, or yellow, or green?

The second reason is that surely we want to allow for illusions with respect to a certain property in which the illusion is phenomenally really rather dissimilar to the comparator veridical experience. For example, a case often described as an illusion in the philosophical literature is the case of someone inverting colour glasses.⁸ According to the description of the case, these glasses make each colours look like the most dissimilar to it—the colour opposite to it on the colour wheel. So red looks green to the wearer, and vice versa, and blue looks yellow to the wearer, and vice versa. When wearing the glasses, one could not be having a more phenomenally different colour experience compared to the veridical one, yet philosophers typically think of this case as a case of colour illusion—and rightly so in my opinion.

So, what account can we give of what it is for there to be a closely matching experience, with respect to the property that we are having an illusion of that avoids the pitfalls of other actual and possible accounts just described? I hold I hold that what is required for there to be a closely matching experience is:

- (i) a suitable causal relation between the experience and the property and,
- (ii) that one would be able to form some correct judgments about the property on the basis of taking the content of one of the experiences at face-value from among the set of illusory experiences that one could have in the specified set-up that produces the illusion.

The idea behind the second condition (ii) is that the illusory experience, let's call it I_1 , must somehow contain information about the property that one is misperceiving. The thought is that this information might not be manifestable by the subject just in respect of having I_1 . However, there will be some illusory experience of that property, I_2 an illusory experience created in just the same way as I_1 (for example if I_1 is created by wearing a certain type of dark glasses, then I_2 is too), which will allow the subject to manifest the fact that they are receiving information about the property in question, by being able to make a true judgement about it by taking the content of the experience as the content of their judgement (and thus treating the connect as true or correct).

⁸ See Byrne (2020).

To give examples of this, consider the case in which you wear a pair of dark glasses and see a boat as darker red than it really is. There are all sorts of accurate judgements one can make about the colour property of the boat in this situation. For example:

- that the boat is red
- that the boat is darker in colour than the ferry from Gourock to Dunoon
- that the boat is more similar in colour to the Gourock to Dunoon ferry than it is to the Gourock to Kilcreggan ferry.

This allows cases in which there are large systematic changes to one's perception to count as cases of illusion—such as those involved in wearing inverting colour lenses. For example, Suppose that you are wearing the lenses and something red look green to you. If you took your experience at face value you would judge that there was something green present. This judgement would be false. Arguably, you would not be able to make any correct judgement on the basis of this experience. However, if we select an experience in the set of experiences that you might have when wearing colour inverting lenses, say an experience in which you were looking at a first object that was red next to a second object that was orange and next to a third object that was green. This would be an experience that represented the first object being green next to the second object being turquoise, next to the third object being red. Taking the content of this experience at face value you would be able to judge that the colour property of the first object was more similar in colour to the colour of the second object, than it was to the colour of the third object. This purely comparative judgement would turn out to be accurate with respect to the red property of the first object. Thus, demonstrating that some information about that property was being taken in by you in virtue of having an experience of that object as being green in the specified set up.

The first condition, (i), is to ensure that it is not luck that enables these true judgments to be able to be formed.

At this point an objection to this account might arise to the canny reader. One might think that the account just given entails that that too many cases of systematic mismatch are cases of illusion—even cases that, intuitively, are not. For example, imagine the following scenario: when you are faced with different colours, you have systematically mismatching experiences as of different smells. Consider a spectrum of colours running from red at one end, through shades of orange in the middle, and on into the yellows at the other end. Suppose that when one has an experience of red, one has an experience of a highly fruity smell, when one has an experience or orange, one has an experience of a medium intensity fruit smell, and that when one has an experience of yellow, one has an experience of a faint fruity smell. One might think, intuitively, these olfactory experiences should not be thought of as closely matching veridical experiences of colours. After all, I chose this case in order to select perceptual experiences as phenomenally dissimilar from each other as possible—so one might think that this case should not count as a case of illusion. But my definition would rule that cases such as this *are* cases of illusion—for the systematic mismatch between shades of colour and intensity of fruity smell would enable one to make *some* accurate judgments about the properties in the environment—judgments of the form, A (the red thing I experience as highly fruity) is more similar to B (the orange thing I experience as mediumly fruity) than to C (the yellow thing I experience as faintly fruity). As a result, the worry is that my definition counts too many cases as being ones of illusion.

My response to this worry, starts by noting that an experience's being a close match to another admits of degree. On my account, this is clear because in different cases, there will be more or fewer accurate judgments that subjects will be able to make about a property. For example, in the colour/smell case, subjects will be limited to merely comparative judgments. In the case of wearing dark glasses, as we have seen, subjects will be able to make comparative judgments and more. Thus, we can think of a spectrum of cases ranging from ones in which one will not be able to make any true judgments about a property in question on the basis of taking the content of one of the experiences at face-value from among the set of illusory experiences that one could have in the specified set-up that produces the illusion, to ones in which one can make only comparative judgments, to ones in which one can make further sorts of judgement (and not through luck).

I believe that where along this spectrum people are inclined to draw the line between misperception and hallucination varies. I am suggesting that the place to draw it is that so long as one can form some true judgments in the specified condition not through luck we are having an illusion of the property, because we are picking up some information about the nature of that property. However, I could understand if some people thought this too minimal, and might want to insist, for example that further true judgments have to be able to be made. For example, someone might insist that one must be able to make at least some true categorical judgments about the property, or that one must be able to make judgments about the type of property one is having an illusion of, for example, that it is a colour property.

I therefore also predict that people's intuitions will vary on the colour/smell case. Some people will take the olfactory experience to be an illusory experience of colour. Some will take the experience to be purely a hallucinatory experience. I hold that such a case is on the cusp between illusion and hallucination because the true judgements that can be made about the environment based on taking experience at face value are very limited—limited to only relative judgements. I think it a strength of my theory that it predicts and explains why this case has these features. And I can understand if people do not want to draw the line between illusion and hallucination in exactly the place that I do. However, if they were accepting of my general framework for deciding whether cases are cases of illusion or hallucination by looking at the number and type of true judgments that can be made on the basis of taking the content of one of the experiences at face-value from among the set of illusory experiences that one could have in the specified set-up that produces the illusion—and that this be a non-lucky outcome—I would be satisfied enough. And will proceed to discuss the further issues in this paper on the assumption that this is so.

Let us take stock then. I have argued that we can distinguish between cases of property illusion and property hallucination both had whilst perceiving an object. This is a distinction that the traditional account of illusion and hallucination elides, as it would, by definition, count both such cases as cases of illusion. We can capture the situation discussed this far in table 1.

| Experience as of an object, O, having a property, P | | | |
|--|---|--|-------------------------------|
| | Perception of O | | Hallucinatory experience of O |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | | ? |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | | ? |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | | ✓ Trad Hallucination |

TABLE 1

In addition to the three cases of veridical perceptual experience, traditional illusion, and traditional hallucination, I have been arguing that we need to also recognize the case of property hallucination—a case which the traditional illusion view would simply treat as a case of property illusion.

Laying out these cases in tabular form, help us start to think of other potential forms of illusion and a hallucination that there could be. For example, could there be cases corresponding to the cells with question marks in them? I think that there could be—as I will explain in due course. Another question arises from consideration of the fact that according to the table there can be cases of perception of an object and cases of hallucination of an object. Can we break down cases of perception of an object into cases of veridical perception of an object (qua object), and illusory perception of an object (qua object)? By this I do not mean veridical perception of an object because one experiences its properties accurately, or illusory perception of an object because one sees some of its properties inaccurately. Rather, I mean that vis a vis the perception of the object, qua object, is there a distinction between veridical object perception and illusory object perception? Again, I think that the answer is yes, as I will now explain.

My account of veridical and illusory property perception turned on the idea that in both cases there is a suitable causal relation between the experience and the environment. The difference is that veridical perception allows one to be able to form wholly accurate judgments, taking experience at face-value. In illusion some judgments will be false. We can apply this general idea to object perception.

People can be better or worse object detectors. If they were perfect object detectors, then they would detect objects when and only when there are some present. Of course, people are not perfect object detectors—they make some mistakes. But consider someone who has *systematically skewed* object perception, for example, suppose that they systematically experienced two objects as being present for every object that is present. They have a form of double vision.

Most of us have double vision when we pull a small object, like a finger, close to our eyes and look at it. We are not typically tempted to think that there are two fingers present because our experience represents each finger to be a bit transparent, and we know of the effect. But imagine an idealized version of double vision in which our experience represents all objects twice and not in a misleading transparent manner. In double vision, one might think that one of the experiences of a finger amounts to perception of the finger and the other does not. And in some cases, there might be some grounds for holding this. For example, if only one of the experiences of a finger represented the finger to be in the location that it actually occupied, and represented it more accurately than the other experience of a finger, then that would be some reason to claim that it was an instance of perception of the finger while the other experience of a finger was not. However, in some cases, there will be no way to choose which experience of a finger is the better candidate for being a perception of the finger. For example, the experience of the location of each finger might be equidistant from that of the actual location of the finger. One experience of a finger might represent the finger to be two inches to the left of the actual location of the finger and the other experience of a finger might represent it to be two inches to the right. And each experience of a finger might, otherwise, accurately represent the finger. In that case, there is no way to choose which experience amounts to perception of the finger and which does not. Therefore, it is more plausible to say that the experience of each finger amounts to perception of the finger: you are seeing the finger twice. This is the conclusion of Lowe (2008) about the nature of double vision, which I endorse.

If we are perceiving the finger twice, then the causal theory of perception, combined with my account of illusion, articulated above, yields the result that, qua object perception, this is a case of illusory, not veridical, perception. In double vision there is a causal relation between the environment and the experience—that leads to systematic skewing. One experiences two objects being present for every one object that is actually present. Taking one's experience at face-value, one will form many incorrect judgments about the number of objects present. For example, one will judge that there are twice as many objects present than are really present, such as, that there are six objects present when there are really only three. So, one's experience are not wholly accurate qua the objects one perceives. But one will be able to form some correct judgments about the objects in the environment in this kind of situation, where one has double vision, if one takes the content of one's experience at face-value. For example, one will be able to correctly judge that there are some objects present, that there are twice as many in one location (on the left, say) than in another, (on the right, say), and so on. Thus, I hold that there can be illusory object perception, qua object perception—double vision being just one example. (We will come to see another form when we examine virtual reality experience.)

Moreover, when undergoing illusory object perception, qua object perception, such as double vision, there will be a variety of different cases with regard to the properties one experiences an object to have. First, there will be some cases in which one accurately sees a property of the object. For example, one might accurately see the colour of a finger experienced in

double vision. Second, there will also be some cases in which one has an illusion of a property of an object where the object is itself experienced illusorily (qua object perception). For example, typically, one will misperceive the colour of a finger experienced in double vision if one was wearing dark glasses. Thirdly, there will also be some cases in which one has a hallucination of a property of an object where the object is itself seen in an illusory fashion (qua object perception). For example, one might hallucinate the colour of a finger experienced in double vision if an evil scientist was tampering with the V4 region of your visual cortex.

These three different kinds of experience (veridical, illusorily, and hallucinatorily) of the properties on an object itself experienced illusorily (qua object perception) are represented by the ticks in the cells of the central column that I have now added to table 1, yielding table 2.

| Experience as of an object, O, having a property, P | | | |
|--|---|----------------------------------|---------------------------------------|
| | Perception of O | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ? |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ? |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |

TABLE 2

Before I am able to explain whether there are cases corresponding to the cells with question marks in them, I must first introduce another type of illusion. Pay attention to the nature of the property perception in the wholly veridical case. This is a case in which one has veridical perception of one of an object O's properties, P, and it is experienced as belonging to O. Reflection on the structure of that case raises the question of whether it would be possible to have a veridical perception of another object's, O*'s, property P, and experience it as belonging to O. I think that the answer is yes.

To see this, consider the following case, BOAT₁: suppose that every time you see an object in the centre of the left-hand side of your visual field you perceive it accurately in all regards,

except that you do not perceive its colour. The colour that you experience the object as having is the colour that you experience the object at the centre of the right-hand side of your visual field to have. Suppose further that you see the colour of the object at the centre of the right-hand side of your visual field accurately. In this case, you attribute the veridically perceived colour of the object at the centre of the right-hand side of your visual field to the object at the centre of the left-hand side of your visual field. So, for example, if there was a blue boat at the center of the left-hand side of your visual field, and a red tomato at the centre of the right-hand side of your visual field, you would accurately see the red colour of the tomato and attribute it to the boat, thus you would have an experience as of a red boat.

Thinking of this case in terms of the causal theory of perception, you are suitably causally sensitive to the left-hand side object and its visible properties, bar its colour, so you see the objects and its non-colour properties accurately. You are suitably causally sensitive to the colour of the right-hand object, so you see its colour, but you incorrectly attribute the experienced colour of the right-hand object to the left-hand side object—creating a new kind of illusory experience compared to any we have encountered thus far in this paper. I will call this kind of illusion, illusory binding, and as I go on to discuss other related cases to BOAT₁, a full account of what I take the nature of illusory binding to be will emerge. BOAT₁, therefore, yields a case of veridical perception of an object's, O*'s, property P, experienced as belonging to O, which is otherwise veridically perceived.

This kind of case may seem far-fetched. I have not given a reason to think that this sort of situation might arise. However, there are similar real cases that are reported in the psychological literature under the label, “failures of binding”. In such cases, subjects are presented with a stimulus such as a red square next to a green circle. In normal conditions subjects would report experiencing a red square next to a green circle when looking at the stimulus. However, when the stimulus is presented very briefly, subjects often report experiencing a green square next to a red circle. This report is usually taken to be an accurate reflection of the experience that the subject has—as I will take it to be. In this case, the redness of the square is perceived, but it is falsely attributed to the circle, and the greenness of the circle is perceived, but falsely attributed to the square. Such cases are discussed in the extensive work of Treisman and colleagues, such as Treisman, & Schmidt (1982). (Note that the case that I have described as involving illusory binding differs from this one as my case is one in which one experiences an object, O*, to have a certain property, and then on account of that, one experiences another object, O, to have that property also, whereas, in the case of failure of binding just discussed, while redness is attributed in perceptual experience to the circle when it really belongs to the square, it is not first experienced as belonging to the square. It is simply experienced as belonging to the circle, while the square is experienced as being green. However, this difference is of little consequence.) We will see other real-life cases involving illusory binding when I come to examine virtual reality experience below.

Note that the traditional account of illusion would classify the subject's non-veridical experience of the green square and the red circle as illusory, as the subject is seeing the square and the circle, but experiencing their properties inaccurately. However, that account does not bring to the fore the important detail of the case that there is illusory binding of the colours to the shapes taking place. It is not a case in which there is simply an incorrect experience of the colour of the objects. I take it to be a strength of my new theory of illusion and hallucination that it can easily lay bare the structure of these different sorts of illusion.

Now that we have the case of veridical perception of another object's, O*'s, property P, experienced as belonging to O fixed in our minds, we can think of a variety of variants on this case that also involve illusory binding.

Two variants can be identified by substituting *veridical* perception of another object's, O*'s, property P, experienced as belonging to O, for *illusory* experience of an object's, O*'s, property, experienced as P and belonging to O in one case, and *hallucinatory* experience of an object, O*, as having property P, experienced as belonging to O. An example of the case of illusory experience can be imagined by supposing a variant on BOAT₁, namely, BOAT₂: suppose that every time you see an object in the centre of the left-hand side of your visual field you perceive it accurately in all regards, except that you do not perceive its colour. The colour that you experience the object as having is the colour that you experience the object at the centre of the right-hand side of your visual field to have. Suppose further that you have an illusory experience of the colour of the object at the centre of the right-hand side of your visual field. For example, suppose that you are wearing dark glasses so that you experience the colour as being several shades darker than it is. In this case you attribute the illusory experienced colour of the object at the centre of the right-hand side of your visual field to the object at the centre of the left-hand side of your visual field. So, for example, if there was a blue boat at the center of the left-hand side of your visual field, and a mid-red tomato at the centre of the right-hand side of your visual field, you would misperceive the mid-red colour of the tomato as dark red due to the dark glasses, and attribute dark red to the boat, thus you would have an experience as of a dark red boat.

An example of the case of hallucinatory experience can be imagined by supposing a variant on BOAT₁ namely, BOAT₃: suppose that every time you see an object in the centre of the left-hand side of your visual field you perceive it accurately in all regards, except that you do not perceive its colour. The colour that you experience the object as having is the colour that you experience the object at the centre of the right-hand side of your visual field to have. Suppose further that you hallucinate the colour of the object at the centre of the right-hand side of your visual field, because an evil scientist is tampering with area of V4 of your visual cortex causing you to hallucinate the colour of that object. In this case, you attribute the hallucinatorily experienced colour of the object at the centre of the right-hand side of your visual field to the object at the centre of the left-hand side of your visual field. So, for example, if there was a blue boat at the center of the left-hand side of your visual field, and a red tomato at the centre of the right-hand side of your visual field, but you hallucinated the colour of the tomato to be green, you would attribute green to the boat, thus you would have an experience as of a green boat.

Thus, I have described the following three cases:

- (1) veridical perception of another object's, O*'s, property P, experienced as belonging to O
- (2) illusory experience of another object's, O*'s, property, experienced as P and belonging to O
- (3) hallucinatory experience of another object's O*'s, apparent property P, experienced as belonging to O.

Moreover, although I described the illusory experience of another object's, O^* 's, property, experienced as P , and the hallucinatory experience of another object, O , as having property P , in a way that made it the case that the illusory and hallucinatory experiences were non-veridical, one can imagine a tweak to these cases so that the illusory experience and the hallucinatory experience in question were veridical, by luck. In the case of hallucination this is easy to see: you hallucinate O^* to have a colour property, and it just turns out by chance that that is the colour O^* has. In the case of illusion, we can draw on the examples of veridical illusion that I outlined in the previous section: you have an experience of O^* while wearing dark glasses, ensuring that the case is one of illusion, yet by chance, you happen to be looking at O^* when it is surrounded by dark colours, so that without the glasses you would see its colour as lighter than it really is, and by chance, the amount lighter is exactly that amount lighter that the dark glasses adjust for, giving you an experience of the colour that O^* actually has—yielding a veridical illusion. This we get the following three cases:

- (1*) veridical perception of another object's, O^* 's, property P , experienced as belonging to O
- (2*) illusory (veridical or non-veridical) experience of another object's, O^* 's, property, experienced as P and belonging to O
- (3*) hallucinatory (veridical or non-veridical) experience of another object's O^* 's, apparent property P , experienced as belonging to O

To complicate matters further, I believe that we could precisify each of (1*) – (3*) by giving more detailed accounts of how the property P is “experienced as belonging to O ”. I believe that you could give accounts that let us see how property P could be experienced as belonging to O in a veridical perceptual, illusorily, and hallucinatory manner, and in the illusory and hallucinatory cases, we could find both cases of veridical and non-veridical illusory and hallucinatory experiences.⁹ However, I spare the reader from running through all the examples that I have in mind that would illustrate this, and leave it to the reader to imagine each of those cases.

We can provide a short-hand to summarize cases (1*) – (3*): Veridical perceptual/illusory/hallucinatory experience of another object's, O^* 's, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical).

If we add cases (1*) – (3*) to the bottom row of our table, we get table 3.

⁹ If this is right, I would have identified more variants of illusory binding cases than were identified in Macpherson and Batty (2016).

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ? |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ? |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | | |

TABLE 3

And the plethora of cases I have been describing allow us to put a tick in the bottom left-hand cell of the table. We can imagine yet further variants of these cases by supposing that the object O in question is perceived illusorily (qua object), for example, it could be that O is experienced in double vision in every case. This allows us find cases corresponding to those specified in the central cell in the bottom row of the table.

We can also see that there could be cases corresponding to those specified in the right-most cell in the bottom row of the table. I will illustrate this just for the case in which you hallucinate an object, qua object, yet you veridically perceptually experience another object's O*'s, property P as belonging to O in a case, PIG: suppose that at certain times you randomly visually hallucinate an object at the centre of your visual field. At other times, you experience nothing. When you so hallucinate, none of the properties that you experience the object as having are dependent on the objects in front of you in your environment, except one: the colour of the object that you hallucinate is determined by the colour of whatever surface actually is in front you at the centre of your visual field.

To flesh a case out in more detail, let us suppose that an evil scientist has connected your brain up to a hallucination experiencing machine. From time to time, at random intervals, she switches on the machine and causes you to visually hallucinate an object. Which object you

hallucinate is also completely random. At other times you visually experience nothing. Now suppose that on one occasion when the hallucination machine is switched on, you hallucinate a pig. And suppose that on that occasion, there is a green frog in front of you. You detect the greenness in front of you and you attribute it to hallucinated pig, giving you an experience of a green pig.

In this case, your hallucination of the pig is not sensitive to whether there is an object in front of you, for you have experiences as of objects at random. But your experience matches perfectly, and is sensitive to, the colour (green) of the object (the frog) at the centre of your visual field—but only when you hallucinate. Thus, you hallucinate an object, but you veridically perceive the colour property in front of you (and incorrectly attribute it to the hallucinated object).

These illustrations allow us to put ticks in the two right-most cells of the bottom row as illustrated in table 4

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ? |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ? |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | ✓ | ✓ |

TABLE 4

With the understanding of all of these cases under our belt, I am now in a position to be able to provide easily understandable examples that show that there could be cases of the sort specified in the right-most cells in the top and middle rows: cases of hallucinatory experience

of and object O, qua object, and either veridical perception of one of O's properties, P, experienced as belonging to O, or illusory perception of one of O's properties, experienced as P and as belonging to O. I think that finding cases of these kinds is dependent on assuming that experience can have content about a particular individual, such as Angela Merkel or Sanna Marin—an assumption that I find not implausible and which I will make from here on out in this paper. Consider the follow, case, DAVID: suppose that at certain times you randomly visually hallucinate an object at the centre of your visual field. At other times, you experience nothing. When you so hallucinate, none of the properties that you experience the object as having are dependent on the objects in front of you in your environment, except one: the colour of the object that you hallucinate is determined by the colour of whatever surface actually is in front you at the centre of your visual field. So far, the case has exactly the same description as PIG. But now, let us flesh out the case in a different way.

Let us suppose that an evil scientist has connected your brain up to a hallucination experiencing machine. From time to time, at random intervals, she switches on the machine and causes you to visually hallucinate an object. Which object you hallucinate is also completely random. At other times you visually experience nothing. Now suppose that on one occasion when the hallucination machine is switched on, you hallucinate the particular individual statue, Michelangelo's David. And suppose that on that occasion, Michelangelo's David just so happens, by luck to be in front of you. Michelangelo's David is made of white marble, and you detect the whiteness in front of you, and you attribute it to hallucinated Michelangelo's David, giving you an experience of a white Michelangelo's David.

In this case, your hallucination of Michelangelo's David is not sensitive to whether there is an object in front of you, for you have experiences as of objects at random. But your experience matches perfectly, and is sensitive to, the colour (white) of the object (Michelangelo's David) at the centre of your visual field—but only when you hallucinate. Thus, you hallucinate an object, but you veridically perceive the colour property in front of you (and incorrectly attribute it to the hallucinated object). Thus, you have a hallucinatory experience of and object O, qua object, and veridical perception of one of O's properties, P, experienced as belonging to O.

To get an example in which you have a hallucinatory experience of and object O, qua object, and have illusory perception of one of O's properties, experienced as P and as belonging to O, just imagine the case DAVID altered so that you are wearing dark glasses, and have an illusory experience of the marble as being a darker shade of white than it actually is, and then you attribute that darker shade of white to the hallucinated Michelangelo's David.

We can thus place ticks in all of the cells of our table, yielding table 5.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | ✓ | ✓ |

TABLE 5

4. Virtual Reality Experience

In this section, I now apply my new theory of illusion and hallucination to virtual reality experience. The numerous new cases of illusion and hallucination that I have uncovered, which I explicated at some length in section 3, which I warned the reader might seem otiose, will now pay dividends for a proper understanding the nature of virtual reality experience.

The question that I will address in this section is whether the sorts of visual experiences we have of virtual reality while using current technology, such as the Oculus Rift or the HTC Vive are (a) illusory or hallucinatory experiences or (b) veridical perceptual experiences of virtual or computational objects.

My favourite virtual reality experience is one in which you seem to be under the sea looking at a jellyfish migration. When I have this experience, standing in my office in Glasgow we would typically agree that there are not hundreds of jellyfish in my office and it is not under the sea. Thus, the idea that my experience is illusory or hallucinatory is attractive. At the same time, when in virtual reality, we seem to be aware of a world that was designed or filmed in a special way for us to see. And, all being well, we see what was intended for us to

see. This thought makes the idea that we have veridical perceptual experiences of virtual or computation objects attractive.

As mentioned in the introduction to this paper, discussion in the contemporary philosophical literature makes it seem as if the answer will be one or other of these (and not both). For example, Chalmers says, “The most common view is that virtual reality is a sort of fictional or illusory reality, and that what goes on in virtual reality is not truly real...” (2017: 309). This view naturally goes along with the view that “[e]xperiences in virtual reality are illusory” (2017: 310). But he defends, “the opposite view: virtual reality is a sort of genuine reality, virtual objects are real objects, and what goes on in virtual reality is truly real” (2017: 309). And “[e]xperiences in virtual reality are non-illusory” (2017: 310).

However, I think that this conception of the debate (i) does not take proper account of the way the contemporary virtual reality technology works, and (ii) has a metaphysically impoverished conception of illusion and hallucination, because it adopts the traditional very limited accounts of illusion and hallucination, as opposed to my new theory and the many different forms of illusion and hallucination that it has uncovered.¹⁰ Therefore, the existing conception of the debate presents us with a false dichotomy and hence it fails to appreciate the complexity of VR experience. If we stick to that dichotomy, then we are stopped from capturing the elements that are attractive about each of what are taken to be opposing views.

I will address and provide an antidote to (i), first explaining the significance of the nature of the technology for understanding experience in virtual reality, before going on to discuss and remedy (ii).

Why does the contemporary philosophical debate fail to take account of the way that present-day virtual reality technology works? The most important thing to note, which is typically not mentioned, is that virtual reality experience is not just experience of a virtual world, it also involves perception of the screens in the headset. The virtual reality headset consists of two small screens side by side, designed so that when you put on the headset one screen is in front of eye, and the other screen is in front of your other eye. This is known as a stereo display and it gives a viewer, who has binocular vision, depth perception by means of stereopsis.

Because virtual reality experience is not just experience of a virtual world but also involves perception of some sort of the screens in the headset, it is useful to start by comparing and contrasting VR experience to a series of more familiar experiences involving screens.

Think, first, about seeing a photo of some real-world person, such as Donald Trump, or of watching a film on television of a real (non-computer generated) event, such as a jellyfish migration that took part in the Pacific Ocean a few months ago, as filmed by David Attenborough. Or think of seeing your Granny on your computer screen via a Zoom call. Along with some other philosophers, I think that you can see Donald Trump by looking at a photo of him, that you can watch a jellyfish migration by watching a film of it on television, and that you can see your Granny by looking at your computer screen. Walton (1984), for example, thinks of photos and video screens as prosthetic devices that in the fullest and most literal sense of the term let you see things that are spatially-temporarily remote.

¹⁰ For example, Chalmers (2017: 327) defines illusion in precisely the traditional way thus, “If one perceives an object as having properties that it does not have, the perception is illusory.”

There are some philosophers who disagree with this point of view. As Cohen and Meskin attest, there are a good number of philosophers who claim that “a necessary requirement for x’s seeing y is that x represents information about the spatial relations between x and y” (1994: 198).¹¹ This is often taken to require that a subject must be able to judge or know the spatial relations between himself or herself and the object in question. However, I can see no good reason to insist that a subject need be able to make such judgments to count as perceiving. Moreover, Walton notes that there can be cases of perception involving mirrors, that his opponents would think of as being cases of perception, that do not allow you to make spatial judgments about where the object is with respect to you. For example, if you saw a carnation flower which had been reflected by a series of mirrors, but you did not know how many there were, or what angle they were at, you might not be able to judge its ego-centric location. And if you were looking at a carnation, and it was surrounded by mirrors and you did not know whether it was reflected in a mirror or not, even though it was not, you would not be able to make ego-centric judgments about the location of the carnation, but there is no doubt that you are seeing it, claims Walton. Walton’s reply seems like a good one to me.

However, Cohen and Meskin provide a slightly different reply to Walton. They do not insist that the subject be able to judge or know the location of a seen object, instead they require that “x sees y through a visual process z only if z carries information about the egocentric location of y with respect to x.” (1994: 201) and, “a process type carries the information of a certain kind just in case the process’s tokens are typically tokens that carry information of that kind.” (1994: 201). Thus, they argue that photographs, films on TV, or Zoom calls do not involve because they are not produced by processes that carry information about the egocentric location of the objects experienced with respect to the viewer. Whereas, they claim, seeing something by seeing it in a mirror is the sort of process that does carry ego-centric information about the experienced object and the viewer.

I am not convinced by Cohen and Meskin’s reasoning. First, it is not obvious to me that the process of seeing something in a mirror, or a long chain of mirrors, does preserve—or typically preserve—ego centric information about the location of the object experienced and the viewer. The reason that Cohen and Meskin give for thinking that this is true, is that, “change in an object’s egocentric location would bring about change in the (mirror-produced) image” (1994: 203). But surely this is true too in the case of Zoom calls. If the person you are Zooming changes egocentric location with respect to you, then typically the image on the screen will change. It would only be in very special cases where a person moved the camera that they were using to film themselves in exactly the same way, and to the same extent that they were moving, and that they managed to make the background around them that was being filmed, impervious to the movement of the camera. No doubt with modern technology that could be done, but it would not be the usual case. Moreover, I am sure that in certain special cases, with suitable care, one could move an object reflected in a series of mirrors without the image appearing to change with suitable changes to the mirrors that would compensate for the movement.

Second, I find the picking out of ego-centric spatial information about an object seen as the thing that must be present in order for seeing to occur to be completely ad hoc. Why should that be the vital magic ingredient that turns a case of not seeing into seeing? Why should it not be seeing the colour of something, or the shape of something? In fact, I think that there is no privileged information that must be transmitted by a process of seeing or an experience of

¹¹ Including Carroll (1995 and (1996), Currie (1991) and (1995), and Warburton (1988).

seeing in order for that experience to count as one of seeing. Seeing can be partial, and seeing it can be degraded, in all sorts of ways.¹² Why not in respect of ego-centric location?

Third, if I am on a Zoom with someone and I tell them that I cannot see them, I never intend to mean that I am using a process to have an experience that represented them but that did not typically carry ego-centric information about them to me. If I tell someone that I cannot see them when on Zoom, it is because their screen has gone blank, or they have moved out of the field of view of their camera or the like. Ordinary language clearly indicates that we have a commitment to saying that we can see people on Zoom. Perhaps the ubiquitous use of this technology has changed our conception of vision in recent times, but I very strongly doubt it. For a long time we have talked about seeing the football match on live television, seeing what a celebrity was wearing last week by seeing a film recorded of them, or seeing just how orange Donald's skin was yesterday by looking at his photo in a newspaper.

Thus, I conclude that seeing a photo, and seeing something on a screen, can be genuine cases of seeing. Nonetheless, I think that these sorts of example are distinctive because they are exemplars of *indirect* perception in which you see one thing in virtue of seeing another. You indirectly see Donald Trump in virtue of directly seeing the photograph. You indirectly see the jellyfish migration in virtue of directly seeing the television screen. In these cases, our perception of Donald Trump and the jellyfish migration is dependent on seeing the photograph and the television screen. If you were not seeing the photograph or the television screen, you would not be seeing Donald Trump or the jellyfish migration.

Now consider what happens when you view a 3-D image or movie. It consists of a *stereogram* (or many in quick succession), which, as mentioned before, consists of two off-set 2-D images—depicting left-eye and right-eye views of the same scene—displayed to each eye of the viewer. There are lots of ways of doing this. One way is via anaglyph images. These images contain two coloured images, which when viewed through anaglyph glasses that place a different filter in front of each eye, allow one of the images to reach one eye and the other image to reach the other eye. This is the standard way that 3-D cinema works. Another way of doing this is via a stereo viewer, such as the child's "View-Master" toy of the 1970s. This simple yet clever device simultaneously presents two off-set images on opposite sides of a card—one to each eye. A modern virtual reality headset is just a more complex version of this device that allows for two off-set movies to be played to each eye. And, in addition, there is typically a motion detection device that registers your head movements, and adjusts the images being played on the screens in line with your head movements, so that it seems to you as if you are looking around the depicted world.

When each eye receives information from one of two appropriately off-set images at the same time, quite an amazing, but commonplace, thing happens: you do not seem to see the two 2-D images. Rather you have an experience of what seems to be one 3-D scene. How should we best describe what is going on? I take as my example a case in which an image of one jellyfish is displayed on each of the two off-set screens.

When your eyes "fuse" the two images, you do not have an experience that represents two 2-D jellyfish. You have an experience of one seemingly 3-D jellyfish. Nevertheless, information from the two 2-D images is being picked up by your eyes and brain.

¹² See Macpherson (2015) for numerous examples of severely degraded, yet as I argue, still visual experience and visual perception.

Systematically, your experience represents one scene/jelly when two are present. What we have here is a case that is the reverse of double vision: it is half vision! For every two objects present on the screen you have an experience of one object. As your experience is sensitive to the images, we have good grounds for holding that you perceive them—but, in the sense described in section three, *qua objects of perception*, in an illusory fashion.

What about property perception in this case? Some of the properties of the 2-D images on the screen are perceived accurately. For example, the shape of the 2-D jellyfish is perceived and experienced as the outline shape one the one apparently 3-D object. You are accurately tracking the outline shape of the jellyfish, and having an experience of that shape, and these are very good reasons to hold that we see that property.

The best overall description of the case, described thus far, is that it is one in which there is veridical perception of an object’s property experienced as belonging to that object, but at the same time as that object is perceived (*qua object*) in an illusory (half-vision) way. In other words, what we have here is the case represented in the highlighted yellow cell in table 6.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O’s properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O’s properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object’s, O*’s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | ✓ | ✓ |

TABLE 6

In this case, there are also some properties that are experienced inaccurately. For example, the location of the 2-D jellyfish is inaccurately seen. Each 2-D jellyfish is a few millimeters

in front of your eyes on the screen, but you experience the location of the 3-D jellyfish—perceived in the half-vision manner—as being, say, around a meter in front of you in the world. This inaccuracy is best described as one of illusion, as you are sensitive to the location of each 2-D jellyfish. If their position changed on the screen your experience would also change in a systematic way that reflects the fact that you are detecting the location of the 2-D jellyfish. So, this is a case of illusory perception of one of an object’s properties (its location), experienced at a different location yet as belonging to that object, which itself is illusorily perceived, qua object, in a half-vision manner. Thus, we have a case represented in the highlighted yellow cell that I have added to table 6 to yield table 7.

One might object at this point that it does not seem to people that they are seeing the two two-dimensional images on the screen, so are they really consciously seeing those? Might it just be unconscious perception of those images that leads them to have an experience as of the one three-dimensional jellyfish? I believe that it is not for two reasons. First, I would argue that although it does not seem to people as if they are aware of the two 2-D images because they seem to see just one 3-D jellyfish, that is not a good reason to think that they are not seeing the two images. For, as we saw in the previous section, in cases of double vision it looks to people as if they are seeing two fingers, but they are really only seeing one finger—just seeing it twice. The apparent number of objects seen is not a good guide to how many are seen. Second, it does not look to people as if they are seeing the images because their experience does not represent anything at the actual location of the images. But, again, that is not a good reason to think that they are not seeing those images. They are just suffering an illusion with respect to their location. Third, people are definitely consciously seeing properties that those images have—in both a veridical and illusory form—as explained above. Therefore, for all these reasons, I reject the suggestion that the images are not seen or not consciously seen.¹³

¹³ Given that my account says that you see something when you have an experience that tracks an object or a property is a wide variety of situations in a non-lucky fashion, then one might wonder whether I am committed to thinking that we see light waves just before they hit our retinas, the images on our retinas (if there are such things), or the brain states that produce our experience. My answer is that we do, so long as there is the right sort of tracking. I am uncertain whether the right sort of tracking occurs. In my opinion, it is more likely to occur in the case of our brain states that produce our experiences than in the other cases. However, let us suppose, for the sake of argument, that that sort of tracking does occur. Is it not a significant problem for my theory that we do not seem to see our brain states? How can I plausibly maintain in the face of the phenomenal character of our experience the idea we that we do? My answer here is to note that the tracking would only be accurate of brain states, qua objects. You have experiences that amount to seeing the brain states, qua objects, but you don’t see any of their properties accurately. You either have an illusory or hallucinatory experience of the properties of your brain states, and you do not experience in any way many of the properties that they do have. You do not experience their location, their colour, their shape. So it is no wonder that you do not seem to see brain states when you have a perceptual experience. The extent to which you see them is vanishing thin. I am very satisfied with this answer to this objection. It accounts for the phenomenal character of our experience, but captures the sense in which we are sensitive to our brain states and their properties. I think that this kind of answer could be usefully adopted by others whose theories of perception seem to lead them similar apparently unpalatable consequences.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | ✓ | ✓ |

TABLE 7

Now let us focus on other elements of the case. Suppose that, rather than a static image, two appropriately off-set films are being played on each of the screens that are in front of your eyes, and the films were generated by two appropriately off-set cameras filming a real-world event of a jellyfish swimming. You would experience one three-dimensional jellyfish apparently swimming in water in front of you. In line with the case of simply viewing an ordinary 2-D film on a television screen, that I argued earlier amounted to perception of what was filmed, I claim that you would thereby be seeing the real jellyfish, and the event of its swimming, that was filmed a few months ago. Just as the case of watching a film on the television was a case of indirect perception—in which you saw indirectly what was filmed in virtue of seeing the television screen—this virtual reality case too is a case of indirect perception: You are seeing the real-world event of the (one) jellyfish swimming in virtue of seeing the succession of two images on the two screens. It is reasonable to claim this because your experience is sensitive to and accurate about many features of the jellyfish that was filmed by the two cameras—you are tracking the fact that there is just one jellyfish present, so qua object, perception, your experience is veridical. Qua property perception you could be accurately experiencing, and not through luck, the jellyfish's colour, its shape, and other properties of it. Your experience though will be inaccurate about some of its properties too: its location relative to yourself, and the time of the swimming (though right about the temporal order of the series of events that constitute the swimming event): giving you both

hallucinatory and illusory property perception. Therefore, in your experience of the filmed jellyfish you have veridical object perception of it, qua object, and a variety of veridical, illusory and hallucinatory property perception of its properties. These cases are represented in the highlighted green cells that I have added to table 7 to give us table 8.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | ✓ | ✓ |

TABLE 8

In addition, we can capture, in such a table, the fact that you are seeing the jellyfish that was filmed in virtue of seeing the two images of the jellyfish on the screens—that is, we can capture the indirect nature of the perception of the filmed jellyfish seen in virtue of the direct perception of the images of the 2-D jellyfish. I proffer that a crucial element of what it is to see one thing in virtue of another, is that you experience some of the properties that the directly seen object seems to you to have, as belonging to the indirectly seen object. If there were no such attribution of location, direction of line of sight, shape, colour, it becomes completely unclear how perception of one thing could be in virtue of another. The attribution of properties from one object to the other explains why there is direct perception.

Let me explain how this attribution works by considering a simple case. Suppose you are watching a filmed event on a television of a cube sitting on a table, and you experience the filmed cube as being red. You could not be indirectly experiencing the redness of the cube unless you were experiencing the colour of the television screen. In a simple case, you might

be accurately seeing the colour of the filmed cube in virtue of accurately seeing the colour of the television screen. In this case, it seems that that you see the redness of the television screen and attribute it to another object—the filmed red cube. Of course, in a variant of the case, you might be seeing the colour of the filmed red cube in an illusory fashion because the television screen systematically represents things as slightly darker than they are in reality. Or you could be hallucinating the colour of the filmed cube as your television set is broken and the colours on the screen are constantly changing and flickering and not accurately tracking the colour of the object filmed. But in each of these cases, you are attributing the colour you experience the screen to have to the colour of the filmed object. There could also be cases in which you have an illusion of the colour of the television screen, perhaps because you are wearing dark glasses, yet you attribute the illusory property that the screen seems to you to have to the filmed object—yielding either a veridical perceptual, illusory or hallucinatory experience of colour of the filmed object, depending on other factors of the case yet to be filled in. Likewise, there could also be cases in which you have a hallucination of the colour of the television screen, perhaps because you have taken psychedelic drugs. Yet you attribute the hallucinated property that the screen seems to have to the filmed object—yielding either a veridical perceptual, illusory or hallucinatory experience of colour of the filmed object, again dependent on other, as yet unspecified, factors of the case.

In short, I have argued that a necessary feature of indirect perception is that some properties of the directly seen object are illusorily bound (in the very particular sense of that phrase that I outlined in section three) to the indirectly seen object, and these cases could involve a large number of combinations of veridical, illusory and hallucinatory experience in the directly and indirectly seen objects.

To summarize, in the case under discussion, in which you are wearing a stereoscopic display, in which images of a filmed 3-D jellyfish are projected to each eye, indirect perception occurs. You indirectly see a filmed 3-D object in virtue of directly seeing the 2-D images on the two screens. Properties you experience the images on the screen to have are illusorily bound to the filmed object that you see in 3-D. We can capture this element of the experience in the highlighted orange cell that I have added to table 8 to give us table 9.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ Indirect Perception | ✓ | ✓ |

TABLE 9

Table 9 represents the full complexity of the case in which one uses a stereoscopic display (such as a View-Master or a modern virtual reality headset) in which two appropriately off-set images or films of a jellyfish are placed, one in front of each eye, and you come to have an experience of a 3-D jelly-fish. The yellow cells represent your experience of the images of the 2-D jellyfish, the green cells represent your experience of the filmed 3-D jellyfish, and the orange cell captures the indirect perception of the filmed 3-D jellyfish, in virtue of the direct perception of the 2-D images of the jellyfish. As has become plain, the case is rather complex.

I will now consider a slightly different case which is important to the experience of virtual reality. While some virtual reality experiences are a product of filming, not all are. Many are purely generated by computer, the coding of which generating the images on the stereoscopic display.

Recall that if the images that you are seeing in virtual reality are generated by a computer, not a video recording, then the options cited in the extant literature for what you experience are:

- (a) an illusory or hallucinated experience of something that isn't there, or

(b) a veridical perceptual experience of a virtual or computation object.

Chalmers advocates (b). He says, what you see are virtual objects that we can identify with “digital objects ... [t]o a first approximation, they can be regarded as data structures.” (2017: 317). Chalmers claims that the the data structures we perceive are the ones that produce experiences of objects in virtual reality.

On my account you could veridically perceive those data structures, *qua objects*, if the right relations hold between the data structures and what you experience. Think back to the case in which you were using a stereoscopic display to watch a real-life filmed event under the sea. In virtue of directly seeing the objects on the screen in the half-vision sense, you were indirectly seeing the objects that were filmed. And you were seeing those filmed objects, *qua objects*, because there was a one-to-one correspondence between the objects filmed and the apparent number of objects that you saw, allowing you to track the filmed objects, *qua objects*, accurately. In the case where the film is generated solely by computer data structures, then you could indirectly see those data structures, *qua objects*, in virtue of directly seeing the objects on the screen, in the half-vision sense, if there was a one-to-one correspondence between the data structures and and the apparent number of objects that you saw, for that would allow you to track the data structure objects, *qua objects*, accurately. We could certainly imagine that there was such a correspondence, and Chalmers thinks it plausible that there could be. Suppose there is.

In this case then, you indirectly see the computational data structures, *qua objects*, accurately. But do we veridically perceive the properties of those data structures? I would argue that we do not. We experience pink jelly-shaped objects in the space in front of us—properties data structures lack. Of course, with the right computational set-up, these properties could correspond to certain properties of the data structures in a way that ensures that we are sensitive to them and can track them in a non-lucky manner, but our experiences won’t accurately represent them. For example, it might be that when a jellyfish appears red, that corresponds to a data structure having a certain property, say, that there is a “0” in the first place of the array, and when it looks orange, that corresponds to the data structure having another property, say having a “0” in the second place in the array, and so on.

Indeed, I think it is because we do not experience many of the properties of data structures, such as their locations, shape and colour, and because if we are perceiving any of their properties it is only in an illusory fashion, that we do not seem to see data structures in our experience. See footnote 12 for further discussion.

Before continuing to elucidate my account, I wish to address an objection that is made to the thought that we do not veridically perceive properties of data structures in virtual reality, but rather experience properties they do not have, like pinkness and jellyfish-shapedness. Chalmers (2017) argues that a novice user of virtual reality will experience illusions—they will experience virtual objects to have properties of shape and colour such as roundness and redness, that virtual objects—on this view, computational structures—do not have. Thus novice users will be in the position that I have articulated. However, he holds that the experience of expert users of virtual reality will change over time so that they will not perceive virtual objects to be in physical space, but to be in virtual space, and not to have shapes and colours like redness and roundness, but to have properties like virtual redness and virtual roundness which, he argues, virtual objects—computational structures—do have.

I am quite happy to agree with Chalmers that our experience can change due to perceptual learning and cognitive penetration. However, it would be very odd, I think, if it were the case that the more one had virtual reality experience, the less it was like our experience of the non-virtual world. It would suggest that with use, virtual reality was experienced as less realistic than it once did. The power of the technology wanes! This is odd because, the goal of much virtual reality design is to make it appear as real as possible. This point is arguable, however, and it does not show conclusively that Chalmers is wrong.

However, there is a feature of my theory that would suggest that Chalmers' position is wrong. Recall that according to my account, we perceive the objects on the screen, qua objects, in an illusory fashion and, we perceive their properties in a mixture of veridical and illusory ways. So long as nothing is amiss with our vision we will see the colours of the objects on the screens accurately. Recall further that I said that it is in virtue of directly perceiving these objects on the screen that we indirectly perceive either filmed objects or virtual objects. I also said that part of what it is to indirectly see one thing in virtue of another is to experience the property of one object and attribute it to the other object. If this is right, then when we accurately see the colour properties of the object on the screen and attribute them to the filmed or virtual objects, it will be real-world colours and not virtual colours that we attribute to them. Therefore, I claim that because this indirect perception occurs, we should predict that filmed and virtual objects are experienced—and continue to be experienced—as having real-world colours, not virtual colours. I will therefore set aside Chalmers' objection, and continue giving my account of our experience in virtual reality.

If we are not veridically perceiving the properties of the data structures, then we need to ask whether we are having illusory perceptual experience of them or hallucinating them. In other words, we need to ask whether we could form any correct, non-lucky judgments about the properties of data structures on the basis of taking our experience at face value. It seems to me that, with the right correspondence between the experienced properties of the jellyfish and properties of the data structure, at best, what we could make would be accurate comparative judgments, that is judgments of the form, A is more similar to B than to C. As we saw in the previous section, when we looked at the unusual case of experiencing smells when looking at colours, which is like this case, as we are experiencing colours when being faced with data structures, whether being able to make such comparative judgments is enough to count this as a case of property illusion rather than hallucination is tough to say. Opinions will vary—it is a case that is right on the cusp between these two notions.

Finally, note that in this case, we can also describe the nature of the indirect perception taking place. It is in virtue of directly experiencing the properties (in a variety of veridical and illusory ways), which the images on the screens have, that we experience the properties of the data structures in an illusory or hallucinatory way. Thus we have a layer of illusory binding taking place in this case too.

We can summarise in total what is going on in this case in which we view stereoscopic images created by computational data structures in table 10. The yellow cells represent the perception of the two 2-D images, qua objects, in the half vision illusory sense, together with a mixture of veridical and illusory property perception of those objects. The red cells represent the veridical perception, qua objects, of the computational data structures, together with the illusory or hallucinatory property perception of those objects. And the grey cell represents the fact that we indirectly see the data structures in virtue of directly seeing the objects on the screen, which amounts to a variety of different sorts of illusory binding.

| Experience as of an object, O, having a property, P | | | |
|---|---|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ Indirect Perception | ✓ | ✓ |

TABLE 10

As Chalmers points out, it is merely an assumption that the virtual objects we seem to see will be correlated with computational data structures in a one-to-one fashion. He says that the relationship between them may be more complicated. For example, he says that it could be the case that, “multiple data structures will be associated with a single virtual object, in which case the virtual object will be a higher-level entity constituted by these data structures”. On my account, if there are such higher-level entities, then it is very possible that we could perceive them in virtual reality, qua objects, if we were to suitably track those objects in a non-lucky fashion via our experience— and we would experience their properties in an illusory or hallucinatory manner. This seems entirely possible to me. However, note that we would not be seeing data structures in this case, but virtual objects dependent on those data structures for their existence.

We should also note that some virtual reality experience is created by in a three-stage process: a real-life event such as a jellyfish migration is filmed, the film is then stored in a computer in a series of data structures, which then projects images onto the stereoscopic screen. In this case, we have a double layer of indirect perception occurring. You directly see the 2-D images on the screen, which allows you to indirectly see the computational data structures or the virtual objects dependent on those data structures, which you experience as 3-D objects in

front of you, and in virtue of seeing those, you indirectly see the objects in the world that were filmed (the jellyfish).

We can capture this scenario in table 11, in which:

- the yellow cells represent perception of the 2-D objects on the screen,
- the red cells represent the perception of the computational data structures or the virtual objects dependent on those data structures,
- the grey cell represents the indirect perception of the computational data structures or the virtual objects dependent on those data structures in virtue of seeing the the 2-D objects on the screen,
- the green cells represent the perception of the filmed real world objects, and
- the orange cell represents the indirect perception of the the filmed real world objects in virtue of seeing the computational data structures or the virtual objects dependent on those data structures.

| Experience as of an object, O, having a property, P | | | | |
|---|---|---------------------|----------------------------------|---------------------------------------|
| | Veridical perception of O (qua O) | | Illusory perception of O (qua O) | Hallucinatory experience of O (qua O) |
| Veridical perception of one of O's properties, P, experienced as belonging to O | ✓ Wholly veridical perceptual experience | | ✓ | ✓ |
| Illusory perception of one of O's properties, experienced as P and as belonging to O | ✓ Trad Illusion (AKA property Illusion) | | ✓ | ✓ |
| Hallucination of a property, P, experienced as belonging to O | ✓ Property Hallucination | | ✓ | ✓ Trad Hallucination |
| Veridical perceptual/illusory/hallucinatory experience of another object's, O*'s, property, or apparent property, experienced as P and as belonging to O (and the illusory or hallucinatory experience could be veridical or non-veridical) | ✓ | Indirect Perception | ✓ | ✓ |

TABLE 11

Thus, we can see that virtual reality experience is highly complex and multifarious, involving many veridical, illusory and hallucinatory elements conjoined in a multitude of ways. I find it

satisfying to see this intricate portrait of virtual reality experience emerge from applying my new theory of illusion and hallucination to virtual reality experience, because the theory was developed as a general account of illusion and hallucination and not designed to specifically account for virtual reality experience. In the future, I intend to apply the theory to other aspects of our perceptual experience, such as dreaming and cross-modal experience, to see whether it can provide illuminating accounts of those phenomena too.

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