

# What Can Synesthesia Teach Us About Higher Order Theories of Consciousness?<sup>1</sup>

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**Abstract:** In this article, we will describe higher order thought theories (so-called H.O.T. theories) of consciousness. Then we will describe some examples from synesthesia. Finally, we will explain why the latter may be relevant to the former.

**Keywords:** synesthesia, Ramachandran, Higher-Order Thought (H.O.T.) theories

## 1. Introduction

H.O.T. theories of consciousness maintain that what makes an experience conscious is a higher order thought that takes that experience as its content. So, for example, one may be exerting pressure on the seat of the chair upon which one is sitting, but not be consciously experiencing that pressure. However, as soon as one's attention turns to that pressure, it will be consciously experienced. On this view, what turns a non-conscious experience into a conscious one is the higher order thought that takes the non-conscious experience as its content.

While experiences themselves may be concept-free, H.O.T.s of their nature involve concepts because thoughts, unlike experiences, involve concepts. The thought that it is raining involves the concept of rain. The thought that Obama is president involves the concept of the presidency. The non-conscious experience of the pressure you are exerting upon your chair does not involve a concept. Not being conscious, there is no concept applied to it, nor is your experience applying a concept to the chair or to pressure. Your non-conscious experience may be responding to pressure or sensory input, but unlike a thought, it is not categorizing or conceptualizing that input. A thought however, by its nature categorizes and conceptualizes.

H.O.T. theories also apply to thoughts themselves. They maintain that what makes a thought conscious is that there is a second higher-order thought that takes the lower-order thought as its content. For example, one may non-consciously think (fear) that one is becoming an alcoholic. Upon reading a brochure about the symptoms of alcoholism, one may form the higher order thought that one has for some time now feared becoming an alcoholic. Thus, this makes conscious the formerly non-conscious thought (fear). However, here we will confine our attention to conscious experiences only.

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<sup>1</sup> We are grateful to Andre Galois and Rocco Gennaro for very useful conversations.

We will limit our discussion here to only the ‘thought’ versions of H.O.T. theories. That is, there are several different versions of higher order theories. Some appeal to thoughts as the key to making lower order states conscious. Others appeal to higher order experiences or non-thought forms of representation to do this. Still others discuss more global forms of representation (Gennaro 2004) as the mechanism to turn a non-conscious state into a conscious one.<sup>2</sup>

Synesthesia derives from the Greek root ‘syn’ meaning together and ‘aesthesis’ or perception, and is a condition where otherwise normal people experience the blending of two or more senses (Ramachandran and Hubbard 2003).

Synesthesia is a condition in which stimulation of one sensory modality causes unusual experiences in a second unstimulated modality (Ramachandran and Hubbard 2005).

Examples of experiences reported by synesthetes would include seeing colors when seeing numerals, seeing red when hearing C-flat or chicken tasting pointy (Ramachandran and Hubbard 2003). One subject experienced a bitter taste when shaping hamburger patties. As a phenomenon, synesthesia has been known at least since the work of Francis Galton (1880). The different types of synesthesia number over 100.<sup>3</sup>

There are different attempts to explain synesthesia, but knowing it runs in families, there is likely an evolutionary explanation. Perhaps the best-known explanation is that there is a ‘cross-wiring’ of sensory modalities due to proximity of brain regions and then some selectional advantage for this new capacity (Ramachandran and Hubbard 2003, Ramachandran 2011).

## **2. Why some examples from synesthesia may present a problem for H.O.T.s**

One of the most important reasons why we think synesthesia is relevant to theories of consciousness is that the phenomenon seems not to be conceptually driven or triggered. In support of this, we turn to the research of Ramachandran (2011).

When Ramachandran first interacted with some students who reported having synesthesia, he wondered whether their seeing colors when seeing numerals was due to a conceptual association or whether it was truly a perceptual phenomenon. His first thought was to see whether a student who saw red when looking at the number 7 would also see red when looking at the Roman

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<sup>2</sup> We agree with Rosenthal (1990) that the ‘thought-versions’ of H.O.T. are the best versions of the higher-order theories, and that is why we will limit our remarks here to them.

<sup>3</sup> Indeed, there are so many varieties that there has been discovery of a kind associated with ideas—so called ‘ideasthesia.’ However, we will not be addressing this variety in this paper. Here we will be concerned only with varieties that are purely perceptual varieties. We explain below how this is determined.

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numeral VII. She did not. This was some evidence that seeing red was not due to a conceptual association, but Ramachandran did not stop there.

He next tested showing the subject uncolored drawings of fruits that would be colored and asking what the subject saw when looking at the drawings—one of which was of a tomato. She reported seeing no colors. She acknowledged that carrots are orange but denied seeing orange when looking at the drawing of carrot. But when observing the numeral 7, she reported that "it keeps screaming red at me."

Next, with the subject's eyes closed, he drew a 7 on her hand. She denied seeing red when feeling the drawn 7, but then reported a tinge of red when she started visualizing a 7. Ramachandran said the word 'seven' to her and again nothing happened until she started to visualize the 7.

Next he drew a green 7. She reported: "I certainly don't mix the real color with the mental color. I see both colors simultaneously, but it looks hideous."

On a subject with a different form of synesthesia, he introduced a galvanometric skin response (GSR) paradigm to test the same question about this being a perceptual phenomenon. For this subject, rather than seeing colors when observing numerals, the person felt emotions when touching fabrics or textures. The same question applies: is the synesthesia a conceptual or perceptual phenomenon?

In normal subjects touching mundane textures caused no GSR response. But in one subject who had experiences of fear, anxiety and disgust when touching certain textures, there was a strong GSR response when touching the relevant items. Ramachandran concluded that this is a perceptual phenomenon that he observed. GSR's cannot be faked. The point of giving the GSR test is to determine whether the phenomenon is top-down or purely perceptual (sometimes called 'bottom up').

Ramachandran was thoroughly investigating as many ways as he and his researchers could think of to test whether this phenomenon was conceptual (or 'top-down') vs. perceptual (not driven by conceptual association or deployment). Clearly GSRs are not driven by conceptual deployment.

In a 'pop-out' experiment, Ramachandran (2011) produced a grid of 5s and 2s that were mirror images of one another. The grid was presented for about one half second. To a non-synesthete, looking at the grid produced only the experience of random figures. The subjects had to press one of two buttons on a computer depending upon whether they saw a triangle or a circle. The instruction was to find a general shape. Twenty 'normal' subjects scored about 50% on whether the shapes were circles or triangles. Hence, they were at chance for success.<sup>4</sup>

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<sup>4</sup> While it is true that pop-out is not experienced by all subjects with synesthesia, there is a significant population in which it is experienced and it is those subjects who we think present difficulty for H.O.T. theory (Ramachandran and Hubbard 2005). A distinct possibility is that

However, when subjects with synesthesia looked at the grid, the colors that they saw on the numbers caused the shapes to pop out. That is, the 2s were arranged either in a circular pattern or a triangular pattern among the 5s (which were randomly placed). The colors seen when observing the 2s and their shapes in circular or triangular pattern were apparent to them at a hit rate of 80-90%. For example, a pattern of 2s that was triangular jumped out as a red triangle. Or a pattern of 2s shaped as a circle popped out as a circular shape. The subjects with synesthesia experienced something the subjects without synesthesia did not.

The reason this is interesting in regard to H.O.T. theories, is that the 'pop-out' phenomena is a bottom-up visual experience. The subjects did not first see the shape (triangle or circle) and then have the higher-order thought ('triangle' or 'circle') causing the experience of the shape to become conscious. Rather, the perceptual pop-out produced the conscious visual experience of the shape prior to the having of the thought about the shape experienced.

According to H.O.T. theory, the experience should be non-conscious before a higher-order thought about it raises it to consciousness. So, an H.O.T. theorist would need to say that when the circular or triangular shape pops out, first the subject is having a non-conscious experience until the H.O.T. is applied. But this seems to have it backwards. The subject has no idea of which shape to look for or whether there will actually be one. The visual pop-out is immediate and vivid in its color presentation. It first looks red and circular or red and triangular and only then has the subject the time to apply the relevant concept ('circle' or 'triangle').

Contrast this pop-out phenomenon with the sort of example mentioned earlier. When you turn your attention to the pressure you are exerting on the seat beneath you, you suddenly make conscious the experience of exerting pressure on the seat. But it takes an act of conscious will or attention to make this happen. First comes the thought about the experience of pressure and then comes the conscious experience.<sup>5</sup>

In the pop-out case, you have no idea which shape you may be about to behold. You have no act of will or attention that is directed towards the circle or triangle.<sup>6</sup> The suddenness of the pop-out experience comes as complete surprise,

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there are distinct neural mechanisms for different varieties of synesthesia. Some synesthetes have color experiences upon hearing spoken words or names.

<sup>5</sup> We are not saying that every H.O.T. itself must be conscious. However, when one directs attention to a state, attention is a conscious state.

<sup>6</sup> Again, there are individual differences among some subjects, but in some only the minimal attention needed to look at the display is needed to induce the pop-out phenomenon. What is more, attention itself may require a 'hybrid' model to explain the differences being discovered (Ramachandran and Hubbard 2005). In addition, both Andre Galois and Rocco Gennaro suggested to us that unconscious H.O.T.s may be able to explain both pop-out phenomena and the example of becoming conscious of the pressure you exert on the chair. But if so, why are you not conscious of the pressure on the chair even prior to one's calling your attention to it?

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even to the synesthetes, who are not expecting it (and who viewed it for only a half-second).

In the pop-out case it is highly implausible to say you are having the experience of the circle or the triangle non-consciously prior to your H.O.T. about the experience. Why? For one, the pop-out phenomena is so sudden and unexpected that the experience and the consciousness are simultaneous. With only half second presentation, there was little time for the visual system to scan the pattern of the 2s prior to the visual pop-out. So we know they don't first see the pattern of 2s, apply the concept 'circle' (or 'triangle') and then have the visual experience of colored circle. There simply is not time.

Second, color qualia are not non-conscious. For the H.O.T. explanation to apply, the subject's non-conscious H.O.T. would have to be applied to the non-conscious color experience, thereby making the experience conscious. If the non-conscious experience lacks the red qualia, how does the subject know which color concept to apply prior to the pop-out? And which colored shape pops out, circle or triangle, should not come as a surprise to the subject, if one has already applied the concept triangle or circle. After all, one would already have the *thought it was a circle* (or a triangle) prior to what phenomenally pops out. This leads us to believe the conscious visual experience happens prior to the H.O.T.

Of course, to our first point, an H.O.T. theorist can always reply: "How long does a thought take?" Not that long. So they may find this example unpersuasive. But we think this example is different than others in the literature. Not just because it doesn't take long. Not just because of Ramachandran's excellent discussion of the difference between perceptually driven phenomena and conceptually driven phenomena. But because the H.O.T. explanation just seems to get things the wrong way around to say that the concepts are applied first in the pop-out cases of synesthesia.

The seeing of color when observing a numeral is not under conscious control. The explanation of why a synesthete sees red when looking at a 2 has nothing to do with having the concept of red or the concept of the number 2. What brings on the color has nothing to do with the application of an H.O.T.. So when the entire shape among the 2s pops out, this too is a low-level sensory phenomenon.<sup>7</sup>

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Attention surely plays a role in that case and attention surely is not non-conscious. In the pop-out case one is consciously scanning the array, looking for a shape. Something brings one's attention to hidden shapes revealed by their color. It is only when attention is focused on the shapes that H.O.T.s would be applied to the shapes. So we don't see how unconscious H.O.T.s can be doing the work needed to explain the phenomenon.

<sup>7</sup> Ramachandran and Hubbard (2005) and Ramachandran (2011) suggest an extensive theory of the evolutionary origins of synesthesia. Nothing in this explanation involves the role of H.O.T.s. The explanation of its origin is that of a purely mechanical low-level phenomena and is attributed to the spatial proximity of the relevant brain regions (for example the exact location of V4 and the number processing areas of the brain). They suggest that crossactivation may occur between adjacent brain regions of the fusiform gyrus involved in letter recognition and

Interestingly, Gennaro (2012) (an H.O.T. theorist) discusses synesthesia in regard to another matter and argues that his account of higher-order theory is compatible with this phenomena. He is not discussing the issue we raise here. Instead, he is discussing the 'binding problem,' of what binds together certain features of conscious experience. He argues:

"Indeed, I have elsewhere argued at length that feedback loops and top-down integration of brain activity are necessary for having any kind of conscious state (Gennaro 2006; 2012). For example, the brain structures involved in feedback loops seem to resemble the structure of at least some form of higher-order theory of consciousness whereby lower-order and higher-order states combine to produce conscious states. On my view, there is essential and mutual interaction between the relevant neuronal levels." (Gennaro 2012, 77)

Gennaro believes this is compatible with higher-order accounts. However, we think this explanation would make higher-order theories rely crucially on sub-personal states. If they do, this removes the 'higher' from the higher-order theories and resorts to replacing higher-order thoughts with the lower level information processing in the brain that is well below what can be accessed even in principle by the person. These sub-personal feedback processes seem too low-level to be compatible with higher-order thoughts.

Other examples of conscious visual phenomena that may be explainable by sub-personal cognitive states might include illusory contours (Lee and Nguyen 2001) or even the Ishihara test for color vision (Dain 2004).

### **3. Conclusion**

In this paper we have suggested that the phenomena of conscious color experience of subjects with synesthesia is problematic for higher order theories of consciousness (H.O.T.s). The phenomena of 'pop-out' for synesthetes who experience color when viewing certain shapes is a specific example of the problem. The phenomena seems to be perceptually driven, not conceptually driven. So the explanation of the pop-out phenomena seem not to be caused by the application of a higher-order thought. There may be higher order thoughts associated with the phenomena but they may happen after the conscious experience not be the cause of the conscious experience. Herein lies the tension between the conscious experience of synesthesia and the higher order thought theory of consciousness.

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color processing. Higher cognitive forms of synesthesia would involve other brain regions such as parietal cortex, and particularly in the region of the angular gyrus, the ventral intraparietal area and the lateral intraparietal area. Their lower level cross-activation model is also useful in explaining phenomena such as 'phantom limb.'

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