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How to test Molyneux's question empirically

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Abstract. In a recent *i-Perception* article, Schwenkler (2012) criticizes a 2011 experiment by R. Held and colleagues purporting to answer Molyneux's question. Schwenkler proposes two ways to re-run the original experiment, either by allowing subjects to move around the stimuli, or by simplifying the stimuli to planar objects rather than three-dimensional ones. In Schwenkler (2013), he expands on and defends the former. I argue that this way of re-running the experiment is flawed, since it relies on a questionable assumption that newly sighted subjects will be able to appreciate depth cues. I then argue that the second way of re-running the experiment is successful both in avoiding the flaw of original Held experiment, and in avoiding the problem with the first way of re-running the experiment.

Keywords: Molyneux's question, perception, multimodal perception, vision, touch, shape.

1 Introduction

Molyneux's question asks whether a man born blind, who can distinguish a cube and sphere by touch, could distinguish those shapes upon having his sight restored (Locke, 1690/1975, p. 146). Schwenkler (2013) criticizes a 2011 experiment attempting to answer Molyneux's question and proposes a way to re-run the experiment. I argue that Schwenkler's proposed experiment is flawed, since it relies on a questionable assumption that newly sighted subjects can appreciate depth cues. In a previous *i-Perception* article, however, Schwenkler (2012) had proposed a second way to re-run the original experiment, substituting two-dimensional shapes like circles and squares for three-dimensional spheres and cubes. I argue that this two-dimensional version of the experiment successfully bypasses Schwenkler's criticism of the original experiment, and also avoids the flaw in his other proposed experiment.

2 Schwenkler's argument

Held and colleagues (2011) conducted an experiment to answer Molyneux's question, involving subjects who had just undergone cataract removal surgery to restore their sight. The experimenters used 20 non-identical pairs of enlarged legos as stimuli. To test whether subjects had sufficient visual ability for the experiment, they were first shown one lego, and then shown that lego along with a second, non-identical lego. Asked which of the two legos was shown in the first showing, they were able to answer correctly at a mean rate of 92%. This was a visual-to-visual (VV) matching task. The next part of the study pertains to Molyneux's question. Subjects were given one lego to touch. Then they were visually presented with that lego along a second non-identical lego, and were asked which of the two legos they were previously touching. This was a tactile-to-visual (TV) matching task. Subjects performed this task at near chance levels, with a mean of only 58% correct. Held and colleagues take the TV results to show that the answer to Molyneux's question is "likely negative," since they indicate that someone with newly restored vision would likely not be able to tell, based on vision alone, which object is the cube or the sphere (Held et al., 2011, p. 552).

The problem with the experiment, according to Schwenkler, is that the bar for the VV task was too low: success at it did not establish that subjects had the visual capacities necessary for passing the TV task. They could perform well in the VV task just by making crude discriminations based on low-level features like shadows and overall contours, aided by the fact that the three-dimensional objects were presented only from a single angle (with the same shadow and the same overall contours). In other words, the experimenters failed to ensure that their subjects were able to form robust visual shape representations involving spatial features invariant to a shifting perspective (Schwenkler, 2013, p. 92).

Furthermore, another study suggests that the subjects in the Held study could not have formed robust visual shape representations given the conditions of the experiment. In that study, subjects were shown three-dimensional objects like pyramids and cubes two weeks to three months after having their sight restored, yet they "were unable to integrate the facets into the percept of a single three-dimensional object" (Ostrovsky, Meyers, Ganesh, Mathur, & Sinha, 2009, p. 1,486). Schwenkler takes this as evidence that under the conditions of the Held experiment, subjects were precluded from forming robust visual shape representations.

Schwenkler suggests a way to re-run the experiment. In the original experiment, subjects were stationary. Schwenkler writes, "This kept them from accessing the richer array of spatial cues that a changing perspective on the object would have supplied, while at the same time making it especially easy to use low-level features in the vision-to-vision task, since they could be sure that they would encounter each object from the same viewing angle" (Schwenkler, 2013, p. 93). He suggests the experiment be re-run, allowing either the stimuli to move, or the subjects to move, or both. According to him, this would allow subjects to access more spatial cues, enabling them to build robust representations of the three-dimensional shapes.

3 Reply to Schwenkler

Schwenkler wants to re-run Held and colleagues' experiment so that subjects might build robust shape representations, but an alternative is to re-run the experiment so that it does not demand robust shape representations for the TV task in the first place. Specifically, the experimenters should re-run the experiment with two-dimensional circle and square raised-line drawings, rather than three-dimensional shapes. (Schwenkler mentions this experiment in his 2012 *i-Perception* article).

Since several studies indicate that raised-line drawings can be difficult to identify by touch, however, it might seem that re-running the Held experiment using raised-line drawings is a non-starter (for a survey of raised-line drawings, see Picard & Lebaz, 2012). If subjects cannot identify a shape by touch, how can they match a shape they see with one they had previously touched? However, as Picard and Lebaz summarize, identifying raised-line drawings by touch is "hard but not impossible" (Picard & Lebaz, 2012, p. 427). Furthermore, some stimuli are harder to identify than others. It is important to note that since raised-line drawing studies typically are testing for proficient tactile identification in general, using a range of complex shapes, they are often testing at a level of difficulty unnecessary for a two-dimensional test of Molyneux's question, where what is required is just proficient tactile identification for a few simple shapes (in particular, circles and squares). All of this suggests that rather than indicating that a two-dimensional test of Molyneux's question is a non-starter, the raised-line drawing studies point to constraints for such a test instead. For instance, as Picard and Lebaz suggest, the two-dimensional pictures should be simple and printed on high-quality paper (Picard & Lebaz, 2012, p. 430).

While using two-dimensional shapes departs from Molyneux's original question, note that in several prominent philosophical treatments of Molyneux's question, philosophers have deliberately changed the original question, often at the very outset of their discussion, from a question about three-dimensional cubes and spheres to a question about two-dimensional circles and squares. Diderot (1749/1977, p. 56), Evans (1985, p. 365), and van Cleve (2007, p. 252) all make this move, and give us a good reason to do so. van Cleve writes, "[A] subject gaining sight for the first time might not be able to perceive depth (as Berkeley maintained), in which case he could nonetheless still presumably distinguish from one another two-dimensional figures like circles and squares" (van Cleve, 2007, p. 252). For Diderot, van Cleve, and Evans, the two-dimensional formulation is Molyneux's question well-formulated.

Schwenkler uses the three-dimensional formulation of Molyneux's question and proposes that Held and colleagues re-run their experiment, allowing either the stimuli to move, or the subjects to move, or both. This is because "watching an object as it moves with respect to one—or as one moves with respect to it—can bring into view features of it that would otherwise have been hidden, and makes available more information concerning how its surfaces are oriented in depth" (Schwenkler, 2013, p. 93). But this is precisely what Diderot, Evans, and van Cleve have questioned as proponents of the two-dimensional formulation of Molyneux's question: "that a newly sighted man would be able to appreciate the depth cues available in visual perception" (Evans, 1985, p. 365). And studies showing that a newly sighted person can appreciate depth cues a few months after surgery, which Schwenkler cites, are not enough to show that they can appreciate them immediately after surgery. We are therefore left with a worry about whether subjects can appreciate depth cues immediately post-surgery. Given this worry, if Schwenkler's proposed experiment were to yield a "no" answer to Molyneux's question, we would be unable to ensure that the reason was not just due to the inability of subjects to detect depth cues.

By running an experiment based on the two-dimensional formulation of Molyneux's question, we can avoid the problem with Schwenkler's proposed experiment. In a two-dimensional Molyneux experiment, given a "no" answer to Molyneux, we can ensure that the reason was not just due to the inability of subjects to detect depth cues. Depth cues are irrelevant to a two-dimensional experiment.

By running an experiment based on the two-dimensional formulation of Molyneux's question, we can also avoid Schwenkler's original criticism of the Held experiment. According to Schwenkler, the problem was that the experimenters "did not ensure that their subjects could form robust representations of visual shape, and other experimental work on the restoration of sight suggests that the subjects cannot have done this within the conditions of the experiment" (Schwenkler, 2013, p. 93). The "other experimental work" references the study where two weeks to three months after having their sight restored, subjects were shown three-dimensional objects like pyramids and cubes, but "were unable to integrate the facets into the percept of a single three-dimensional object" (Ostrovsky et al. 2009, p. 1486). But in a two-dimensional Molyneux test, subjects would not need to integrate distinct facets into a single object. No such robust representations of visual shape are required. So, Schwenkler's criticism of the Held experiment would not apply to a two-dimensional Molyneux experiment.

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