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MOLYNEUX'S QUESTION AND THE SEMANTICS OF SEEING

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The aim of this chapter is to shed new light on the question of what newly sighted subjects are capable of seeing on the basis of previous experience with mind-independent, external objects and their properties through touch alone. This question is also known as "Molyneux's question." Much of the empirically driven debate surrounding this question has been centered on the nature of the representational *content* of the subjects' visual experiences. It has generally been assumed that the meaning of "seeing" deployed in these disputes is more or less clear and unproblematic, and therefore requires no analysis or clarification. In this chapter, we wish to challenge this assumption. We argue that getting clear on the meaning of "seeing" is the only feasible way to determine whether the empirical attempts to answer Molyneux's question accurately capture what newly sighted subjects are in fact capable of seeing. Specifically, we show that the dominant interpretations of the empirical results from a recent study (Held et al., 2011) fail to take into account that seeing can be not only purely visual but also epistemic in that it requires background knowledge (such as what an object with a particular viewpoint-independent shape looks like from a particular perspective).

Introduction

In 1688, William Molyneux—an Irish scientist and politician—posed the following, now celebrated, question in a letter to John Locke (adopted from Degenaar & Lokhorst, 2017):

> Dublin July. 7. 88
> *A Problem Proposed to the Author of the Essai Philosophique concernant L'Entendement*
>
> A Man, being born blind, and having a Globe and a Cube, nigh of the same bignes, Committed into his Hands, and being taught or Told, which is Called the Globe, and which the Cube, so as easily to distinguish them by his Touch or Feeling; Then both being taken from Him, and Laid on a Table, Let us Suppose his Sight Restored to Him; Whether he Could, by his Sight, and before he touch them, know which is the Globe and which the Cube? Or Whether he Could know by his Sight, before he stretch'd out his Hand, whether he Could not Reach them, tho they were Removed 20 or 1000 feet from Him?

> If the Learned and Ingenious Author of the Forementiond Treatise think this Problem Worth his Consideration and Answer, He may at any time Direct it to One that Much Esteems him, and is,
>
> *His Humble Servant*
> *William Molyneux*
> *High Ormonds Gate in Dublin. Ireland*

In contemporary parlance, the question can be framed as follows: "Would a person who was born blind and could distinguish a cube from a sphere by touch be able to distinguish them by sight alone if she were to regain her sight?" Now known as "Molyneux's question" (MQ), the query has inspired sundry research initiatives within philosophy and psychology, including studies of whether our sensory experiences individuate the sensory modalities and whether our perception-based knowledge of common sensibles (i.e., properties that can be perceived by more than one sense) is specific to each sense or shared among the relevant sensory modalities (e.g., sight and touch).

During Molyneux's lifetime, MQ could only be addressed through thought experiments. Locke (*Essay* II. ix 8), for example, thought of it as a question about ideas of shape (or what we might now call "percepts of shape") and maintained that ideas associated with touch cannot help a newly sighted person acquire ideas specific to vision (see also Mackie, 1976). However, by the eighteenth century, the ability to remove cataracts and restore sight elevated MQ to an empirical inquiry.

A variety of empirical findings on newly sighted individuals have been reported over the past few centuries. For example, William Cheselden (1728), who had removed cataracts from a congenitally blind person, reported that his patient could not distinguish one object from another by sight alone despite having regained his sight. More recently, Richard Gregory and Jean Wallace (1963) reported that a subject, S.B., who was blind for over 50 years, was unable to identify faces and at least one of the objects with which he was previously acquainted through touch. For example, when shown a cutting lathe (during a visit to the Science Museum), he was unable to recognize it until he was allowed to touch it. Another case study from the 1960s involving subject M.M., who was blind for about 40 years, likewise indicated that M.M. had severe deficits in the ability to visually identify faces and three-dimensional shapes (Fine et al., 2003). His visual impairments were still rather severe more than a decade after his sight was restored. For example, in a three-dimensional object identification task, M. M. was able to correctly name some household objects but significantly fewer than the controls (Huber et al., 2015).

One of the most widely discussed empirical inquiries into MQ was conducted by Richard Held and collaborators in 2011. This study looked at whether newly sighted subjects are able to match visually presented stimuli to shapes they have previously only experienced through touch. The researchers found that the newly sighted test subjects were unable to immediately match the shapes they saw to those with which they were previously acquainted through touch. The team took these findings to indicate a negative answer to MQ. However, this conclusion has received its fair share of criticism.

In a couple of articles responding to their research, John Schwenkler (2012, 2013) mounted a serious critique of what such empirical results can tell us about MQ. According to Schwenkler, the question of what the newly sighted subjects actually see is not so easily answered. For it remains possible that since subjects were only allowed to view the three-dimensional shapes from a single perspective, their visual system was unable to form the sort of shape representations which would make them visually sensitive to the perspective-invariant spatial features needed to successfully complete the touch-vision task (we discuss this response in further detail later in the chapter). Schwenkler's critique has received considerable attention and has, in the process, engendered novel suggestions regarding how to empirically ensure that what research participants see are in fact geometric shapes and not, say, two-dimensional outlines of objects seen from a certain angle. Indeed, the question that Schwenkler raises—namely, that of what newly sighted subjects really see—has gradually begun to take center stage in the analysis and interpretation of the empirical data pertaining to Molyneux's original query.[2]

Our aim in this chapter is to offer a more comprehensive analysis of the question of what newly sighted subjects really see. However, instead of approaching the issue by focusing directly on the *content* of the subjects' visual experience and hence by presupposing that "see" has a single meaning or has been disambiguated, which has been a tendency in recent scholarly investigations of MQ, we propose to begin by getting clearer on the meaning of "see." We argue that unless we gain a better understanding of what we mean by "see," and hence on which mental state the query is about, there is no way to adequately address the question of what newly sighted subjects are capable of seeing.

What case studies pertaining to cataract surgery tell us about Molyneux's question

The problem Molyneux raised initially received numerous a priori treatments by various philosophers, including John Locke, George Berkeley, and Gottfried Wilhelm Leibniz. Marius von Senden (1932) was the first to directly address the question empirically, by conducting a review of case studies of individuals who had undergone operations to remove congenital cataracts. His review emphasized the extent to which newly sighted patients had to "learn to see" as well as their reluctance to do so. As Alva Noë (2004) notes,

> What we learn from the case studies is that the surgery restores visual *sensation*, at least to a significant degree, but that it does not restore sight. In the period immediately after the operation, patients suffer blindness despite rich visual sensations.
>
> *Alva Noë, 2004: 12*

Barrett and Bar (2009: 1325) make a similar point about M.M.'s experiences: "What Mr May did not know is that sighted people automatically make the guesses he was forced to make with effort."

Von Senden's observations seem consistent with Cheselden's (1728: 448) claim that when the patient whose cataract was removed "he was so far from making any judgment of distances, that he thought all objects whatever touched his eyes (as he expressed it) as what he felt did his skin." However, contrary to Cheselden (and Berkeley) von Senden notes that after this initial stage, when patients learned to see objects, they would see them at a distance from them—which points to a significant difference between visual and tactile experiences (for, only the latter requires contact between the sensory organ and the object).

Subsequent to von Senden's review, two case studies have shed additional light on MQ. The first was conducted by Richard Gregory and Jean Wallace (1963) and involved a patient, S.B., who lost his sight when he was a toddler and did not regain it until he was 52 years old. S.B. had an operation on his left eye 48 days before his right eye was operated on. The eye surgeon who performed the two operations reported that, after the first surgery (to his left eye), S.B. seemed to have no difficulty identifying everyday three-dimensional objects such as cars, windows, or doors, as well as some colors. However, he had difficulties recognizing faces. After the second surgery (to his right eye), Gregory and Wallace examined S.B. and found that he was able to name almost every object in his hospital room as well as tell the time on the large clock on the wall. S.B. told Gregory and Wallace that he was able to identify objects with which he was previously acquainted with through touch because he had precise and accurate mental images of the objects he had previously experienced through touch. He had also previously learned how to tell the time using a large hunter watch with no glass, which suggests that he was able to transfer at least some of the information acquired through one sense modality (touch) to another (vision). Further, S.B. was able to recognize the capital letters he was already acquainted with through touch. On one occasion, he was able to correctly name a popular magazine Gregory and Wallace had brought with them to the hospital. Although he was unable to say anything about the picture on its cover (which consisted of a large image of two musicians wearing striped shirts), he told the researchers that he was able to guess that the name of the magazine was *EVerybody's* because he recognized the first two (capital) letters, EV, and used that information to guess the rest of its name.

Gregory and Wallace observed that S.B. was proud of his ability to name objects correctly on the basis of sight and seemed averse to making mistakes on visual tasks. The Matron at the hospital told the researchers about an error S.B. made three days after his surgery when he saw the moon for the first time. He initially took the crescent shape to be a reflection on the window, but when he was told that it was the moon, he was surprised because, as he explained, he had expected a quarter moon to look like a piece of cake rather than half a cookie. Since S.B. was able to guess correctly from comparatively little evidence (e.g., guessing the magazine's name by recognizing its first two capital letters), Gregory and Wallace decided to conduct more sophisticated tests involving visual illusions. The findings from the latter studies indicated that S.B. was considerably less susceptible to depth illusions than neurotypical subjects. For example, when shown the Hering illusion, he reported that the lines looked straight and parallel rather than bowing outward (Figure 12.1).

Moreover, Gregory and Wallace noted that when shown the Ishihara color vision templates, S.B. did not use his fingers to trace the number on the cards prior to correctly identifying them. Rather, he read the numbers confidently and swiftly, despite the low color contrast and the lack of contours, indicating that he was making negligible mental effort to identify them.

S.B. was more adept at recognizing objects in his hospital room than in other locations. In a supervised visit to the Science Museum, he was unable to recognize a Maudslay screw cutting lathe kept behind a glass case prior to touching it, despite being intimately familiar with this type of instrument through touch. After having had a chance to manipulate it with his hands, he proclaimed: "Now that I felt it I can see." On another supervised visit to the zoo, S.B. was able to visually identify giraffes, elephants, monkeys, and snakes, but unable to visually identify bears, seals, rhinos, hippopotami, crocodiles, or gazelles. In addition, S.B. showed impairments in face identification. After a visit at S.B.'s home, six months following the (second) surgery (on his left eye), Gregory and Wallace remarked that "to a great extent [S.B.] lived the life of a blind man, sometimes not bothering to put on the light at night, and [making] little of the normal visual occupations of cinema or television." The researchers concluded that despite improvements in his visual abilities since his last examination, S.B. was rather disappointed with his newly restored sight, as it afforded him little additional benefits in terms of perceiving his environment.

In a more recent case study, patient M.M., who had lost his right eye and was blinded in his left eye in a chemical explosion when he was only three years old, regained his sight at the age of 43. That was in 2000, when he received a corneal transplant and stem cell therapy to restore vision in his left eye. Two years after the successful surgery, M.M. was diagnosed with severe amblyopia (Fine et al., 2003). Amblyopia involves loss of central vision due to

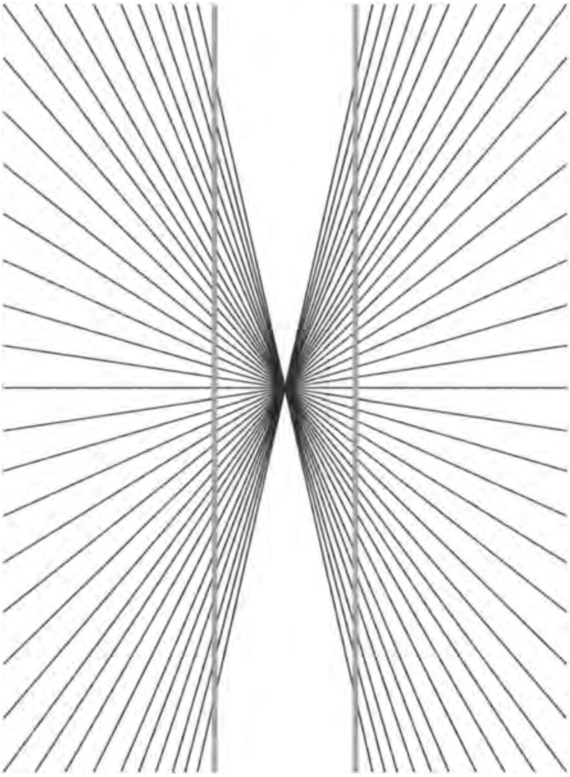

Figure 12.1 Hering illusion. When two parallel lines are presented in front of a radial background, the parallel lines look as if they bow outwards.
Source: *Wikimedia Commons*.

some defect in the eye (typically a cataract but in M.M.'s case a damaged cornea), during the early period of development of the visual system, usually between six and 30 months of age in neurotypical individuals (Vaegan, 1979). M.M. appeared to quickly learn to identify simple (i.e., two-dimensional) shapes, colors, and motion but showed impairments in three-dimensional shape and face identification. While three-dimensional shapes (or objects) and faces activated occipital regions near the primary cortex (V1) in M.M., the visual processing areas required to visually recognize three-dimensional shapes and faces (i.e., areas beyond V1) remained inactive (Fine et al., 2003). These findings are consistent with studies indicating that while color, simple shape, and motion capacities develop in infancy, certain aspects of the capacities for face and three-dimensional object recognition continue to develop well into adolescence, and hence many years after M.M. and S.B. lost their sight (Nishimura et al., 2009; McKone et al., 2012). It is likely that Molyneux and his contemporaries assumed that a newly sighted person would have fully functional vision. In other words, it is possible that they did not anticipate the domain specificity of vision with multiple distinct functions, believing it to be a sort of "all or none" ability. However, the current empirical evidence indicates that the functional capacity to make full use of visual signals requires more than an optically restored eye; it requires the activation of area V1 as well as the activation of areas beyond V1, which are responsible for object and face recognition (Fine et al., 2003; Held et al., 2011; Huber et al., 2015; Sacks, 1995).

Ten years after his sight was restored, M.M. volunteered to participate in additional testing (Huber et al., 2015). Elizabeth Huber and her collaborators (2015) used complex, three-dimensional shapes, novel face stimuli, and common household items to which M.M. was regularly exposed such as chairs. They found that M.M. was able to discriminate common household objects (e.g., chairs) and three-dimensional shapes (e.g., a cube) although his performance was significantly below that of the control subjects. Moreover, M.M. showed no significant improvement in performance since his last testing in 2003 for any of the tasks on which he was tested.

There are also similarities in M.M.'s and S.B.'s performance with respect to vision-guided actions (Gregory & Wallace, 1963; Fine et. al., 2003; Chen et al, 2016; Gallagher, 2005; Ferretti, 2017). For example, prior to regaining his vision, M.M. was able to use verbal directions from a guide, which allowed him to become an expert skier. After regaining his sight in his left eye, he initially kept it closed when skiing, because, as he noted, using it made him frightened of colliding with other skiers (Fine et al., 2003). Two years later, after having learned how to use shading patterns on snow to estimate the shape of a slope, M.M. gradually began opening his left eye when skiing, except during the most difficult descents. Similarly, S.B. initially hesitated to rely on his restored vision for vision-guided action (Gregory & Wallace, 1963). Prior to having his sight restored, S.B. crossed roads with confidence. However, after regaining his vision, he was more reluctant when he had to cross a road, even a familiar one. There is no evidence that S.B.'s confidence when crossing a road improved with practice. Moreover, consistent with von Senden's review, which indicated that newly sighted patients were reluctant to make use of their sight, Gregory and Wallace (1963) found that, for the most part, S.B. had chosen to live a life of a blind man. By contrast, M.M. reported making significant use of his sight in everyday life but noted that this was only because he had become better at guessing what he was seeing: "*The difference between today and over two years ago is that I can better guess at what I am seeing. What is the same is that I am still guessing*" (Fine et al., 2003: 2; emphasis in the original). In all of these cases, the ability to make guesses by relying on visual cues played an important role in their ability to gain information about their surroundings through sight.

The guessing newly sighted subjects make use of when trying to determine what they are seeing most likely has nothing in common with the sort of guessing that blindsight patients rely on when asked what's in front of them. Blindsight is caused by extensive damage to V1, which can result in either a complete (reported) absence of consciousness but spared unconscious visual abilities in contralateral regions of the visual field (type 1 blindsight) or significantly degraded consciousness but spared unconscious visual abilities that vastly outrun their conscious visual experience (type 2 blindsight).[3] Unlike type-1 blindsight patients, who report not seeing anything, type-2 blindsight patients occasionally report seeing something or seeing something move without being able to detect any other features of that "something". They are literally consciously seeing extension or motion without consciously seeing other qualities of the objects in front of them (Brogaard, 2015; Macpherson, 2015), yet they are able to unconsciously detect other features of the objects when forced to guess.[4] For example, one type-2 subject explained his visual phenomenology by referencing the experience of seeing an object through a nearly opaque screen. The residual visual consciousness is akin to merely consciously seeing the shadows of objects as opposed to the objects themselves (Brogaard, 2015).[5] These blindsight patients consciously see things through a veil of perception, so to speak.

In forced-choice paradigms, where blindsight subjects are forced to guess what they are unconsciously seeing, the accuracy of the responses is significantly above chance. For example, a blindsight patient, G.Y., exhibited close to 100 percent response accuracy (Brogaard, 2011). Although the accuracy of the responses for newly sighted subjects is also significantly above chance, the latter appear to depend on visual cues to guess what is in front of them (as in the case of the magazine title *EVerybody's*, where the capital letters EV served as a cue for S.B.). By contrast, type-1 blindsight patients report not seeing anything when making accurate guesses in forced-choice paradigms while type-2 blindsight patients report consciously seeing very few features of the stimulus – far fewer than they are able to detect when forced to guess. Indeed, neither types of blindsight patients *depend on* visual cues for unconscious visual detection.

These differences in the sort of guessing utilized by blindsight subjects, on the one hand, and newly sighted subjects, on the other, lead to a crucial distinction for the MQ literature. Namely, while blindsight patients have extensive damage to one or both primary visual cortices (V1), subjects treated for congenital blindness suffer from ocular defects (see also Ferretti, 2017 and Glenney, 2013) (similarly, in Leber's congenital amaurosis (LCA), the light receptors in the retina are gradually damaged). This explains why newly sighted individuals (but not blindsight subjects) are able to rely on visual cues to make guesses about what they see to navigate the environment.

As mentioned above, in a recent study five young participants (between 8 and 17 years of age) were tested shortly after they had been treated for congenital blindness (Held et al., 2011). The aim of this experiment was to provide an answer to MQ by testing whether newly sighted participants can use tactile shape knowledge to successfully perform visual tasks. From this perspective, providing an answer to MQ requires determining whether a subject representing a shape tactually (having experiences whose content includes what we will call S(tactual) representations) and representing the same shape visually (having experiences whose content includes what we will call S(visual) representations) is able to map S(tactual) onto S(visual). If the results were to show that newly sighted subjects could use tactile shape knowledge to successfully perform visual tasks, they would thereby indicate they can map S(tactual) onto S(visual).

The experiment involved three tasks. In the vision-to-vision (VV) task, subjects had to choose which of the two visually presented stimuli had the same shape as a visually presented sample. In the touch-to-touch (TT) task, they had to match one of two tactually presented stimuli to a tactually presented sample. Finally, in the touch-to-vision (TV) task, they had to match a tactually presented sample to one of two visually presented stimuli (Figure 12.2). The order in which the tasks were performed was: TT-TV-VV.

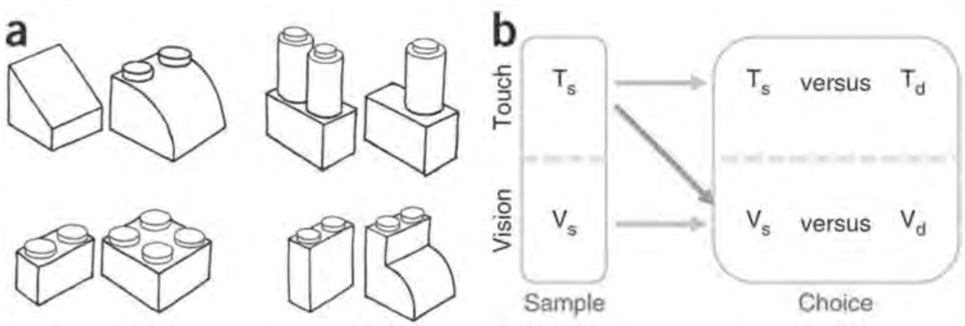

Figure 12.2 Image used in testing and depiction of testing procedure.

a. sample of the 3D shapes presented to their subjects. b. The depiction of the testing procedure. Grey arrows indicate intramodal testing (touch to touch, and vision to vision). The dark grey arrow indicates intermodal testing (touch to vision).
Source: Adopted from Held et al., 2011.

The findings from the study indicate that while the subjects' performance in the VV and TT tasks was "excellent," their performance in the TV task was near chance level. Accordingly, when the objects were presented visually, the subjects were able to tell which one had the same shape as the initial, visually presented sample. Similarly, when the objects were presented tactually, the participants were able to tell which one had the same shape as the initial, tactually presented sample. But when the sample was presented tactually, but the choice was between two visually presented objects, the participants' performance fell to just above chance. These findings indicate that newly sighted participants are able to compare three-dimensional shapes by sight as well as by touch (as demonstrated by their success in the VV and TT tasks). Yet when asked to compare a three-dimensional shape presented visually to a three-dimensional shape presented tactually, their performance was no better than mere guessing. According to Held and colleagues (2011), this suggests that newly sighted participants could not map S(tactual) onto S(visual) since they were unable to use tactile shape knowledge to successfully perform visual tasks. Rather, they must learn to associate felt and seen shapes through a process of perceptual learning (indeed, some of the participants were tested again after the initial testing, and their performance in the TV task improved substantially with time). Given these findings, the researchers concluded that "the answer to Molyneux's question is likely negative" (Held et al., 2011: 2).

Put another way, the researchers are suggesting that while the subjects could discriminate two shapes presented visually, they did not yet have the capacity to visually recognize a shape on the basis of a prior tactile experience of the same shape, since the possession of such a capacity would require storing tactually acquired information about the shape in a form that is decodable by the visual system and hence is available for use in visual shape recognition tasks. In this case, the information they had previously stored about the shape through touch was apparently unavailable to them as a resource for recognizing the three-dimensional shape visually. The researchers thus argue that since the newly sighted subjects cannot map S(tactual) onto S(visual), there is no straightforward connection between stored tactile and visual representations of shape.

In sum, while there are relatively few studies of subjects recovering from prolonged blindness (due to the rarity of cases), the empirical work that has been carried out seems to indicate that newly sighted subjects do not exhibit any immediate (Held et al., 2011) or long-term (Huber et al., 2015) transfer of tactile shape information to the visual domain that can be used in visual object recognition. In the next section, we want to offer a framework that can shed light on why the subjects in the study by Held and colleagues (2011) performed superbly on the VV tasks but not on the VT tasks.

To this end, we will make use of insights gained from a recent semantic theory of propositional seeing proposed by Brogaard (2017) and further developed in Brogaard (2018: Chap. 6).[6] Specifically, we will use Brogaard's semantics of "seeing" to show that "see" could be understood not only in a purely visual sense but also in an epistemic sense, which requires that the subject has knowledge about what she is seeing. We argue that this distinction can be used to explain, among other things, apparent puzzles associated with newly sighted subjects. Moreover, we will show that failure to attend to this distinction undermines the conclusions about MQ that Held and colleagues draw from their experiment.

The semantics of seeing

In what follows, we present an account of the semantics of "seeing" proposed by Brogaard (2017) and show why it can enable us to adequately address MQ. Brogaard (2017) argues that "to see" is an intensional transitive much like the search verb "to look for" (see also Brogaard, 2018). Search verbs like "look for" are intensional transitives that are anomalous in that "substituting one expression for another that is coreferential with it in the complement of the verb can change the truth-value of the sentence in which the VP [verb phrase] occurs" (Forbes 2013). Lois Lane may be looking for Superman. But, according to Graeme Forbes (2013), it does not follow that she is looking for Clark Kent, even though Superman is Clark Kent. By definition, necessarily co-extensional terms are co-substitutional in merely intensional contexts but not in hyperintensional contexts. So, on Forbes' treatment, search verbs are hyperintensional (Forbes, 2003). A verb is hyperintensional just when substituting an expression for a necessarily co-extensional expression within the scope of the verb results in a change in the truth-value of the sentence containing the verb (Brogaard, 2014). "I believe that," "I hope that," "It seems to me that," "On a planet where water is not H_2O," and "In the movie *The Big Lebowski,*" are prime examples of hyperintensional operators. When a term is substituted for a necessarily co-extensional term within the scope of any of these operators, this can result in a change in truth-value. Consider the sentences in (1) and (2) (as per usual, we will assume for argument's sake that the Superman stories are true in the actual world):

(1) Lois Lane believes that Superman is in love with her.
(2) Lois Lane believes that Clark Kent is in love with her.

Here the proper names "Superman" and "Clark Kent" are necessarily co-extensional: they both refer to the same person (who we assume is a real person). However, while (1) provides an accurate description of Lois Lane's intensional state (here assuming that she believes that Superman is in love with her), (2) does not do so. Lois Lane doesn't believe that her co-worker at the *Daily Planet* is in love with her. So, (1) is true, whereas (2) is false. This shows that "believe" is hyperintensional.

Search verbs create a hyperintensional context in much the same way as attitude verbs like "believe." Consider the sentences in (3) and (4) (taken from Brogaard, 2017):

(3) Lois Lane is looking for Superman.
(4) Lois Lane is looking for Clark Kent.

Here, the verb "look for" follows the same pattern as "believe" follows in (1) and (2): substituting one expression (in this case a proper name) for another that is necessarily coreferential with it within the complement of the verb "to look for" changes the truth-value of the proposition expressed by the complement. (3) provides an accurate description of Lois Lane's intensional mental state, but (4) does not.

Brogaard argues that "to see" is an intensional transitive verb much like "to look for" and that it therefore creates a hyperintensional context. Brogaard's proposal runs counter to the dominant view of "seeing" that construes the verb as a factive, non-intensional verb.

On a traditional and still prevalent view initially proposed by Fred Dretske (1969), when the verb "to see" occurs together with noun-phrase complements (e.g., "Superman," "him," "the table," "the car crash") or unsupported clauses (e.g., "Lois Lane go downstairs," "Superman land on the top of the building"), the construction depicts a purely perceptual form of seeing, whereas "see-that" constructions have an epistemic reading (Dretske, 1969). In his development of Dretske's proposal, Craig French (2013) argues that uses of "see" that combine with a "that"-clause are not purely visual but rather "visuo-epistemic" because they imply that the subject is knowledgeable about what she is seeing. Compare the following cases:

(5) Lois Lane saw Superman.
(6) Lois Lane saw Clark Kent go downstairs.
(7) Lois Lane could see that Clark Kent was wearing his new glasses.

In (5) the verb "to see" combines with a noun-phrase complement, viz. "Superman." On its most natural reading, (5) doesn't imply that Lois Lane knows or believes that the person she is seeing is Superman. So, on this reading, "to see" picks out a purely visuo-sensory state. In (6) "to see" combines with an unsupported clause, viz. "Clark Kent go downstairs." On its most natural reading, (6) doesn't imply that Lois Lane knows or believes that the person she sees go downstairs is Clark Kent. So, "to see" picks out a purely visuo-sensory state here as well. In (7) "to see" takes a "that" clause as its complement. On its most natural reading, (7) implies that Lois Lane knows that it's Clark Kent who is wearing new glasses and not Superman. It is this knowledge implication that gives it its visuo-epistemic reading.

It is this general framework that Brogaard challenges. As she points out, the fact that "seeing that" constructions can have a visuo-epistemic reading does not support the claim that there are no purely visuo-sensory readings of "seeing-that." To see this, consider the sentence in (8):

(8) Lois Lane could see that there was nothing threatening in her office, but she nonetheless still believed that someone dangerous was hiding in there.

(8) would be an accurate description of a scenario in which Lois Lane believes that someone is hiding in her office but in which she is unable to see anyone in there, even after looking everywhere. For example, we can imagine that Lois thinks that the alien that Superman warned her about who can disguise her appearance by blending in with the background is hiding somewhere in the office, but she is not able to see her. Brogaard argues that examples of this kind show that the epistemic reading is not mandatory for propositional uses of "see."

Moreover, Brogaard argues, "seeing-that" constructions depict representational mental states. She offers the following argument:

I. "See-that" is a hyperintensional mental state operator.
II. Hyperintensional mental state operators operate on representational content.
III. So, "see-that" operates on representational content.
IV. If "see-that" operates on representational content, then seeings are representational mental states.
V. It follows that seeings are representational mental states.

Here is the justification for Premise (I). Sentences containing hyperintensional mental state operators do not preserve their truth-value when necessarily co-extensional terms are substituted within their scope. Consider the following discourse fragment:

> Perry White, the editor-in-chief at the Daily Planet, came storming into her office, yelling:
> "That little piece of $#?@&%. You knew all along, Lois, didn't you? Answer me!"
> Lois had no idea what her boss was getting at.
> "I don't know," she replied. "What do you mean?"

Perry's face was fuming red. "Never mind, just tell me where he is!"
"Who?" Lois was puzzled by the sudden uproar.
"Your #$!@&%* co-worker!?" Perry snapped.
She could feel drops of saliva land on her cheeks.

(9) "Oh, Clark Kent … I saw that he left the office to get coffee at Starbucks about 30 minutes ago."

As before, we assume that Lois Lane never realizes that Clark Kent, her co-worker, is Superman, the man with whom she is in love. Given this assumption, if "Superman" were substituted for "Clark Kent" in (9), Lois's comment wouldn't have made much sense, suggesting that the substitution would change the meaning and truth-value of Lois's utterance. This is so in spite of the fact that "Superman" and "Clark Kent" are necessarily co-extensional, that is, the two proper names refer to the same person in all possible worlds in which they refer to anything at all. Examples like these suggest that "see-that" can function as a hyperintensional operator.

The argument for Premise (II) runs as follows: It is because hyperintensional mental state operators (and, in fact, intensional mental state operators more generally) operate on representational contents that the sentences embedded within their scope can have different truth-values relative to different circumstances of evaluation. Consider the sentences in (10) and (11), uttered by Lois Lane:

(10) I think that Clark Kent left the office to get coffee at Starbucks this morning.
(11) I think that Superman left the office to get coffee at Starbucks this morning

If Lois Lane saw Clark Kent leave the office to get coffee, she could sincerely utter (10). But she would adamantly deny (11). (11) isn't an accurate description of any of her intensional mental states. The sentences embedded under the hyperintensional mental state operator "I think that", viz. the sentences "Clark Kent left the office to get coffee at Starbucks this morning" and "Superman left the office to get coffee at Starbucks this morning" have exactly the same truth-values, because "Clark Kent" and "Superman" are necessarily co-extensional, and necessarily co-extensional terms are co-substitutional in extensional and intensional contexts (though not, as we have seen, in hyperintensional contexts). But when the sentences are embedded under a hyperintensional operator (here: "I think that"), then substituting "Superman" for "Clark Kent" results in a change of truth-value. Such a change in truth-value can only happen if the complements have representational content, because only representational content can undergo a shift in truth-value when embedded under an intensional or hyperintensional operator. To see this, suppose for reductio that hyperintensional operators do not operate on representational content. The question then arises what role expressions like "Lois Lane believes that" play. Consider the sentences in (12) and (13), as uttered by Lane:

(12) I believe that Superman is in love with me.
(13) I believe that Clark Kent is in love with me.

If the expression "I believe that" does not operate on representational content, then presumably its function is to specify that the relation of belief obtains between Lois Lane and an external, mind-independent fact. (12), for example, informs us that the relation of belief obtains between Lois Lane and the fact that Superman is in love with her (which we assume is true). The

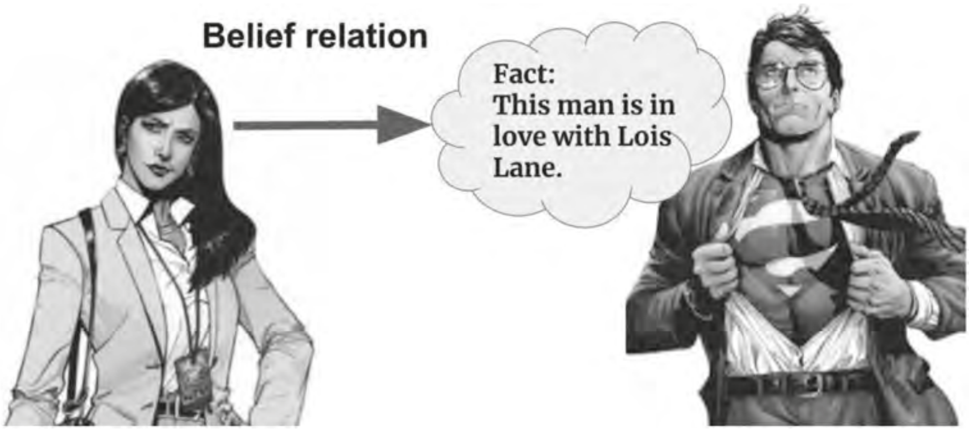

Figure 12.3 Hyperintensional operators. Expressions like "Lois Lane believes that" function as specifiers of an attitude relation (here that of belief) between the person holding the attitude (depicted on the left), and a fact, here the fact that Superman (depicted on the right) is in love with Lois Lane.

problem is that if it is a fact that Superman is in love with Lois Lane, then clearly it is also a fact that Clark Kent is in love with her. After all, Superman and Clark Kent are one and the same person. So, the fact that Superman is in love with Lois Lane is identical to the fact that Clark Kent is in love with her (see Figure 12.3). So, (13) then conveys exactly the same information as (12). Yet intuitively, (13) is true and (12) is false. So, by reductio, it follows that expressions like "I believe that" are operators on representational content.

The intermediate conclusion in (III) follows from (I) and (II). The argument for Premise (IV) runs as follows: The only natural candidate to serve as the intensional mental state depicted by "see that" constructions is the state of seeing. So, given that "see-that" operates on representational content, seeings too have representational content. So, they are representational mental states. This establishes the truth of Premise IV.

In what follows, we will utilize this account of the semantics of "seeing" to argue that the dominant interpretations of the empirical evidence fail to take into account that seeing can have both purely visuo-sensory and visuo-epistemic readings. Moreover, we shall show that this distinction sheds light to MQ.

The semantics of "see" and Molyneux's question

We are now ready to apply Brogaard's semantics for "seeing" to discuss the empirical evidence pertaining to MQ. Though we will briefly revisit the historical cases here, our focus will be on the question of why the research participants in the more recent study by Held and colleagues (2011) did remarkably well when asked to compare, say, two shapes visually (in the VV task) but performed at a chance level when the task was to compare two shapes when one is presented through touch and the other through sight (in the TV task).

As noted above, when it's implied that the perceiver is knowledgeable about what she is seeing, "seeing-that" constructions have visuo-epistemic readings rather than purely visuo-sensory or perceptual readings. Consider the following:

(14) S.B. could see that the crescent object outside the window was the quarter moon.

The visuo-epistemic reading is not an option in the scenario in which S.B. is still under the impression that the crescent shape he was seeing when looking out the window was just a reflection. This is apparent in example (15) below:

(15) S.B. could see that there was an object with a crescent shape outside the window, but he did not realize that it was a quarter moon.

(15) indicates that S.B. did not know that what he was seeing prior to being told that the crescent shape he was seeing was the moon. So, "to see" picks out a purely visuo-sensory state in (15). That also goes for "to see" in (14). Recall S.B.'s surprise when he realized that the crescent shape he was seeing was a quarter moon. He was seeing the moon, but since he thought that the quarter moon would look like a piece of cake, he didn't know that the (crescent shaped) object he was looking at was the moon. It was not until he was told as much that he became aware of the identity of the object whose (crescent) shape he was already able to see. So, S.B. was immediately capable of seeing certain low-level properties of the objects he was looking at, for instance, the crescent shape of the moon, but he was unable to identify the crescent shape as the quarter moon. Visual object identification (or recognition) requires visually detecting higher-level properties, e.g., being the moon or being a MacBook Pro (see Brogaard & Chomanski, 2015), which may not have been tactually available to newly sighted subjects. So, the mental states associated with visual object identification are not purely visuo-sensory states but rather visuo-epistemic states. The reason for the lack of a visuo-epistemic reading of (14) thus is that S.B. never had a chance to explore a model of the quarter moon (let alone the quarter moon itself) through tactile manipulation. But if no tactile information about the identity of an object is acquired in the first place, then no tactile information is available for the visual system to access for the purpose of visually identifying the object and not just its shape.

We can avail ourselves of a similar explanation in order to account for the relevant reading of (16).

(16) When M.M. regained his vision, he saw that the curtains in his hospital room and the armchair by the wall both had this strong, fascinating, bright color, but he did not recall ever having seen that color before and he was unable to name it.

(16) could be an accurate description of a scenario in which M.M. is able to see that the curtains and the armchair have the same color ("this color," where "this color" refers to red), even though he does not possess the concept of red and is unable to recognize the color of the fire truck parked outside the hospital when he eventually is allowed to go home. Because colors are not common sensibles, M.M. clearly doesn't and couldn't have had information about the color red through the sense of touch. Yet after regaining his vision, he is able to pick up on properties such as chromatic contrast and brightness, which enables him to see when two objects presented to him simultaneously have the same color. Yet picking up on such properties doesn't suffice for identifying or recognizing the color as, say, red.

To see this, imagine a task in which you (a normally sighted person) are asked the following question: What are the names of the specific shades of the three colored shapes, e.g., chartreuse, lime, and lemon, placed in front of you? Even if you were able to identify these shades when they are presented next to each other, would you be able to tell which is which if they were then presented one at a time in a random order? Although this task differs from the color tasks S.B. and M.M. actually performed, it may illustrate the difficulties S.B. and M.M. were facing when looking at colors. Indeed, the available empirical evidence indicates that the descriptions in (15) and (16) above fairly accurately captures what S.B. and M.M. initially were able to see prior to learning to recognize *what* they saw.

Because S.B. and M.M. lacked the concepts of moon and of red, they were unable to *recognize* the relevant objects as being the moon or being red, even though S.B. was able to see the crescent shape and M.M. was able to see that the red armchair and the red curtains each had *that color*, where "*that color*" refers to red, and, therefore, also were able to see that the armchair had the same color as the curtains. Recall that once S.B. and M.M. had the respective color concepts, they quickly learned to recognize the colors shown to them after further practice.

In the above case studies, there is a very good explanation of why S.B. was unable to recognize the crescent shape *as the moon* and why neither S.B. nor M.M. were able to recognize colors prior to practicing. S.B. was unable to recognize the crescent shape as the quarter moon because he had no previous tactual experiences with the quarter moon. S.B. was unable to recognize the object he was looking at *as the moon* because he never had explored a model of the moon (let alone the moon itself) tactually. In the case of the failure to recognize colors after having their sight restored, the explanation is that colors aren't common sensibles, they are unique to vision. So, S.B. and M.M. wouldn't have had any information about colors that they would have acquired through the other senses.

It's one thing to completely lack prior information about a certain type of thing (e.g., colors, which are not common sensibles) owing to a visual deficiency (as with the color cases discussed above) and quite another to lack visual information about common sensibles (such as shapes) one is already highly acquainted with but only through the sense of touch. It is the latter question that was of interest to Molyneux. This is the question we want to turn to now.

Unlike most earlier studies, the study by Held and colleagues (2011) examines whether information acquired in a more direct fashion through touch alone can be transferred or made accessible to the visual system once one's sight is restored. Recall that in this study, newly sighted subjects were given three tasks: a vision-to-vision (VV) task, where they were asked to match one of two visually presented stimuli with a visually presented target; a touch-to-touch (TT) task, where they were asked to match one of two tactually presented stimuli to a tactually presented target; and a touch-to-vision (TV) task, where they were asked to match a tactually presented target to one of two visually presented stimuli (Figure 12.2). The shapes used in these experiment were complex and unusual (again, see Figure 12.2). Nevertheless, the results indicated that newly sighted subjects performed well on the TT and VV tasks but not on the TV task. Why is that? According to the experimenters' own interpretation, the results indicate that the answer to MQ is negative because the newly sighted subjects were capable of forming both visual representations of the requisite shapes (S(visual)) and tactile representations of the requisite shapes (S(tactual)), but were unable to properly connect the tactile shape representations to the visual shape representations (at least not without perceptual learning).

As can be expected, the results by Held and colleagues (2011) did not escape critical scrutiny from philosophers interested in MQ. In what follows, we first outline one of the most widely discussed critiques of the experimenters' own interpretation of the results. We then propose an alternative (though perhaps not necessarily a competing) way of disputing the original interpretation, ultimately connecting it with Brogaard's semantics of seeing and showing how the latter can be helpful in both formulating the critique of the conclusions of Held and colleagues (2011) and sharpening our understanding of their results' relevance to MQ.

Low-level properties and low visual acuity

One argument against Held and colleagues' own interpretation comes from Schwenkler (2012, 2013), who points out the experiments failed to establish that the subjects did indeed form "robust" visual representations of shape. He writes:

> In the VV task, subjects needed only to make gross discriminations based on the overall appearance of the stimuli, *which were presented from a single viewing angle*. Intuitively, this can be done by attending to low-level visual features like colour, shadow and approximate overall contours: think for example of what it is like to distinguish objects seen at a far distance, without being able to really make them out. In contrast, such a crude strategy would not suffice for the cross-modal task, which made low-level visual cues irrelevant and demanded robust shape representations that could be compared across modalities. Given this difference, the subjects' evident ability to discriminate objects visually does not guarantee that their capacity for visual form perception sufficed for an experimental resolution of Molyneux's puzzle.
>
> *Schwenkler 2013: 91; italics added*

Schwenkler's point is that the subjects' inability to match *seen* to *felt* shapes in the TV task need not have resulted from the alleged inability to match robust visual representations of the shapes to robust tactile representations of the very same shapes. Recall that the experimenters maintain that subjects must have been able to form robust visual representations because they performed extremely well on the VV task. Schwenkler, however, rejects this assumption. He argues that the combination of low visual acuity (a possible result of prolonged blindness) and suboptimal viewing circumstances (viz., subjects were only allowed to view the stimuli from a single perspective) could have prevented the subjects from forming the sort of robust visual shape representations needed for better performance in the TV task. Intuitively, he argues, if the subjects were only able to detect low-level visual features and those were insufficient for the formation of the requisite visual shape representations, we would expect them to perform better in the VV task than the TV task. In fact, if they were not forming robust visual representations, then their visual performance ought not to have been affected, provided that the detection of low-level visual features is all that's needed to successfully match seen shapes. The inability to form robust shape representations would only have negatively affected performance in the VV task if non-cross-modal tasks require the ability to form robust visual representations. So, if these differences in performance between the VV and the TV tasks are attributable to the subjects' lacking the requisite visual representations, they have no bearing on MQ.

Higher-level perception and viewpoint-independent properties

A second argument against the experimenter's own interpretation runs as follows. It is possible that the subjects could not map their tactile shape representations to their visual shape representations because newly sighted individuals lack the capacity to form viewpoint-independent visual shape representations (or what are also known as "allocentric" visual representations (see e.g. Ma et al., 2003; Brogaard, 2012a; Farivar, 2009). As mentioned earlier, the functional capacity to make full use of visual signals requires the activation of area V1 as well as the activation of extrastriate areas, which are responsible for face and object recognition (Fine et al., 2003; Held et al., 2011; Huber et al., 2015; Sacks, 1995). An optically restored eye enables individuals to form viewpoint-dependent (roughly, what David Marr

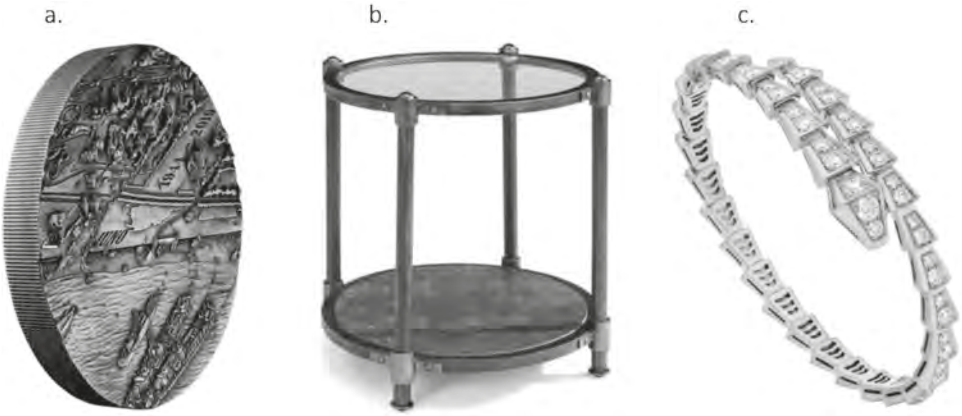

Figure 12.4 Circular-shaped objects seen from an angle.

a. Surface of a Canadian silver coin. b. Tabletop. c. Bracelet.
Image credit: Brit Brogaard.

calls 2½ sketches) or egocentric visual shape representations but that is insufficient if cross-modal tasks require the ability to form viewpoint-independent (or allocentric) visual shape representations.[7] In that case, contrary to Schwenkler, even if the subjects were allowed to view the stimuli from various perspectives, their performance on the TV task would still have been below average. However, their performance on the VV task would likely remain unaffected, as the task of comparing visual stimuli that are presented simultaneously arguably doesn't require viewpoint-independent representations. The latter are only required for visual object identification or recognition.

To appreciate the difference between the two ways of seeing shapes, consider the three objects in Figure 12.4. Perceivers always perceive three-dimensional objects from a specific point of view. From their vantage point, the surface of the silver coin, the tabletop, and the bracelet make oval-shaped imprints on the retina. Yet people with normal sight only rarely pay any heed to the viewpoint-dependent, egocentric properties of objects. When viewed in their natural environments, the surface of the silver coin, the tabletop and the bracelet all look circular-shaped. Yet newly sighted individuals initially only see their viewpoint-dependent *oval* shape.

Blind people often use touch to explore their environment (e.g., with a cane) and to form viewpoint-independent *tactile* shape representations (although an increasing number of blind people now rely on visuo-auditory representations generated on the basis of echoes from clicking sounds they produce with their tongue or an artificial device (see Brogaard & Marlow, 2015). However, even within the visual domain, it can be rather difficult to create a three-dimensional shape that matches a visually presented two-dimensional shape (Figure 12.5). Also known as "block design testing," this type of 2D to 3D matching task is a component of the Wechsler intelligence scale, one of the most widely distributed intelligence scales in the world (Wechsler, 1949).

There is a difference between what newly sighted subjects see and what we (that is, perceivers who have had no visual defects) see because our visual system has acquired the ability to compute shape constancy. This means that we don't just see the viewpoint-dependent properties, but also the viewpoint-independent properties, and typically pay no heed to the viewpoint-dependent properties. That is why even we find block design tests challenging. Newly sighted

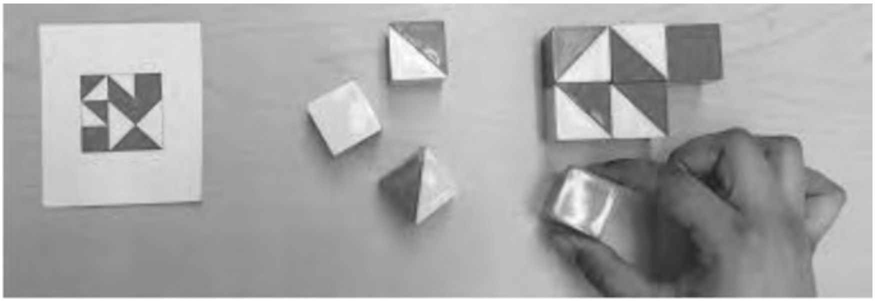

Figure 12.5 Matching task.

The block design component on the Wechsler intelligence scale assesses your ability to match two-dimensional visual inputs to three-dimensional visual outputs. The difficulty level of the task should give us some idea of just how difficult matching viewpoint-dependent (2½ sketch) visual shapes to three-dimensional tactile shapes is for newly sighted people.
Image credit: Wikimedia.

subjects, by contrast, lack the ability to compute shape constancy and, as a result, are not knowledgeable about what an S-shaped object would look like from their particular perspective. It is not surprising then that they are unable to match the felt S-shape with the seen S-shape.

Visuo-sensory states and MQ

The above arguments against the experimenters' interpretation of their results provide plausible explanations for why the newly sighted subjects (in Held et al., 2011) performed better in the VV task than they did in the TV task. They are nevertheless at odds with the experimenters' view that their findings indicate that the answer to MQ is negative. We shall argue that adequately addressing MQ requires a better understanding of what we mean by "see". To appreciate the significance of the semantics of seeing to this issue, let us start by reconsidering the argument involving viewpoint-independent properties.

Recall that it is plausible that the subjects see that the S-shaped object has the viewpoint-dependent shape that an S-shaped object has when seen from that particular perspective. What matters in considering the answer to MQ is whether the subject is knowledgeable or not about the viewpoint-*independent* shape of the S-shaped object. In other words, what matters is whether seeing (as it pertains to newly sighted subjects) is visuo-epistemic or visuo-sensory. Recall that visuo-epistemic seeing is not a purely perceptual state because it requires that the subject can identify the object or property she is seeing. If visuo-epistemic seeing requires tracking the viewpoint-independent properties of the object, then newly sighted subjects would underperform on the TV task (despite succeeding on the VV task). The reason is that they would be unable to detect the viewpoint-independent shape of the object since they would lack the ability to form viewpoint-independent shape representations through sight. Matching two visually represented shapes, both seen from an angle, is presumably a lot easier than matching a viewpoint-independent tactile shape representation to a viewpoint-dependent, visual 2½ sketch.

Consider again the Canadian silver coin in Figure 12.4. We know that the visual system of newly sighted subjects is not yet capable of representing the circular coin's surface as circular-shaped (that would require activation of extrastriate areas, which is not present in these subjects. See Fine et al., 2003; Huber et al., 2015). Newly sighted individuals are prone to see the coin as oval-shaped because they are not sufficiently knowledgeable about how objects with a given viewpoint-independent shape looks from different vantage points. This is why they are unable to see the viewpoint-independent shapes of the objects until they have gone through the requisite perceptual learning process. Consider the following example:

> (16) Subject *S* was able to see that the tabletop was oval-shaped from her vantage point but unable to see that its surface was circular-shaped.

In the envisaged scenario, (16) would provide an accurate description of visuo-sensory seeing, not visuo-epistemic seeing. It's only once *S* becomes knowledgeable about how a circular-shaped tabletop looks from a vast number of different vantage points that she will be able to acquire the ability to (visuo-epistemically) see what the tabletop's viewpoint-independent shape (or its "shape-constant") is. For, what's required for visuo-epistemic seeing is higher-level properties (e.g., viewpoint independent/allocentric properties). By comparison, when *S* is asked to match the coin she sees as oval-shaped with another coin she also sees as oval-shaped (in the VV task), she is more successful since her ability to correctly match the two coins is not based on having the ability to (visuo-epistemically) *see* its viewpoint-independent shape. Purely visuo-sensory seeing (as opposed to visuo-epistemic seeing) does not require background knowledge, say, of what an object with a particular viewpoint-independent shape looks like from a particular perspective. For, what's needed for visuo-sensory seeing are low-level properties (e.g., viewpoint-depended/egocentric properties). However, once a subject has background knowledge, then she will be more likely to attend only to the viewpoint-independent shape of the object.

Assuming that newly sighted subjects are unlikely to pay attention to the viewpoint-dependent tactile shape of objects when they are using their sense of touch, it seems unlikely that they would be able to match the felt viewpoint-independent shape they acquired through touch to the viewpoint-dependent shape that they acquired through vision. So, if seeing is visuo-sensory, Held and colleagues (2011) are right in saying that their results suggest a negative answer to MQ. If, however, seeing is visuo-epistemic—if seeing requires knowledge of, say, viewpoint-independent properties—then Held and colleagues' experiments do not yield a clear answer to MQ. This is because the participants in their study do not seem to have such knowledge—hence, they do not see in the relevant sense.

Conclusion

In this chapter, we argue that the current empirical evidence can only provide an answer to MQ once we get clear about the semantics of "seeing." However, as we have shown, the dominant interpretations of the empirical evidence fail to take into account that seeing can be not only purely visuo-sensory but also visuo-epistemic. In other words, they fail to take into account that in many cases seeing requires prior knowledge of what is being seen. On the one hand, the fact that S.B. was surprised when he realized that the crescent shape he was seeing was a quarter moon suggests that seeing should be understood as visuo-epistemic. On the other hand, the fact that S.B. was able to see the crescent shape *as* the moon only after he learned that the quarter moon does not look like a piece of cake but like a half-eaten cookie suggests that, in this case, seeing should be understood as visuo-sensory. What these cases illustrate is that whether empirical findings provide a negative answer to MQ will depend on whether seeing is visuo-sensory or visuo-epistemic. Specifically, it should not be assumed that because a newly sighted individual's vision has been corrected at the retinal level (as has been the case with cataract surgeries) that their ability to navigate the world is based purely on vision-sensory seeing. It follows that having a better understanding of the semantics of seeing can helps us to better assess whether the current empirical findings can provide a negative or positive answer to MQ. Moreover, a better understanding of the semantics of seeing can enable researchers to devise experiments that can settle the debate in the future.

Notes

1 The authors names appear in alphabetical order and do not indicate the order or extent of contribution.
2 For criticism of Schwenkler proposal see Connolly, 2013, and Cheng, 2015.
3 For example, if the lesion is located in the left hemisphere, the blindsight patient will lack or have noticeably degraded visual consciousness in portions of their right visual field.
4 Interestingly, type-2 blindsight seems to challenge the part of Berkeley's (1709/1975) argument for idealism that begins with John Locke's (1658, see Book II, Ch VIII) distinction between primary qualities (e.g., extension) and secondary qualities (e.g. color). Berkeley argues that you cannot perceive extension without also perceiving color (and vice versa); so if color is a mind-dependent property, as Locke claimed it was, then so is extension. Type-2 blindsight casts doubt on Berkeley's premise that you cannot perceive color apart from extension or extension apart from color.
5 It has been suggested that blindsight patients can consciously see action properties of an object without seeing *the object* (Nanay, 2012), although this view has been criticized (see e.g., Raftopoulos, 2014, and Ferretti, 2019).
6 See also Bourget, 2010.
7 Jesse Prinz (2012) takes the 2½ sketches to be distinct from the egocentric representations. He calls them "mid-level representations" and takes those to be correlates of consciousness.

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