

APhEx 19, 2019 (ed. Vera Tripodi)
Ricevuto il: 25/10//2017
Accettato il: 14/5/2018
Redattori: Andrea Borghini & Matteo Morganti

APhEx
PORTALE ITALIANO DI FILOSOFIA ANALITICA
GIORNALE DI **FILOSOFIA**
NETWORK
N° 19, 2019

O P E N P R O B L E M S

Molyneux's Puzzle: Philosophical, Biological and Experimental Aspects of an Open Problem

Gabriele Ferretti

Can a subject born blind, who learnt to discriminate specific shapes by using touch immediately recognize, in the case in which her/his vision is suddenly restored, the same shapes placed before her/his eyes by using vision? This is the famous Molyneux's puzzle. This paper explains why such a question still represents a significant open problem for both philosophers and vision scientists. The paper will focus on the following crucial aspects concerning the investigation of the problem: (i) the interpretation of the question; (ii) the possibility of sight restoration from blindness, in relation to (ii a) the biological issues we must face when trying to restore sight successfully and (ii b) the experimental issues we must face when trying to test whether sight has been successfully restored. The analysis of these three important aspects of the

problem at stake here will lead us to understand what we can (and what we cannot) do at the moment, when trying to answer to this question. This will be possible by tackling the problem from an interdisciplinary perspective, in the light of what we know about vision from ophthalmology, visual neuroscience, biology, phenomenology and analytic philosophy of vision.

TABLE OF CONTENTS

1. INTRODUCTION
 2. DIFFERENT INTERPRETATIONS OF MP
 3. DIFFERENT KINDS OF BLINDNESS
 4. BIOLOGICAL AND EXPERIMENTAL CONSTRAINTS ON VISUAL RESTORATION
 5. Q1, Q2 AND RESTORATION
 6. WHAT WE CAN('T) DO AT THE MOMENT
 7. CONCLUSIONS
- REFERENCES

1. Introduction

You're going for a walk and you put your keys, your wallet, and your phone inside your bag. As you are walking, your phone rings. You decide to pick up. To do so, you don't need to look into the bag. Tactile exploration suffices to realize where the phone lies.

This familiar situation suggests something important about cross-modal associations: touch and vision are related so deeply that we can effortlessly be entertained with the shape of the phone in two different sense modalities. Sometimes, the cross-modal association is accidental. When you sniff an olive in your hands, there is a sense in which you can tactilely recognize that the object you are sniffing is the same you are touching: the olive. There is no strict link between this particular odor and that particular shape. Perceptual learning structures this form of arbitrary association. With cross-modal recognition of forms concerning vision and touch things are different. Touch delivers the same shapes we explore through vision: we can be acquainted with a shape through both sense modalities. Shapes can manifest, one might say, cross-modally: in vision *and* in touch.

How can vision and touch be so closely related? A way to investigate the question is to ask whether the cross-modal relation of vision and touch requires

perceptual learning in order to be performed or whether, conversely, touch and vision are bound prior to and independently of any form of perceptual learning. Such an investigation remains, at the moment, an *open problem*, captured by the famous Molyneux's puzzle (MP): can a subject born blind who learnt to discriminate specific shapes by using touch, immediately recognize, in the case in which her/his vision is suddenly restored, the same shapes placed before her/his eyes by using vision (Degenaar and Lokhorst 2014; Glenney 2012, 2018)? This paper explains why MP still represents a significant open problem for both philosophers and vision scientists.

MP could be regarded as a genuinely philosophical question about the nature of perceptual experience, i.e. about the nature of our capacity to entertain the same perceptual content, a shape, across different modalities. Philosophers embracing a naturalistic perspective agree that, in order to answer this philosophical question, we can rely on the empirical results from vision science based on appropriate experimental settings in which subjects with properly restored vision are asked to visually judge the shapes they were able to discriminate tactually when they were blind.

However, a question related to the biological nature of vision stands in the way of our experimental investigation: can we successfully restore vision (and if so, to what extent)? To answer such a question we must build an appropriate experimental condition. We need to understand both whether vision can be successfully restored and whether we can build a reliable empirical test to provide evidence that, with respect to the biological constraints over vision, vision is restored. Only such a test would prove whether the cross-modal matching is already present or not.

Now, several conceptual and empirical problems stand in the way not only of a possible solution to this puzzle, but also of a proper realization of the conditions we need to obtain in order to properly realize the experimental setting needed to test the puzzle. Furthermore, we still do not know whether the challenges in reaching this experimental scenario, an enterprise that is ruled by the biological constraints of such an attempt, is a matter of principle or, rather, depends on our present knowledge of the biology of vision. But we saw that investigating such an impossibility at the experimental and at the biological level is crucial for the conceptual evaluation of the philosophical puzzle, at least from a broadly naturalistic perspective.

Also, several attempts to reach the experimental scenario needed to answer the MP have failed, as we shall see, for different reasons. One reason used in support of a negative answer to MP – i.e. as to whether such a cross-modal match is possible before perceptual learning - turned out to be, however, only a negative answer to the biological question concerning whether, in the specific experimental case at stake, vision was properly restored. The basis of error was that the experimental test was poorly designed to assess the effectiveness of such a restoration. Further challenges include a need to define what ‘visual restoration’ means, vision being a very complex phenomenon. This suggests that the problem is open in a hierarchical manner.

The task of this paper is to make the reader able to appreciate the distinction between answers to MP itself and the methodology used to appropriately evaluate them in order to reach a satisfying answer to MP. I’ll offer a general analysis of the main specific problems we need to resolve in order to properly be in the conditions of trying to answer MP. Most of the focus of MP has been devoted to whether the answer would be negative or positive. I review the recent attempts that have tackled such a puzzle in order to suggest whether, on the basis of what we have obtained up to now, Molyneux’s question can be answered at all, by discussing the biological and experimental problems, and the related conceptual interpretations, standing in the way of a possible reliable empirical test.

2. Different interpretations of MP

A first important specification is about what the question is actually asking (Gallagher 2005; Ferretti 2017). We know that “Subjects must exhibit acuity sufficient to discriminate visually among the objects used for testing” (Held 2009: 585). They have to be able to visually discriminate and identify shapes in a way that is sufficient for shape cross-modal matching (Schwenkler 2013: 92). So, it is one thing to ask the following question:

(Q1) Can Molyneux subject see the shapes in question, so as to be able to make a sufficient ‘visual discrimination’ concerning the distinction between the shapes?

It is another to ask this other question:

(Q2) In case the Molyneux subject *can see* the shapes in question, and is, thus, able to make a sufficient ‘visual discrimination’ concerning the distinction between the shapes - so as to “form robust representations of visual shape” (Schwenkler 2013: 93) - can she recognize the cube and the sphere?

Q2 is the question at stake in MP (see the discussion by Gallagher 2005 of Degenaar 1996 and Evans 1985; see also Ferretti 2017). But asking Q2 requires a positive answer to Q1.¹ The shrewd reader might be wondering about whether we can even answer Q1, a question grounded on further important specifications concerning sight restoration. The first thing to consider in answering Q1 is the existence of different forms of blindness.

3. Different kinds of blindness

Can we properly restore sight? When talking about restoration of sight (or vision),² we need to explain what we mean by ‘sight’ so as to be clear about what we mean by its restoration.

Vision is a complex phenomenon that can be analyzed at different levels and with respect to different tasks: colour vision, spatial vision, motion visual detection, etc. (Cattaneo and Vecchi 2011). To this extent, we can visually represent, in different manners, several aspects and properties of the visual scene. What does it mean, then, to obtain a proper answer to Q1 (which, remember, is the only one able to set us in the position to test Q2)? Having visual experience of some kind is not sufficient (though obtaining recovery of visual experience is not trivial from a biological point of view): “What is sight restoration? Certainly meaningless blobs of light should not be considered as such, but equally the ability to restore even relatively poor vision would be a triumph” (Fine et al. 2015).

¹ Degenaar (1996) suggests a ‘no answer’ to MP based on a ‘no answer’ to Q1. I do not endorse this view here. A ‘no answer’ to Q1 does not mean a ‘no answer’ to MP, but just we lack proper biological and experimental conditions that meet the criteria to provide a positive answer, empirically testable, to Q1, which is the prerequisite to test Q2. Many attempts have suggested this way of reasoning (Gallagher 2005; Ferretti 2017). Crucial empirical tests supposed to suggest a negative answer to MP have been proven fallacious, for what they really provided a negative answer to was Q1 (§6).

² ‘Sight’ and ‘vision’ are used interchangeably here.

The process of visual shape recognition must be restored (here I use ‘visual shape recognition’ and ‘visual recognition’ as synonyms), so that the newly sighted subject can exhibit visual acuity sufficient to visually discriminate shapes (Held 2009: 585) thanks to the ability to form robust shape representations (Schwenkler 2013: 93). These recognitional capacities are needed for cross-modal matching (Schwenkler 2013: 92; for a review of this point see Ferretti 2017). This is not a trivial point: we can have a poor visual phenomenal experience of some aspects of the visual scene without recognizing the objects we are in front of (Milner and Goodale 1995/2006; Farah 2004).

In order to further consider whether we can effectively answer Q1, we have to take a closer look at the nature of visual processing. Vision is only possible because of the complex functioning of our visual system whose processing is dependent on the specific interplay of the eyes and the visual cortex. Both of these two components are crucial in order to have visual experience in general and accurate object recognition in particular. The eyes absorb visual information from the environment. This visual information is then transmitted to the visual cortex, which manipulates it in order to give us visual experience of the external world (Milner and Goodale 1995/2006). (Of course, there are very specific portions of the visual cortex involved in visual object recognition we need to restore in order to properly answer to Q1. I’ll get back to this point below). To this extent, the reader should consider that there are two different kinds of blindness: *ocular blindness* and *cortical blindness* (Glenney 2013; Noë 2004: 12; Ferretti 2017). The former depends on malfunctioning of *ocular processing*. The latter depends on malfunctioning of the *cortical visual areas* involved in visual processing.

Suppose we have a case of congenital blindness due to the presence of cataracts. This problem seems to be, *prima facie*, related to ocular processing: cataracts mist up the lens of the eye and, thus, prevent several aspects of the spatial function of vision, like object recognition (luminance and color detection are still possible to some degree). Now, suppose that cataracts are removed through surgery. Arguably, ocular processing is thus restored: the eyes can correctly absorb the information coming from the external environment. One might argue that, in this case, the subject comes back to see, i.e. to perform correct visual recognition. Thus, we might be able to test MP, in the sense of Q2. After all, if cataracts are properly removed, the subject should be able to provide a positive answer to Q1.

Unfortunately, things are not so easy. This restoration does not guarantee restoration of sight, for restoring ocular processing from ocular blindness may not be sufficient to restore visual processing in its entirety: we should assure restored vision at the cortical level of visual processing³, which depends on the cortical development of the individual, i.e. on the fact that the visual cortex has been trained to perform one of its proper functions, namely, visual scene/object recognition, transforming the information provided by the light and filtered from the retina into visual experience related to recognition of things in the environment. Without the possibility of receiving information from the eyes, it is likely that our visual cortex has not been properly stimulated as it should be during the ontogenetic development: cortical visual processing has not undergone the proper *training* needed to develop its proper functioning in object recognition⁴, whose correct development is hugely based on the active coupling with the environment (Ferretti 2017). Furthermore, there is a specific period of recovery from which cortical visual processing involved in object recognition cannot be restored anymore (Gallagher 2005; Ferretti 2017). Thus, if we investigate Molyneux's puzzle by using subjects who have not overcome the critical period, a possible positive answer might be, in principle, positive. But this only suggests that, after the critical period, visual restoration is not possible, while not excluding that, even before the critical period, achieving visual restoration may be very difficult. Cortical visual processing involved in visual recognition can't be restored, in general, as easily as ocular processing can.⁵ Thus, even if ocular processing is 'adjusted' so as to function in an appropriate manner, the computations at the level of cortical visual processing might be still impaired, this leading to visual deficits in visual recognition (Ferretti 2017: Sect. 6; Barrett and Bar 2009: 1325).

Even when ocular processing is restored, the subject shows the same visual impairment as brain-damaged subjects with different lesions of the visual cortex (see Gallagher 2005; Ferretti 2017), in particular, those with specific

³ There might be ocular blindness even if the cortical visual processing is functioning.

⁴ I do not offer any teleosemantic definition of the proper function of the activity of the visual cortex (Millikan 1984). I just focus on one of the most crucial activities it subserves in humans and other animals: visual object recognition (Milner and Goodale 1995/2006).

⁵ Cataracts prevent several aspects of the spatial function of vision, like object recognition, while, however, luminance and color detection are still possible (this meaning that, in this situation, ocular and cortical visual processing are not completely impaired, but their performance of object recognition is).

forms of visual agnosia, an impairment in visual recognition (Ferretti 2017, §6). In some cases, a corneal transplant might restore the possibility to absorb visual information from the environment that can be then sent to the visual brain (Barrett and Bar 2009: 1325 of Fine et al. 2003), while inactivation of the areas involved in visual processing can persist even after a long time (Fine et al. 2003: 915). Research on early visual deprivation from cataract (and even on permanent blindness) suggests that early sensory inputs are crucial for the functional organization of the visual cortex: “when visual input is delayed until cataracts are removed, there is only partial recovery of visual capabilities” (Maurer et al. 2005: 144).

Someone might suggest restoring ocular processing before we lose the opportunity for cortical visual processing to perform its proper function. But, things become more complicated because there exists other problems we have to consider concerning the possibility of visual restoration, which I will address below. Before this discussion, there is an important specification I need to make.

Since we might distinguish, in principle, between two forms of blindness, i.e. ocular and cortical blindness, we can also consider two kinds of restoration. And since the visual system is a complex machine, restoring ocular processing might not be sufficient to restore visual brain processing. Thus, restoration from ocular blindness will not provide a subject with ‘proper’ visual recognition.

I’ve been using the notion of ‘restoration’ of visual processing involved in visual recognition broadly. Now I discuss the conceptual problems related to the experimental practice which stand in the way of a possible reliable test specifically regarding a scenario in which ocular processing is restored before the critical period of deterioration of the proper function of cortical visual processing.

4. Biological and experimental constraints on visual restoration

Investigating the puzzle at stake requires following a crucial constraint: at the time of the experiment vision must be known to be successfully restored, or what is taken to be a negative answer to MP is, indeed, a proof that we have not reached the scenario that allows us to properly test the puzzle. In other words, a negative answer to Q1 undermines a test of Q2, though it might be taken as

leading, mistakenly, to a negative answer to Q2.⁶ This is something that has frequently happened in the experimental practice aimed at tackling MP (Jacomuzzi et al. 2003; Schwenkler 2013; Gallagher 2005; Glenney 2013; Ferretti 2017).

Restoration presents several problems. For one, vision scientists suggest that the test be performed “as soon after surgery as possible - ideally when bandages are first removed” (Held 2009: 595). This would exclude acquisition of visual capacities by experience. However, for different reasons, restoration is never immediate but slow and, in most of the cases, cannot be complete, even after a long time period (Jacomuzzi et al. 2003: 260-262; Fine 2003; Smith 2000: 497). Also, in the critical period of recovery we cannot distinguish between optical problems due to the post-operative traumas and the effects of perceptual learning (Jacomuzzi et al. 2003: 262). Furthermore, several visual problems at the computational neurophysiological level (Gallagher 2005; Degenaar 1996; Ferretti 2017; Smith 2000) “persisted after as much as 4 months, and, in one case, even after 1 year” (Jacomuzzi et al. 2003: 260). There are also different times related to different visual recoveries in relation to different visual impairments (Ostrovsky et al. 2006; Lewis and Maurer 2005; Maurer et al. 2005; see also the data recollected from *Project Prakash*: (Thomas 2011). To this extent, it has been clearly shown that “visual recovery after blindness that occurs early in life is never complete.” Thus, several problems related to visual memory, visual organization, shape and face recognition, and simultaneous processing of visual information are present (Šikl et al. 2013: 498). Crucially, even in a case where vision was almost sufficiently and almost suddenly restored, allowing to test the subject not long after the surgery (Held et al. 2011; Held 2009), the arrangement of the experimental setting has been judged inadequate (Schwenkler 2013, §6).

This suggests that the possibility of successful restoration of visual processing is the most insidious and problematic aspect standing in the way of an answer to MP. But, the reader might not want to give up, and may invoke the

⁶ There might be variants of MP, investigated with different methodologies (for example, the case of sensory substitution devices (Jacomuzzi et al. 2003: 270) or the case of phosphene perception (Evans 1979)), for which it seems that the negative answer to Q1 does not entail a negative answer to Q2. Here I do not consider these ‘many lives of Molyneux’s question’ (Glenney 2013: 541) their constraints and their implications. I thank an anonymous reviewer for suggesting me to add this important point.

methodological claim that testing whether cross-modal matching is possible at first sight depends on what we mean by 'at first sight'. Arguably, the test should be done provided that the subject has visual recognition restored when, at first sight, she is asked to judge. Can this condition be satisfied? We saw there are several problems. This condition is unlikely to be met if we want that recognition *at first sight* coincides with the first sight the individual can take soon after bandage removal. So, we should grant more time for visual recovery.

Thus, maybe the constraint that the test should be performed "as soon after surgery as possible" (Held 2009: 595) is too demanding and strong. Call this the constraint concerning *temporal immediacy*. We might decide to use another constraint, the one called of *epistemological immediacy*, introduced by Levin (2008; for discussion see also Glenney 2013; Ferretti 2017). We should allow the subject to heal "between visual restoration and shape recognition, while assuring, through controls, that subjects remain experientially and inferentially naive regarding identifying shapes by sight alone" (Glenney 2013: 460). Unfortunately, what seems to be a more reasonable constraint on restoration might be very hard to apply. Levin's epistemic criterion aims to avoid the numerous problems associated with the possibility of visual restoration by allowing subjects to heal, without allowing them to develop perceptual learning. However, several philosophical analysis and experimental practices suggested this is something very hard to obtain: we don't dispose of a criterion that guarantees complete healing of the visual system without the risk of acquisition of perceptual learning (Jacomuzzi et al. 2003; Ferretti 2017). For example, we need to remove the bandage from the subject's eyes after the surgery, in order to allow her visual system to absorb visual information so to initiate the process of reacquisition of the capacity to manage the visual input from the environment. But we can't exclude the possibility that right after bandage removal there will be a perceptual learning that marches in step with the recovery of the physiological function of the visual system. Indeed, that there are no satisfying controls allowing to manage whether, soon after the operation (and bandage removal) visual processing functions in such a way due to full (optical and cortical) visual restoration or due to learning experience (Jacomuzzi et al. 2003; Gallagher 2005; Ferretti 2017: Sect. 3). It is also very difficult to exclude the possibility that "simple world exposure" (Held et al. 2011) does not foster perceptual learning. In certain cases, visual processing might not be completely restored, but might have begun to become minimally

functioning. But restoration might also take so long so as to be impossible to offer a very meticulous observation and control on the subjects.

For these reasons, the default experimental practice employs *temporal immediacy* (e.g. Held et al. 2011): as soon after surgery as possible, ideally when bandages are first removed (Held 2009: 595). However, as I discuss in Section 6, it has been argued that these subjects were not ready for the discrimination test, even if they had been judged to have sight (Schwenkler 2013).

5. Q1, Q2 and restoration

The literature from vision science, as well as the philosophical reflection about the empirical results provided by such a literature, seem to suggest that we are not in the position to obtain a positive answer to Q1, and, thus, to reliably test Q2. If the subjects being tested have some visual experience, it is judged too poor; they are not in a condition for performing robust visual discriminations for shape recognition. In some cases, patients describe a cube as “a square with lines” (Fine 2003: 915) and seem to possess a “limited capacity to form 3D visual representations of complex objects” (Schwenkler 2015). Problems in the 3D interpretation of retinal images is also present (Fine 2003: 915). In certain cases, after cataract removal, all visual experience seems to be mixed up and blurred in the visual scene (Sacks 1995: 114; cfr. with Noë 2004: 5).

While “causes for failing to recognize shapes may be due to residual effects of either optical or cognitive blindness” (Glenney 2013: 544) - blind subjects can be ‘double blind’: perceptually and cognitively (Noë 2004: 12) - visual processing presents several stages (Downing et al. 2006), and so visual problems might occur at any different stage of the computational visual processing (Glenney 2013; Ferretti 2017): “The number of ways to see and the variety of kinds of visual deprivation all directly related to the physical level alone suggest that there are a number of ways in which the newly sighted might both succeed and fail in shape recognition” (Glenney 2013: 544). All this to say, there are several experimental settings used to test Molyneux’s puzzle and related debates about which is the best experimental paradigm and best kind of subject for such a paradigm (Jacomuzzi et al. 2003).

Unfortunately, subjects involved in the test show several problems both at the ocular level and at the different stages of the cortical visual processing (for a review see Jacomuzzi et al. 2003; Gallagher 2005; Ferretti 2017).

6. What we *can('t)* do at the moment

Here is a recent crucial experiment. Held et al. (2011) tested, after ocular sight restoration, the ability of some patients “to visually match an object to a haptically sensed sample after sight restoration” (p. 551). The study is supposed to show, as the title says, that “newly sighted fail to match seen with felt”, because immediate cross-modal transfer is impossible before perceptual learning (and it develops after a few days with real world contact) (p. 552). This seems to suggest that vision and touch are not linked before experience so as to allow to perform cross-modal recognition.

Schwenkler (2013) suggested that the negative result might be due to problems with the experimental setting, which does not allow the subjects to recover robust 3-D shape representations⁷. Thus, instead of providing an answer to MP, this study only suggests that vision is not completely restored: subjects can attend to “low-level visual features like colour, shadow and approximate overall contours” (p. 91), without having “robust shape representations that could be compared across modalities” (Id.) Therefore, this study only seems to suggest that we have to carefully pay attention to the constraints imposed by such a very sharp puzzle: the test only shows that we do not have a positive response to Q1. But, as argued above, such a response is a prerequisite to test Q2⁸.

Schwenkler proposed to “re-run Held and colleagues’ experiment with the stimulus objects made to move, and/or the subjects moved or permitted to move with respect to them” (Schwenkler 2013: 94). This, arguably, might help the subjects build proper shape representations (Schwenkler 2013: 94 of Fine et al. 2003: 915; Ostrovsky et al. 2009: 1489).

But things are not so easy. Connolly (2013) suggests that allowing the subjects to move around the shapes is not sufficient to improve the experiment.

⁷ For a discussion of similar experimental scenarios see (Gregory 2003; Ostrovsky et al. 2006; Glenney 2013: 548; Jacomuzzi et al. 2003: 259-262).

⁸ See footnote 6.

Indeed, the subjects' visual systems likely cannot properly process depth properties of objects.

Schwenkler also suggested another way to re-run the experiment: using planar shapes instead of 3-D objects. This proposal is, according to Connolly, feasible. However, Cheng (2015) suggests that this is very problematic and that, maybe, testing the puzzle reliably might be harder than previously thought, thus leaving open the experimental question of whether we can build a reliable experimental test. Accordingly, Clarke (2016) suggests that subjects might present several problems concerning not only recognitional visual processing, but also the inferences that allow the formation of the perceptual beliefs related to visual recognition.

In a previous work, I have suggested (Ferretti 2017) that we should analyze MP in the light of our most recent and influential account from vision science of how our visual system works, '*The Two Visual Systems Model*' (Milner and Goodale 1995/2006), which suggests the hodological separation of our visual brain in (at least) two main visual streams: a ventral stream that subserves conscious visual recognition and a dorsal stream that subserves unconsciously guided action. The analysis of MP based on this model considered not only the classic MP, but also another formulation of it concerning vision-for-action, which asks about whether Molyneux's subject would be able to grasp the object 'at first sight'. This contribution suggests that, due to the lack of proper ontogenetic development, the subjects of Molyneux's two different questions show the same visual impairment as brain-damaged subjects with different lesions of the visual cortex: the subject of MP shows the same impairment in visual recognition as a visual agnostic subject, while the subject of the question concerning vision-for-action shows the same visual impairment in visuomotor processing as an optic ataxic subject⁹. Taking into account the difference between ocular and cortical blindness suggests that these impairments still hold, even if ocular processing is restored. Therefore, without the possibility of an answer to Q1, the required experimental setting for Q2 cannot be properly reached. Thus, the answer to Q2, based on the interpretation we select, is either negative or the experimental setting cannot be properly reached, making Q2 experimentally null. This is in line with several findings showing that, though

⁹ It is also pointed out the extent to which, in answering MP, we can take into account the degree of possible anatomo-functional dissociation and cooperation between the streams, whose nature is fueling the contemporary debate on vision.

our visual brain is very plastic, completely restoring dorsal and ventral processing in a perfect manner after blindness might be very hard, especially after the critical period (Maurer et al. 2005).

The presence of experimental problems due to the restoration of visual processing is not new (see Degenaar 1996; Gallagher 2005). Sensorimotor theorists also suggested that, since vision is a form of action, sight can be restored only if a subject is also provided with the possibility of performing a dynamic and active exploration of the environment (Noë 2004: Sect. 3.8). But this would violate the constraint of an immediate test after bandage removal, which is aimed at avoiding perceptual learning. Indeed, even the minimal “simple world exposure” (Held et al. 2011) fosters perceptual learning, especially in the case of periods of high plasticity before the critical period (§3). Sight restoration might be provided only by allowing the use of methodological constraints which, however, should not be permitted if we want the experiment to be informative for MP (Schwenkler 2013: 89).

In a recent experiment by Chen et al. (2016), a 44-month-old child with congenital cataracts, who underwent cataract removal surgery and intraocular lens implantation for both eyes, was tested immediately after bandage removal (in line with the suggestion by Held 2009). The results show that the visual capacities of the child develop surprisingly fast concerning both visual recognition and visually guided action. However, this result is not very relevant for the investigation of the MP (Ferretti 2017: 7.4), (not even by following the constraint of epistemological immediacy) for it only shows that, within the period of high neuroplasticity, object recognition and visuomotor performance can be both developed very rapidly (Chen et al. 2016: 1071, 1072), in line with other studies confirming that, in the case of high neuroplasticity, development of vision is very fast (Held 2009; Lungarella and Sporns 2006). So, this study shows, at best, the quick recovery of visual capacities by allowing for sight to interact with touch, something that is forbidden if we want to properly investigate MP itself.

7. Conclusions

Several problems prevent us from finding an empirical solution to MP, especially a failure to realize an acceptable experimental scenario.

One outcome of the experimental stalemate is that MP will remain a thought experiment whose conditions exclude it from our laboratories. Or maybe we do not have the correct conceptual distinctions at the basis of our experimental practice, which is often theory-laden.

This leaves room for *a priori* reasoning about MP. We might imagine the different scenarios of sight opened by such a conundrum, even if a proper answer supported by a naturalistic approach is still unavailable. We might still try to figure out a possible answer in case the conditions of visual restoration become accessible. We could also imagine possible worlds, with different creatures, much simpler than human beings, whose vision is so elementary that we can know the conditions of complete and immediate restoration¹⁰. We might also think of an 'ideal' situation in which the subject would not have the several problems suggested by the empirical analysis. In this situation, we might think, this 'ideal' subject would be able to positively answer MP (Gallagher 2005).

Here the discussion was limited to the situation we can reach following the neurophysiology of vision, insofar as using a naïve, pre-experimental notion of 'vision' cannot take into account the conundrum at stake here, insofar as it does not capture the complex nature of human visual neurophysiology. But even doing so, tackling such a problem still remains very difficult, given the numerous conceptual constraints it requires. It has even been suggested that a miraculous healing, as the famous one made by Jesus, could not produce a perfect Molyneux subject (Glenney and Noble 2014).

Crucially, the interplay between analytic philosophy and vision science is crucial to understand what it means to restore 'vision'. Answering MP by assuming, against the evidence, that the very complex phenomenon of vision can be completely and immediately restored on the basis of an anti-empirical assumption is thus improper. We cannot proceed *a priori* avoiding the empirical facts that suggest that the situation we are looking for can be hardly obtained: "it would be a mistake to think that those who know nothing of the science of the mind can just stick to the relatively *a priori* parts of philosophy of mind, since one needs to understand the empirical facts to even know where there is room for relatively *a priori* philosophy" (Block 2014: 570-571).

Without direct evidence that the scenario requested is reachable, we can still tackle MP by using what vision science has taught us up to now. However, the final solution appears hostage to a conceptually well-regimented empirical

¹⁰ For a similar point see Grice (1962/2011) on 'alien organs'.

test.¹¹ To conclude, the debate remains open concerning both the original question and the new ways to tackle it, as well as its possible new formulations, which will serve as basis to understand what we really know about vision (see Ferretti and Glenney, *Under Contract*).

References

- Barrett L. F., Bar M., 2009, «See it with feeling: affective predictions during object perception », *Philosophical Transactions of the Royal Society*, 364, pp. 1325-1334.
- Block N., 2014, «Seeing-As in the Light of Vision Science», *Philosophy and Phenomenological Research*, LXXXIX (3).
- Cattaneo Z., Vecchi T., 2011, *Blind vision: the neuroscience of visual impairment*, Cambridge, The MIT Press.
- Chen J., Wu E. D., Chen X. Z. *et al.*, 2016, «Rapid integration of tactile and visual information by a newly sighted child», *Current Biology*, 26(8), pp. 1069-1074.
- Cheng T., 2015, «Obstacles to Testing Molyneux's Question Empirically», *I-Perception*, 6(4), pp. 1-5.
- Clarke S., 2016, «Investigating what felt shapes look like», *I-Perception* (1)6.

¹¹ I warmly thank Matteo Morganti, Andrea Borghini, Pierluigi Graziani and Vera Tripodi for their interest in this project, thanking the former two also for their fruitful comments on early drafts of this paper. I also have to thank two anonymous referees, whose comments allowed me to massively improve the paper. Furthermore, I want to offer a special thank to Brian Glenney, who is always very enthusiastic in discussing with me the many marvelous aspects of Molyneux's puzzle. A special thank goes also to these excellent scholars who are always open to discuss with me about the wonderful world of vision: Bence Nanay, Silvano Zipoli Caiani, Albert Newen and Giorgia Committeri. Finally, special thanks go to the students in Philosophy in Urbino, who attended my lessons in 'Philosophy of Mind and Cognitive Science' and offered several points on this topic.

- Connolly K., 2013, «How to test Molyneux's question empirically», *Iperception* 4, pp. 508–510.
- Degenaar M. J. L., 1996, *Molyneux's Problem: Three Centuries of Discussion on the Perception of Forms*, Dordrecht, Kluwer Academic Publishers.
- Degenaar M., Lokhorst G-J., «Molyneux's Problem» (2014), *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition). On-line: <<http://plato.stanford.edu/archives/spr2014/entries/molyneux-problem/>>.
- Downing P. E., Chan A.W., Peelen M.V., Dodds C. M., Kanwisher N., 2006, «Domain specificity in visual cortex», *Cereb Cortex*, 16(10), pp.1453-1461.
- Evans G., 1985, «Molyneux's Question», in Evans, G., *Collected Papers*, A. Phillips (ed.), Oxford, Clarendon Press.
- Farah M., 2004, *Visual Agnosia*, Second Edition, Cambridge, The MIT Press.
- Ferretti G., 2017, «Two Visual Systems in Molyneux Subjects», *Phenomenology and the Cognitive Sciences*, 17(4), pp. 643-679.
- Ferretti G., Glenney B., (Under Contract), *Molyneux's Question and the History of Philosophy*, Routledge.
- Fine I., Cepko C. L., Landy M. S., 2015, «Vision research special issue: Sight restoration: Prosthetics, optogenetics and gene therapy», *Vision Res*, 111(Pt B), pp.115-23.
- Fine I., Wade A. R., Brewer A. A., May M. G., Goodman, D. F., Boynton, G. M., Wndell, B. A. & MacLeod, D. I. A. 2003, «Long-term deprivation affects visual perception and cortex», *Nature Neuroscience*, 6, pp. 915-916.
- Gallagher S., 2005, *How the Body Shapes the Mind*, New York, Oxford University Press.

- Glenney B., 2013, «Philosophical problems, cluster concepts and the many lives of Molyneux's question», *Biology and Philosophy*, 28(3), pp. 541-558.
- Glenney B., Noble J.T., 2014, «Perception and Prosopagnosia in Mark 8.22-26», *Journal for the Study of the New Testament*, 37 (1), pp. 71-85.
- Glenney B., 2012, «Molyneux's Question», *Internet Encyclopedia of Philosophy*. On line: <https://www.iep.utm.edu/molyneux/>
- Glenney B., 2018, Molyneux Problem, Routledge Encyclopedia of Philosophy, Taylor and Francis. On line: <https://www.rep.routledge.com/articles/thematic/molyneux-problem/v-2>.
- Grice H. P., 1962, «Some Remarks About the Senses», In, R. J., Butler (ed.), *Analytical Philosophy, First Series*, Oxford, Oxford University Press, pp. 35-54.
- Held R., 2009, «Visual-haptic mapping and the origin of crossmodal identity», *Optometry & Vision Science*, 86, pp. 595-98.
- Held R. Y., Ostrovsky B., de Gelder T., Gandhi S., Ganesh S., Mathur U., Sinha P., 2011, «The newly sighted fail to match seen shape with felt», *Nature Neuroscience*, 14, pp. 551-53.
- Jacomuzzi A.C., Kobau P., Bruno N., 2003, «Molyneux's question redux», *Phenomenology and the Cognitive Sciences*, 2, pp. 255-280.
- Lewis T. L., Maurer D., 2005, «Multiple sensitive periods in human visual development: Evidence from visually deprived children», *Developmental Psychobiology*, 46(3), pp. 163-183.
- Lungarella M., Sporns O., 2006, «Mapping information flow in sensorimotor networks», *PLoS Computational Biology*, 2, e144.
- Maurer D., Lewis T. L., Mondloch C. J., 2005, «Missing sights: consequences for visual cognitive development», *Trends in Cognitive Science*, 9(3), pp. 144-51.

- Millikan R.G., 1984, *Language, thought and other biological categories*, Cambridge, The MIT Press.
- Milner A., Goodale M., 1995/2006, *The Visual Brain in Action* (2nd ed.), Oxford, Oxford University Press.
- Noë A., 2004, *Action in Perception*, Cambridge, The MIT Press.
- Ostrovsky Y., Andalman A., Sinha P., 2006, «Vision following extended cortical blindness», *Psychological Science*, 17, pp. 1009-14.
- Ostrovsky Y. E., Meyers S., Ganesh S., Mathur U., Sinha P., 2009, «Visual parsing after recovery from blindness», *Psychological Science*, 20, pp. 1484-91.
- Sacks O., 1995, *An Antropologist on Mars: Seven Paradoxical Tales*, Knopf, New York.
- Schwenkler J., 2015, Commentary, «Multimodal Theories of Recognition and Their Relation to Molyneux's Question», *Frontiers in Psychology*, 6, p. 1792.
- Schwenkler J., 2013, «Do things look the way they feel?», *Analysis*, 73(1), pp. 86-96.
- Šikl R., Šimecček M., Porubanová-Norquist M., 2013, «Vision after 53 years of blindness», *I-Perception*, 4(8), pp. 498-507.
- Smith A. D., 2000, «Space and Sight», *Mind*, 109(435), pp. 481-518.
- Thomas S., 2011, «Project Prakash: challenging the critical period», *Yale Journal of Biology and Medicine*, 84, pp. 483-85.

APhEx.it è un periodico elettronico, registrazione n° ISSN 2036-9972. Il copyright degli articoli è libero. Chiunque può riprodurli. Unica condizione: mettere in evidenza che il testo riprodotto è tratto da www.aphex.it

Condizioni per riprodurre i materiali --> Tutti i materiali, i dati e le informazioni pubblicati all'interno di questo sito web sono "no copyright", nel senso che possono essere riprodotti, modificati, distribuiti, trasmessi, ripubblicati o in altro modo utilizzati, in tutto o in parte, senza il preventivo consenso di APhEx.it, a condizione che tali utilizzazioni avvengano per finalità di uso personale, studio, ricerca o comunque non commerciali e che sia citata la fonte attraverso la seguente dicitura, impressa in caratteri ben visibili: "www.aphex.it". Ove i materiali, dati o informazioni siano utilizzati in forma digitale, la citazione della fonte dovrà essere effettuata in modo da consentire un collegamento ipertestuale (link) alla home page www.aphex.it o alla pagina dalla quale i materiali, dati o informazioni sono tratti. In ogni caso, dell'avvenuta riproduzione, in forma analogica o digitale, dei materiali tratti da www.aphex.it dovrà essere data tempestiva comunicazione al seguente indirizzo (redazione@aphex.it), allegando, laddove possibile, copia elettronica dell'articolo in cui i materiali sono stati riprodotti.

In caso di citazione su materiale cartaceo è possibile citare il materiale pubblicato su APhEx.it come una rivista cartacea, indicando il numero in cui è stato pubblicato l'articolo e l'anno di pubblicazione riportato anche nell'intestazione del pdf. Esempio: Autore, *Titolo*, <<www.aphex.it>>, 1 (2010).
