



What stereoblindness teaches us about visual reality

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Abstract

Our experience seems to be populated by *mind-independent* objects. These very same objects are also experienced as offering the possibility of *motor interactability*. Thus, one may be tempted, *prima facie*, to consider these two experiences as always related. In this paper, I propose that this idea is not tenable, by invoking evidence from vision science and ophthalmology about a special case of blindness, *stereoblindness*. Stereoblind subjects cannot rely on stereopsis. Stereopsis is the visual mechanisms responsible for the experience of *motor interactability* with objects. Nonetheless, as I argue, stereoblind subjects can experience objects as *mind-independent* (notwithstanding the diminished quality of the experience of their spatial features for action). This claim is crucial for the literature. First, it *explicitly* suggests that the visual experience of *motor interactability* and the experience of *mind-independence* do not always correlate, and can be disjointed, though they may be usually considered two simultaneous aspects of our experience of objects. Second, it offers a novel philosophical discussion, showing the significance, for the first time, of this visual impairment, i.e., *stereoblindness*, for the literature on philosophy of perception.

Keywords Stereoblindness · Vision · Motor interactability · Mind-independence

1 Introduction

Our experience seems to be related to objects that appear to belong to an external environment and that, thus, do not seem to be dependent on our experience of them: they seem to be *mind-independent* objects (Dokic & Martin, 2015; Matthen, 2005; Burge, 2010; Lyons 2017; Siegel, 2006). Furthermore, we have experience of the enhanced material qualities of objects, e.g., three-dimensional structure, material architecture, size, shape, texture, which, thus, seem to be located in the external

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environment, occupying a portion of the external space placed within the same world our own body occupies. Indeed, we encounter these objects in the external environment, where our body can physically meet them for *interaction*. We can touch them, manipulate them, even destroy them. Objects display, in our experience, the possibility of *motor interaction*, or *motor interactability*. They offer action possibilities that we experience, and that we can satisfy with our actions (Ferretti, 2016a, 2021a; Matthen, 2005; Nanay, 2013). For example, in this moment, I visually experience the possibility of tapping on the keys of my computer.

One may argue that, *prima facie*, the experience of an object's *motor interactability* is related, somehow, to the experience of this very same object as being in the external world, as a *mind-independent* object. Indeed, *at first glance*, it may seem that these two experiences are *always* related. After all, the idea that when we experience we can interact with an object, the object also seems to be an object in the external space, independent from our experience, and accordingly, that external mind-independent objects seem to offer interaction, seems to be very *intuitive*. Material objects are those objects in the external world, whose existence is manifested by our physical access to them. Thus, the experience of *motor interactability* and the experience of *mind-independence*, the intuition goes, may be taken as always occurring together.

At this point, we may wonder about whether this relation can be tenable, as to be defended philosophically, beyond our mere intuitions.

In this paper, I propose that this idea is not tenable, by invoking evidence from vision science and ophthalmology about a special case of blindness, *stereoblindness*. Stereoblind subjects cannot rely on stereopsis. Stereopsis is the visual mechanisms by means of which we visually experience the world outside in general, and an object in particular, as displaying all the visuo-spatial cues responsible for the experience of *motor interactability*. Nonetheless, as I argue, stereoblind subjects can experience, overall, these objects as *mind-independent* (notwithstanding the diminished quality of the experience of their spatial features for action). This claim is crucial for the literature for two reasons.

First, this *explicitly* suggests that the visual experience of *motor interactability* (i.e., *possibility for*, or *availability to*, *motor interaction*) and the experience of *mind-independence* do not always correlate (as stereoblindness shows), though they may be usually considered two simultaneous aspects of our experience of objects. This also suggests, as I show, that these two features belong to different levels of experience.¹

Second, this offers a philosophical discussion, which shows the significance, for the first time, of this visual impairment for the literature on philosophy of perception, within an analysis directly devoted to this case study, per se. Indeed, while philosophical conundrums in perception have been investigated starting from visual impairments (Jacob and Jeannerod 2003), and even blindness, such *congenital blindness*, for example concerning Molyneux's question (Degenaar et al., 2024; Ferretti, 2017; Ferretti & Glenney, 2020; 2024; Glenney, 2013), *visual neglect* (Nanay 2013;

¹ This account complements other strategies, I've proposed, suggesting that these two experiences may be disjointed, when analyzing other mental phenomena; see (Ferretti, 2023, 2024a, 2024b).

Ferretti, 2019), and *blindsight* (Brogaard 2015), the precious case of *stereoblindness* has not been directly and explicitly tackled, per se.² The present paper offers an analysis of the status of stereoblind experience.

Summing up, the paper explicitly analyzes a crucial question for the literature on epistemology and philosophy of perception, and the analysis is carried out by using an unexplored and novel case in this literature (cfr. Ferretti, 2023, 2024a, 2024b).

I must state, when mentioning these two aspects of experience, that philosophers have been relying on different jargons. Some used *reality* to denote *mind-independence* (Lyons 2017; Siegel, 2006; Textor, 2019; Burge, 2010; Ratcliffe, 2008; cfr. Ferretti, 2023, 2024a, 2024b; Deroy and Rappe 2022). Some used *presence* to denote *motor interactability* (Matthen, 2005, 2010; Ferretti, 2016a, 2021b, 2023, 2024a, 2024b). And someone else used *presence* to denote *reality* as *actuality*, which may also be linked to *mind-independence* (Dokic & Martin, 2015; cfr. Ferretti, 2024b).³ It has also been suggested that these may be considered two *indicators of reality*, independently of the jargon (Ferretti, 2023; see also Ferretti, 2024b). In this paper, I maintain a general terminology. I will stick to these two notions, which also are clear with respect to the nature of the experience in play: the experience of *motor interactability* and the experience of *mind-independence*. I am interested in these two experiences, about their relation, and with respect to how stereoblindness call tell us something important on them. This, independently of whether we want to involve the notions of *reality* and *presence*, or other jargons.

Here's the plan for the paper. I first introduce these two experiences: *motor interactability* and *mind-independence* (§2). I then discuss the case of stereoblindness, firstly in relation to the experience of *motor interactability*, showing that stereoblind subjects cannot undergo this experience. This is supported by evidence on lack of stereopsis in stereoblindness, as well as by reports concerning stereoblind experience and recovery of stereopsis (§3). At this point, I analyze the case of stereoblindness with respect to the experience of *mind-independence*. I show that while stereoblind subjects do not experience the possibility of *motor interactability*, nonetheless, they do experience *mind-independence*. This is supported by the evidence from the clinical literature, by reports concerning stereoblind experience, by evidence that stereoblind subjects do not enter derealization (i.e., a disorder in the experience of reality, *as per* mind-independence), and by evidence on healthy subjects (§4). I also offer some considerations about the (lack of) experience of *motor interactability* in stereoblindness, which strengthen my claim (§5), and some clarifications on the claim, with respect to the implications from the fact that these two experiences can be disjointed (§6). Finally, I provide some conclusive remarks (§7).

² I've already mentioned stereoblindness (Ferretti, 2021b), especially when analyzing derealization disorder, and its status, with respect to *motor interactability* and *mind-independence* (cfr. Ferretti, 2024b; see also below, §4.3), but here the focus is explicitly on an analysis of stereoblindness, its peculiarities and its philosophical relevance, something not offered within the philosophical literature.

³ Dokic and Martin (2015) have investigated the relation between, on the one hand, the sense of presence as the sense of reality as *actuality* in the world of an object and, on the other, the sense of presence as the sense of acquaintance of an object, which does not depend on representational mediation. This is a very different investigation with respect to the one proposed here (cfr., Ferretti, 2024b).

2 Mind-independence and motor interactability

To understand the relation between *mind-independence* and *motor interactability*, in the light of stereoblindness, I should first say something on these two experiences. In this respect, however, while the former is usually mentioned, and very famous in philosophy of mind (cfr. above), and thus does not need to be further clarified (see Ferretti, 2023, 2024b, for a recent analysis), the latter notion may need to be narrowed down with respect to the idea defended in this paper.

First of all, the reader should bear in mind that, by experience of *motor interactability*, I mean the experience of the *impression of the possibility of motor interaction* with objects, e.g., I have the impression I can grasp the mug in front of me.

In this respect, what does grant our experience of objects as offering *motor interactability*? There are, of course, different levels of description concerning the *representations* of objects as offering *motor interactability*. But here we are interested in *experience*. Thus, I won't focus on the neural underpinnings of this experience (see Ferretti, 2016b, 2016c, 2019, 2020c, 2021a, 2021b). I've already suggested that, if we focus on the *experience* of *motor interactability*, it seems that, qualitatively speaking, the visual mechanism of *stereopsis* is the one that offers the *particular visual experience* of a world in its pronounced three-dimensionality, of a solid and immersive world, whose objects seem to be vivid, concrete, material, with a deep sense of tangibility (cfr. Ferretti, 2016a, 2023, 2024a, 2024b).

This is shown by evidence from vision science (see the most recent theory by Vishwanath, 2014, especially its definition, esp. p. 153, see also Vishwanath, 2011, 2022; Vishwanath & Hibbard, 2010, 2013; Uji et al., 2019a, 2019b), clinical-medical perspectives from optometry and ophthalmology (Niechwiej-Szwedo 2019; Barry, 2009; Levi, 2022; Webber, 2018; Ibrahimi et al., 2021, 2022; Mckee et al., 2003; Webber et al., 2016; Grant & Moseley, 2011; Melmoth & Grant, 2006; Servos et al., 1992; Rafique & Northway, 2015; O'Connor et al., 2010; Alramis et al., 2016) and philosophical interpretation thereof (Ferretti, 2016a, 2021b, 2023, 2024a, 2024b).

What is the nature of this visual mechanism? Stereopsis has to do with a peculiar experience of space that puts the viewer in the position of evaluating the targets for the purpose of correct action (Vishwanath, 2014; Levi, 2022; Niechwiej-Szwedo 2019; Ibrahimi et al., 2021, 2022; Webber, 2018). A crucial point here, indeed, is that it allows the viewer to experience *egocentric absolute depth* with respect to objects, which is demanded for the correct guidance of motor performance toward a target (Vishwanath, 2011: 206–222, 2014: 155).

More precisely, if vision science is right, this is demanded to obtain an experience that *reliable* action performance can be *successfully* carried out: “The capacity to consciously experience the reliability of derived estimates of egocentric parameters would allow the perceiver to have a direct impression of interactability, specifically, an impression of the *probability of the success of a motor action*” (Vishwanath, 2014: p. 174).

Not by chance, the phenomenology of the spatial experience brought by stereopsis seems to be special with respect to the visual encoding that is directed toward action performance, with specifically enhanced cues like a “separation in depth

between points on an object/part or between objects/parts themselves; the former yielding the characteristic visual impression of ‘solidity’, and the latter yielding the impression of a ‘real’ negative space” (Vishwanath, 2014: 174), “a sense of clarity and visual sharpness” (Ibid.), “a more enhanced impression of color and color variation” (Ibid.), “a more enhanced impression of material qualities such as glossiness, shininess, roughness” (Ibid.), and “the sense of tangibility and the sense of spatial immersiveness. Tangibility can be thought of as the impression of the manipulability of a real material object, while spatial immersivity can be thought of as the impression of the capacity to move through a palpable negative space” (Ibid.), “a vivid sense of protrusion where a tangible solid object reaches or looms out through the negative space toward the observer” (Ibid.). This led to suggest that the ensemble of the features above “appear related to a sense of the capacity to interact with objects in a 3-D space. Successful motor interaction has a singular prerequisite: reliable egocentrically defined perceptual estimates of direction and spatial scale (size, distance, and absolute depth)” (Vishwanath, 2014, p. 174).

There has been a long history over the exact visual mechanisms at the basis of stereopsis (cfr. Barry, 2009; Vishwanath, 2014). Long story made short, it seems to be reached through binocular perception, i.e., a perception carried out with both the eyes, correctly gaining information from a given target (Barry, 2009; Niechwiej-Szwedo 2019; Levi, 2022; Webber, 2018; Ibrahimi et al., 2021, 2022; Webber et al., 2016; Grant & Moseley, 2011; Mckee et al., 2003; Melmoth & Grant, 2006; Rafique & Northway, 2015; Alramis et al., 2016; O’Connor et al., 2010; Servos et al., 1992). However, some minimal forms of it can be achieved also in experimental settings not involving this ocular condition (Vishwanath, 2011, 2014, 2022; Vishwanath & Hibbard, 2010, 2013; Uji et al., 2019a, 2019b; see also Ferretti, 2016a, 2023; cfr. footnote 12; more on this in §§5, 6).

The phenomenon of stereopsis is, then, at the basis of the visual experience of *motor interactability*. It permits to obtain all the features that, once experienced, foster in the viewer the impression that the object she is dealing with has the proper spatial qualities that permit suitable manipulability.⁴ Thus, the experience of *motor interactability* is precisely brought by the peculiar features for action granted by stereopsis. Also, this is *perceptual, visual* experience.

Now, here is the crucial question: does this experience of *motor interactability* always come hand in hand with the experience of *mind-independence* (and vice versa)? Are these two experiences always related?

⁴ Sometimes vision scientists working on stereopsis also refer to the notion of *reality* (see, for example, Vishwanath 2014, pp. 156, 174, 175; in general, see the analysis by Ferretti 2023 of Vishwanath’s theory of stereopsis). But, in those cases, this notion refers to the experience of *motor interactability*, in all its three-dimensionality, immersivity, solidity, vividness and so on (in opposition to *pictoriality*), not of *mind-independence*. Things being so, stereopsis seems to refer to *motor interactability*, not *mind-independence*, there (see Ferretti 2016a, 2021b, 2023, 2024b). Accordingly, Vishwanath (2014) defines stereopsis as follows: “The characteristically vivid impression of tangible solid form, immersive negative space and realness that obtains under certain viewing and stimulus conditions” (p. 153). Unfortunately, no specific philosophical analysis of stereoblindness, per se, has been offered (but cfr. footnote 2). The present paper fills this gap within the literature.

To answer this question, I discuss the case of stereoblindness, which shows that subjects with this impairment in vision lack stereopsis, and then the visual impression fostered by all these visual features related to *motor interactability*. Nonetheless, as I suggest, they still experience the *mind-independence* of such objects. This supports the claim that there can be an experience of *mind-independence* without the visual experience of *motor interactability*.

Let us start with an analysis of stereoblindness and its relation to the experience of *motor interactability*.

3 The case of stereoblindness and the experience of Motor Interactability

The case of stereoblindness can illuminate our analysis about the relation between the experience of *mind-independence* and the experience of *motor interactability*. Stereoblind subjects exhibit several differences in visual processing, as well as in visual experience, compared to healthy subjects (Barry, 2009; Brock, 1959).

I first introduce the impairment in stereopsis as related to the experience of *motor interactability* (§3.1). I then discuss reports on lack of stereopsis impacting on the experience of *motor interactability* (§3.2). I finally discuss reports on recovery of stereopsis, and subsequent recovery of the experience of *motor interactability* (§3.3).

3.1 Stereoblindness

Given its relation to stereopsis, and being indeed a form of blindness to stereopsis, *stereo-blindness* results from the lack of the natural capacity to obtain, combine and compare, from the visual system, the images registered from both the eyes. This happens in all those cases where the eyes do not display a successful interplay. This is (usually) due to problems of coordination of the eyes in vergence, that is, their simultaneous movement to register the image of an object within the center of the retinas. This may happen in the case of *strabismus*, as the eyes do not properly align during object fixation. But this may also happen in the case of *amblyopia*, in which information processing concerning the visual stimulus registered from one eye is not correctly processed, with the result of obtaining monocular vision (for a general discussion, see Brock, 1946; McLaughlin, 1964; Etting, 1978; Flax & Duckman, 1978; Lennerstrand, 2007; Birch & Wang, 2009; Ibrahimi et al., 2022; Levi, 2005, 2022; Levi et al., 2015). Not by chance, stereoblindness is primarily given by a lack of proper binocular vision,⁵ resulting from these conditions, and which is necessary to

⁵ Stereoblindness can sometimes also relate to problems within the visual cortex, concerning the (impaired) activity of *disparity neurons* (Barry 2009; for other aspects of stereoblindness, see also Blake 1982; Chopin et al., 2019a, 2019b; Ding and Levi 2011; Dorman and Van Ee 2017; Levi 2022; Richards 1970; Van Ee and Richards 2002; Yang et al., 2022). However, most of the time, the main causes are strabismus and *amblyopia*. Concerning the disparity between the two images with respect to eye movements, related to convergence and divergence, and other technical details on stereoblindness, see (Burian 1941; Kenyon et al., 1980, 1981; Schor et al., 1983; Ibrahimi et al., 2022; Zhong et al., 2019).

gain stereopsis (cfr. footnote 12). This is in line with the notion of stereopsis above considered (§2).

The impairment in this visual mechanism reflects, as a result, a lack of the peculiar experience provided by stereopsis, described above. As this literature shows, the visual scene stereoblind subjects experience does not display the peculiar visual qualities, discussed above (§2), related to *egocentric absolute depth*, three-dimensionality, solidity, vividness, etc., which are proper of stereopsis. Moreover, since stereopsis provides the experience of *motor interactability*, in lacking the former, stereoblind subjects cannot experience the latter. Let me go more slowly on this.

Several studies have investigated loss of stereopsis (see above, *Ibid.*) and the fact that this amounts to lose all the vivid visuo-spatial qualities discussed above. The most famous case concerns Dr. Susan Barry (*Stereo Sue*) a stereoblind born vision scientist, affected by *esotropia*, a particular form of strabismus in which one of the eyes tends to turn inward (as opposed to the outward turning in *exotropia*), with the consequent lack of stereopsis. In her famous book (2009),⁶ which represents the most important testimony of this impairment, a reference indeed quoted in many technical articles in vision science, optometry and ophthalmology (Levi 2022; Levi et al., 2015; Vishwanath, 2014; Chopin et al., 2019b), Barry offered an analysis, with phenomenal reports, of the lack of these visual features, reported above, in stereoblind experience. (It is important to note that here we are talking about *congenital stereoblindness*, so that subjects have never experienced stereopsis; we are not, thus, talking of loss of stereopsis after experiencing it in the past). These reports are very useful here, to understand the aspects of the visual experience at stake.

3.2 Reports on stereoblind experience

When it comes to visual experience, stereoblindness can lead to *diplopia* (double vision), as the brain registers the two images, but they are differently processed from each eye, which do not converge properly. As a consequence, rather than experiencing an object (or scene) in its visuo-spatial, three-dimensional richness in depth, some stereoblind subjects just see, simultaneously, two flat images of the same object (or scene), as if each of them were pictorial (and whose visual quality is not high), and they have to guess concerning which of the two sister images is the one that pertains to the external environment, as only one of them accurately comes from the external source of the stimulus (for more technical details, see Barry, 2009: pp. 26–28). This is clearly suggested by reports, concerning the spatial source of the target:

“I pointed to the coffee mug in front of her. “From which of your two coffee cup images does the delicious coffee aroma come from?” “Now that you mention it,” she said, “it only comes from the cup image seen by the right eye”. (Barry, 2009, p. 27)

These flat stimuli clearly impact the visual experience for action:

⁶ See also (Bridgeman 2014).

“If I were to shake hands with you (...) I could reach accurately for and shake only the hand seen by the right eye.⁷ If I tried to use the left-eye image, I would miss your hand. It’s not that I think about this. I just reach for your hand automatically using the right-eye image”. (Barry, 2009, p. 26)

“For Sarah, only the image from the right eye was associated with a defined location in space. This was the image she could accurately touch or manipulate. If she tried to climb the stairs while using only her left eye, she would tumble. If she tried to hammer a nail as seen by only the left eye, she might hit her hand instead. As she learned over time to rely almost entirely on the right eye, she imbued the right-eye image with nonvisual, physical properties, like sounds and smells. Only the right-eye image was “real”⁸ to her, and this influenced her entire behavior”. (Barry, 2009, p. 27)

In some cases, not only is considered the information coming from just one eye, but information coming from the other eye is suppressed:

“Red’s difficulties highlight the problems with spatial localization that arise if your eyes are misaligned. If you can’t direct both eyes to the same point in space, the two images of a single object do not fall on corresponding points of your retinas. How do you interpret the unique location of an object when your two eyes present conflicting information? Throughout most of his life, Red coped with this issue by discounting, or suppressing, the input from his right eye. He used only his left eye to locate objects around him.” (Barry, 2009, p. 53)

This stereoblind experience of a flat world clearly hinders the experience of *motor interactability*. Subjects try to interact with objects, but their spatial experiences of the vivid object’s qualities (reported above), which should commonly display a reliable call to action, are absent. They can rely on a single image, and even if they try to use this image to guide action, they do not have an experience of a world in all its three-dimensional, vivid, solid, immersive dimension (recalling action). They just move their action toward one of the two flat images of the scene. As we shall see (§§5, 6), this usually leads to some sensorimotor problems (either failure of action, or action requiring several adjustments).

⁷ The subject talks about ‘accurate reaching’, but actions do not come, many times, without problems in visually guided motor performance of stereoblind subjects (cfr. §5). The same holds for the subsequent quotation mentioning accurate touch or manipulation.

⁸ ‘Real’ here means ‘pertaining to the external, *mind-independent*, target’ (cfr. §§4.1, 4.2). Footnote 4 explains that, in vision science of stereopsis, ‘real’ refers to *motor interactability*. This is because healthy subjects use ‘real’ to refer to objects offering interaction (Ferretti 2023). Here, conversely, especially in Barry’s book, the notion of ‘real’ seems to refer to mind-independence (this interpretation will count for the future occurrences of the term, within the quotations reported). Stereoblind subjects are aware that one of the two images pertains to the external environment, i.e., to the real, mind-independent world, as it conveys information about a physical object outside. Of course, they are aware of this being an object they may act upon. But, as it will become clear (§§5, 6), this falls short of the claim that they experience motor interactability, though they can (be aware, at some level, they may) interact with external objects (which ‘influence their behavior’). Thus, this use of the notion refers to external objects, as mind-independent. This does not conflict with the link between stereopsis and motor interactability, not mind-independence (aside of the uses of ‘real’). For an analysis of the notion of reality, in vision, with respect to motor interactability and mind-independence, see (Ferretti 2023, 2024a, 2024b).

Moreover, as I'll suggest, even in case a stereoblind subject can successfully interact with an object, this falls short of the claim that she can experience *motor interactability*, for one thing is to have motoric success, concerning physical interaction, on an object (performing a grasping action that leads to correctly manipulating the object), while another is experiencing an object as offering *motor interactability* (experiencing spatial qualities recalling action). I'll get back to this point later (§§ 5, 6). Before this, it is precious to consider also reports on recovery of stereopsis.

3.3 Reports on recovery of stereopsis

Were the reader not convinced by the reports concerning the poor spatial *what-it-is-likeness* of stereoblindness, suggesting that (and the extent to which) these subjects cannot enter the peculiar spatial experience related to *motor interactability*, as they see a flat, pictorial world, in 2-D, this is even clearer from the reports⁹ about *recovery of stereopsis* (Barry, 2009; Ding & Levi, 2011). Brand novel stereo-sighted subjects reported the astonishing, sudden appearing, in their new experience, of visual qualities such as looming effects, palpable and negative space, and immersiveness, enhanced three-dimensionality and solidity, all offering the impression that the world is *at hand* for interaction. That is, they experience, for the first time, the visual sense of a three-dimensional world offering reliable *motor interactability*. The peculiarity of *spatial visual experience* (that is relevant to action invitation) is clearly illustrated in these cases:

“As I looked up to adjust the rearview mirror, the mirror popped out at me, floating in front of the windshield. I was transfixed. Throughout the day, my stereovision would emerge—intermittently, fleetingly, unexpectedly—bringing me moments of absolute wonder and delight. The most ordinary objects looked so beautiful. A large sink faucet reached out toward me, and I thought I had never seen such a lovely arc as the arc of the faucet. The grape in my lunchtime salad was rounder and more solid than any grape I had ever seen before. I could see, not just infer,¹⁰ the volume of space between tree limbs, and I loved looking at, and even immersing myself in, those inviting pockets of space.” (Barry, 2009, pp. 94–95)

The effect of a *solid space*, *looming*, or *popping out*, in all its *egocentric absolute depth*, is clear to the viewer (in accordance with Vishwanath's (2014) descriptions of protrusions, looming effects, etc., p. 174, reported in §2 above):

“But just eight days after I began to see in stereo depth, I was walking to my office and happened to glance directly at the horse's head. The horse's skull, with its large teeth and two empty eye sockets, loomed so far out in front of its body that I thought it was moving toward me. I jumped backward and cried out. (...) This sense of objects projecting straight toward me was novel.

⁹ For all the phenomenal reports, in details, see (Barry 2009, pp. 122–132).

¹⁰ This denotes an important passage, from acquiring an idea of space through inferences, to visual experience of it (cfr. §4.2).

Objects had always appeared a little to one side, depending upon whether I was paying attention to the input from my right or left eye. Now that I was developing stereovision, I saw the horse's head projecting straight toward me in the direction of a virtual "cyclopean eye." The same was true for my view of car bumpers, open doors, light fixtures, tree limbs, and outside corners of large buildings." (Barry, 2009, p. 95)

"(...) Her 3D vision "clicked in." Suddenly, she was looking at a salad in which tomatoes popped out at her and the lettuce leaves appeared to lie in very distinct layers of depth. Cyndi was so alarmed that she couldn't eat her food and headed straight to her optometrist instead. As she drove, roadside trees and signs seemed to loom threateningly toward her. Her optometrist (...) ran some tests and informed her that she was now seeing in stereoscopic depth. He had tried to warn her that her work in vision therapy might bring about these changes, but without any prior experience with stereopsis, Cyndi couldn't imagine what he meant." (Barry, 2009, p. 128–129)

And so is the effect of *negative, palpable, tangible* space and *immersivity* (in accordance with the descriptions reported in §2):

"When he gained stereovision, he told me that he could see one hundred times more negative space. Indeed, when I walk in a forest these days, I pay more attention to the pockets of space between the branches and trees than to the trees themselves. I seek out particularly beautiful volumes of space and like to immerse myself in their pockets." (Barry, 2009, p. 123)

"When I gained stereopsis, I felt like I was immersed in a medium more substantial than air, a medium on which tree branches, flower blossoms, and pine needles floated." (Barry, 2009, p. 123)

"This new sense of immersion in space is completely captivating and enchanting. Indeed, Rachel Cooper, who had a form of amblyopia (lazy eye), notes that before gaining stereopsis, "It felt like I was here and everything I was looking at was over there. I couldn't visually perceive or measure the space between me and other objects." Now, Rachel sees in 3D, and she says, "It feels like I am in the world. Empty space looks and feels palpable, tangible—alive!" (Barry, 2009, pp. 123–124)

"She echoed my feelings when she described her first experience seeing in 3D: "The coolest thing is the feeling you get being "in the dimension." It is alive and open and you can actually see things floating by you as you walk and the depth is everywhere.... [I]t is ahead, but it is also down towards my feet.... [T]ables looked really low and walls looked really high and sitting at a desk I just wanted to put my hands all over it and push my hand in between the spaces of the objects on the desk." (Barry, 2009, p. 124)

There is the strong impression that objects are *close (or not) to the subject, around the subject* (cfr. §2)¹¹:

¹¹ This is in line with the fact that stereopsis goes hand in hand with visuo-spatial localization of objects in peripersonal action space (Ferretti 2021b; Vishwanath 2014).

“Although the estimate of the object’s exact location or depth is not precise, you have an impression of its “nearerness” or “furtherness.” It was this new-found sense of stereo depth for objects all around me that gave me the powerful feeling of being enveloped by the world.” (Barry, 2009, p. 125)

The relevance of these reports on stereoblindness and recovery of stereopsis is twofold, with respect to the visual experience of objects for *motor interactability*.

First, they show that stereoblind subjects cannot rely on stereopsis,¹² so that their experience of *motor interactability* is impaired. The structure of their spatial perception does not make egocentric absolute depth, immersivity, negative space, etc., i.e., all the peculiar vividly enhanced cues related to stereopsis, available within their visual phenomenology (cfr. §2). This clearly impairs what should be, in healthy conditions, the normal visual enhancement of the experience of objects a subject correctly perceives she can interact with.

Second, accordingly, these reports show that, after recovery, these subjects can, for the first time, appreciate (and then gradually improve in such an appreciation of) all these very enhanced visual spatial cues, related to stereopsis, which characterize the visual experience of objects. This visual experience related to stereopsis is, as we have seen, crucial for action, i.e., for the experience of *motor interactability*, an experience that is gained only after recovery by these subjects.

That lack of stereopsis, i.e., stereoblindness, entails lack of those visual features crucial for the experience of reliable *motor interactability* is also confirmed by several pieces of empirical evidence in the literature on ophthalmology and vision science (cfr., §§5, 6). Stereoblind subjects cannot perceive the spatial aspects of an object that recall action in many different tasks (for different examples, see Drover et al., 2008; Birnbaum, 1994, 1974; Slavik, 1982; Levi, 2022; Niechwiej-Szwedo et al., 2019; Barry, 2009; Webber, 2018; Grant & Moseley, 2011; Ibrahimi et al., 2021, 2022; Mckee et al., 2003; Webber et al., 2016; Servos et al., 1992; Melmoth & Grant, 2006; O’Connor et al., 2010).

All in all, taken together, these different pieces of evidence confirm, from different angles, that stereoblind subjects cannot (visually) experience *motor interactability*.

¹² Barry (2009) presupposes that stereopsis depends (only) on binocular perception. It is interesting to note that Vishwanath (2014) showed that stereopsis can be achieved even without it, in peculiar experimental cases (looking at a picture through a monocular aperture), cfr. (§2). However, the effect comes in less degree. Furthermore, stereoblind subjects, contrary to intuitions, don’t have the visual experience of healthy subjects asked to perceive, on request, in monocular conditions; their experience is less enhanced, and depth is not really appreciated (§5). Accordingly, Vishwanath recognized that the strongest sense of stereopsis is reached, binocularly, with concrete material objects (Vishwanath 2011, 2014; Vishwanath and Hibbard 2013; Ferretti 2016a, 2021a, 2023). It is crucial that both the eyes are attuned to the same target to gain the full visual experience of stereopsis. Since in stereoblindness this ocular status cannot be achieved (mostly because of lack of coordination; also, again, the stereoblind condition is perceptually different from monocular perception, on request, in healthy subjects), then stereopsis is lacking. Indeed, (static) monocular viewing of concrete objects fosters no stereopsis (and a low level of depth perception). More on this in (§§5, 6).

At this point, a further analysis of stereoblindness permits us to tackle the main question this paper is about. Does this impairment in the experience of *motor interactability* lead to a loss of the experience of *mind-independence*? Answering this question permits to understand the relation between the two experiences, as to whether they *always* occur together. In what follows, I suggest that, though impaired in stereopsis, and thus not having the experience of *motor interactability*, these subjects do not lose the experience of *mind-independence*.

4 Stereoblindness and the experience of mind-independence

Stereoblind subjects cannot rely on stereopsis and its peculiar phenomenology related to the spatial qualities that lead to obtain the impression of *motor interactability*. Here I suggest that, nonetheless, their experience of a *mind-independent* world is intact. This seems to be supported by specific reasons, which I discuss in what follows. The clinical literature does not mention any impairment in the experience of *mind-independence* (§4.1). Accordingly, their reports do not flag any problem of this sort (§4.2). Not by chance, they do not enter derealization (§4.3). This is supported by experimentation on healthy subjects (§4.4).

4.1 Clinical results on stereoblindness

There seems to be no passage (at least to my knowledge), in the literature on stereoblindness (relating stereopsis to action and the experience of the external environment) which mentions a description of a stereoblind subject (before recovery of stereopsis, of course) as not experiencing the external world as *mind-independent*, even if the aspects of this world are tracked by an impaired visual perception (for different angles, see Niechwiej-Szwedo 2019; Levi, 2022; Barry, 2009; Webber, 2018; Ibrahim et al., 2021, 2022; Mckee et al., 2003; Webber et al., 2016; Grant & Moseley, 2011; Servos et al., 1992; Melmoth & Grant, 2006; Rafique & Northway, 2015; Alramis et al., 2016; O'Connor et al., 2010).

This is in line with the fact that stereoblind subjects often talk about one of the two simultaneous 2-D scenes they experience to be *real*, which means that scene being the one that refers to the external, *mind-independent* space (cfr. above footnote 8, about Barry, 2009, p. 27; see below, §4.2). These subjects do experience an external world, and try to direct their action toward it, notwithstanding their poor visual spatial experience, which cannot grant the experience of *motor interactability* (and several times, indeed, endangers successful action performance). They have to make guesses to find the correct visual stimulus, i.e., the one that actually pertains to the external space, with respect to the two sister flat images. However, they do not abandon the strong overall experience, about the objects they see (notwithstanding the visual problems, and being aware that only one stimulus pertains to the external object), that these are *mind-independent*. It's just that these objects do not look available to action (in the sense exposed above). This is confirmed by the reports, discussed in what follows.

4.2 Reports on mind-independence in stereoblindness

That stereoblind subjects do not seem to question (even before recovery) the *mind-independence* of the world, is also clear from the reports.

First, subjects with *diplopia* do not doubt of the *mind-independence* of their poor visual world. They are aware that only one image of their flattened vision pertains to the object outside, i.e., the *mind-independent* object, or what they call *the ‘real’ object*, that is, that only one of the two 2-D objects they are entertained with belongs to the *mind-independent* external space, which nonetheless does not look like a three-dimensional object offering *motor interactability*. They seem to have an intact overall experience,¹³ concerning *mind-independence* (i.e., what they call ‘reality’, cfr. footnote 8), of objects, *pace* their lack of stereopsis:

“I see two images but only one is real.¹⁴ I can be driving and see two images of a car, but I know which one to steer around.” (Barry, 2009, p. 26)

“(…) the car image seen by her right eye was in context. In other words, the right-eye image of the car was located relative to other things in her surroundings. To Sarah, it had a defined location in space. She added that in class she might see two images of me at the blackboard, but, again, only the right-eye image was real.¹⁵ (….) Sarah (….) said that the voice came from the image seen by the right eye.” (Barry, 2009, p. 26)

Second, Barry herself, as stereoblind, was aware of a world outside as an external, even three-dimensional, world, notwithstanding her deeply diminished visual experience, clinically ascertained. She was not even questioning her experience of the world outside, while trying to infer (literally) the spatial characteristics of objects (without, however, visually experiencing them). She didn’t even realize, at the beginning, that there could be a quite richer experience of space, beyond her stereoblindness:

“Stereoblind? Was I stereoblind? I looked around. The classroom didn’t seem entirely flat to me.¹⁶ I knew that the student sitting in front of me was located between me and the blackboard because the student blocked my view of the blackboard. When I looked outside the classroom window, I knew which trees were located further away because they looked smaller than the closer ones. The footpath outside the window appeared to narrow as it extended out into the distance. Through cues like these, I could judge depth and distance. I knew

¹³ The set of their feelings, not simply their beliefs of knowledge. I’ll get back to this point in (§§5, 6), cfr. footnotes 10, 17. Cfr. also footnote 8, about (Barry 2009, p. 27).

¹⁴ Again, ‘real’ here means pertaining to the external, *mind-independent* object (and, of course, this can modify the behavior, while this falling short of granting experience of motor interactability). Cfr. footnote 8.

¹⁵ As above, ‘real’ here means pertaining to the external, *mind-independent* object. Cfr. footnotes 8 and 14.

¹⁶ As the reader may guess, this is just an impression. Stereoblind subjects do see, as also Barry herself confirms, in 2-D (more or less), and for sure not in 3-D depth given by stereopsis (cfr. the quotations immediately below). But they fully realize so only after recovery, as the reports showed in (§3.3), in line with what said here by Barry’s professor, at the end of the quotation (again, cfr. the quotations immediately below; cfr. also footnote 10).

the world was in 3D. Yet, my professor implied that there was another, different way to see space and depth. He called this way of seeing stereopsis. I couldn't imagine what he was talking about." (Barry, 2009, p. 3)¹⁷

As she lately realizes, she could not rely on visual experience brought by stereopsis, a *unique experience* (with an accent here on empty spaces and looming effects, which are related to *motor interactability*):

"While I could infer indirectly a sense of depth through cues like perspective and shading, I could not synthesize stereoscopic depth from other visual attributes, such as color, position, form, or brightness. The sensation provided by stereopsis of empty space and things projecting or receding into that space is unique." (Barry, 2009, p. 102)¹⁸

Accordingly, here it is even more clearly suggested how stereopsis is a powerful experience, which, before being undergone, cannot be imagined:

"When I first learnt about stereopsis (...), I wondered if I could imagine this way of seeing. Now I had my answer. I could not.¹⁹ Stereopsis provides a distinctive, subjective sensation, a *quale*". (Barry, 2009, p. 101)

Now, these reports, taken together, clearly suggest two crucial things: first, the way in which stereoblind subjects cannot rely on stereopsis, and then on the spatial experience of *motor interactability*; second, that they can, nonetheless, experience *reality*, as they call it, i.e., *mind-independence*. They experience, upon awareness of the stimulus' source, the external objects as such, namely, as pertaining to the external world, even if these objects do not offer the profound spatial experience subjects with stereopsis can enjoy.

Indeed, curiously, at first glance (literally), it seems that Barry herself not only does not question the external world, but neither her experience of it. Lately, she could realize her visual experience was not as enhanced as it could have been, while gaining stereopsis. Of course, the experience of mind-independence does not change, but only the one related to motor interactability.

Summing up, crucially, stereoblindness clearly shows that these two experiences can be detached, as the world of the stereoblind subject is not visually experienced as displaying *motor interactability*, while it is, nonetheless, still experienced, overall, as *mind-independent*.

¹⁷ While Barry repeatedly talks about '*knowing*', when discussing the inferences about space (which is not successfully encoded via visual experience), at the same time, it's highly reasonable to suppose, as we shall see, that (potential jargons aside) the *mind-independence* of the world was *experienced* (though not *perceptually experienced*, as this is a non-perceptual experience, cfr. §§5.6), not simply '*known*' by these subjects (cfr., *Ibid.*). This will become clearer below, in (§4.3). That said, her alleged knowledge about spatial features of the objects outside tells us that she was not questioning the *mind-independence* of these objects, and of the world.

¹⁸ This confirms what already said in footnotes 10 and 16.

¹⁹ This difficulty, of course, has an impact on how stereoblind subjects, before recovery, may be aware of what they are lacking (as emerging from the reports of their visual experience). This is clear from these different quotations, by Barry, about the periods before and after recovery (cfr. footnote 16).

There is, however, another crucial argument, a litmus test for this claim, which deserves attention.

4.3 No derealization in stereoblindness

If an indissoluble relation between *motor interactability* and *mind-independence* were in play, this would be clear in the case of stereoblindness. By missing the former, stereoblind subjects should automatically miss the latter. However, it seems clear that they have intact experience of *mind-independence*, even without the experience of *motor interactability*.

The reader not convinced by this claim should consider that, were this not the case, stereoblind subjects should offer a report that is very similar to some psychopathological conditions where the experience of *mind-independence* is not in play. For example, as the in case of *derealisation disorder*, where the experience of reality, whereas reality refers to *mind-independence*, is compromised, as the external world seems to be not real, i.e., not mind-independent (see the recent analysis in Ferretti, 2024b; see also DSM-5; Hunter et al., 2004; Parnas & Sass, 2001; Sacco, 2010; Sierra and David 2011; Dokic & Martin, 2015). This is, indeed, considered as a disorder leading to a *feeling of unreality*, or defined as a *reality disorder* (Ferretti, 2024b; DSM-5; Hunter et al., 2004; Dokic & Martin, 2015; Parnas & Sass, 2001; Sacco, 2010; Sierra and David 2011; Ratcliffe, 2008; Shorvon et al., 1946; Seth et al., 2012).

Now, stereoblind subjects do not display any symptom of derealization, as there is no single correlation between derealization and stereoblindness. This is clear both in the literature on stereoblindness, where there is no mention of derealization (Ferretti, 2024b; Niechwiej-Szwedo 2019; Levi, 2022; Webber, 2018; Ibrahimi et al., 2021, 2022; Mckee et al., 2003; Webber et al., 2016; Grant & Moseley, 2011; Melmoth & Grant, 2006; Rafique & Northway, 2015; Alramis et al., 2016; O'Connor et al., 2010), as well as in the one on derealization, where there is no correlation with stereoblindness, and which shows that (most of) derealized patients have no problems in visual experience of motor interaction (Ferretti, 2024b; Dokic & Martin, 2015; DSM-5; Hunter et al., 2004; Parnas & Sass, 2001; Seth et al., 2012; Sacco, 2010; Sierra and David 2011).²⁰ (For a more technical analysis on the (lack of any) relation between derealization and stereoblindness, see Ferretti, 2024b).

In this respect, in several instances of *derealisation disorder*, visual experience seems to be intact (Ferretti, 2024b; Dokic & Martin, 2015). Even more interesting, in some cases, there is also *macropsia*, due to which not only is object perception not lacking (as these subjects have intact stereopsis), but it is also enormously improved and altered (subjects see bigger, wider, closer objects, all aspects that, in normal conditions, are crucial for the visual experience of *motor interactability*)

²⁰ It is important to note that some derealized patients do report visual problems. In this case, it may be *prima facie* hard to assess whether these problems are indeed located at the visual level, or the mental disorder has a direct influence on their cognitive elaboration of sensory experiences, or rather it has an influence just on their report. However, at a more accurate analysis, the evidence seems to show that, in most of the cases, there is no actual visual impairment correlating with the psychopathological disorder, which indeed seems to influence the emotional evaluation on what they perceive, not what they perceive per se. Moreover, these patients seem not to be afflicted by stereoblindness (Ferretti 2024b).

(Ferretti, 2024b; DSM-5).²¹ Nonetheless, there is no overall experience of *mind-independence*.²²

Thus, derealized patients have correct visual experiences of objects, and also visual experience of the possibility for motor interactability with them. However, these objects do not feel, within their experience, as mind-independent (and this is arguably due to a meta-cognitive feeling onto the objects of perception, not to perception per se). This, in opposition to stereoblind subjects, in which there is no visual experience of the possibility for motor interactability and, nonetheless, there is the feeling, within their experience, of mind-independence. This already suggests how mind-independence, differently from motor interactability, may be given by a non-perceptual experience (cfr. §6; see Ferretti, 2024b).²³ (Note also that stereoblind subjects are usually so from birth, i.e., the condition is congenital, while derealized patients are not. Thus, the latter may appreciate, differently from the former, the passage from a healthy status to an impaired one and back, as it is indeed documented, cfr. Ferretti, 2024b; while the former may just appreciate the transition to novel experiences given from recovery; cfr. footnote 19).

4.4 Experimentation on Healthy Subjects

There is a parallel interesting case here. In some experimental settings (cfr. footnote 12) devoted to the study of stereopsis, (healthy) subjects are exposed to pictorial stimuli, through an oval aperture, monocularly. Thanks to this peculiar experimental condition, they have a (germinal) visual experience of stereopsis with these objects, and thus do *visually experience*, toned down, *motor interactability* (cfr. Uji

²¹ Even in this case, this may be psychogenic (cfr. footnote 20). But, if perceptual, this is interesting to consider, when analyzing the perceptual status of derealized subjects (Ferretti 2024b).

²² Other philosophers have referred to derealization, mentioning it as an example to analyze different claims. For example, whether there can be visual experience without *presentational phenomenology*, that is, without that the content of experience seems to refer to an object that is given immediately to our experience (Miyazono 2021); presumably accordingly, whether visual experience offers a sense of *acquaintance* with the object, that is, the object appears as unmediated, being directly before our eyes (Dokic and Martin 2015); whether visual experiences can lack *phenomenal force*, referring to the fact that the specific phenomenology of experience leads us to immediately justify our beliefs about what we perceive within the external environment (Teng 2022); whether problems within perception can affect the sense of reality (Deroy and Rappé 2022). This clarification complements the one offered in (§1), about the distinction between presence and reality, with respect to *mind-independence* and *motor interactability*. Here, I am precisely interested in the experience of motor interactability and mind-independence, aside of any other jargon about those two, whether in terms of presence or reality. In this respect, furthermore, I am not interested in *acquaintance*, *presentational aspects*, or *phenomenal force*. Finally, as it may now be clear, presence, reality, mind-independence, motor interaction, acquaintance and presentational aspects, and phenomenal forces may denote different aspects of experience, within different literatures, concerning different jargons, and should not be confused (cfr. Ferretti 2024b). I thank an anonymous reviewer for suggesting to explicit this point.

²³ The analysis offered here, on stereoblindness, complements the other one on derealization, already offered elsewhere, with respect to the experiences of mind-independence and motor interactability (cfr. Ferretti 2024b). Both papers refer to the relation between these two conditions, but each of them specifically focuses on one case study and its philosophical relevance (and then mentions the significant aspects of a comparison to the other), concerning the analysis of the two experiences and their relation.

et al., 2019b; Vishwanath, 2014; Vishwanath & Hibbard, 2013).²⁴ Nonetheless, they clearly don't experience these objects as *mind-independent* (for a review of this point, see Ferretti, 2023).

Stereoblind subjects have precisely the opposite experience. When in front of a concrete, material object, they visually experience it as flat, two-dimensional object. Thus, they cannot have *visual experience of motor interactability* with respect to the object. Nonetheless, they experience it as *mind-independent*.

Then, it is safe to say that stereoblindness suggests a dissociation between the experiences of *motor interactability* and *mind-independence*.

At this point, there are some important clarificatory considerations about the experience of stereoblind subjects, for my claim, which I discuss in the next two sections.

5 Physical response to motor interactability vs. visual experience of motor interactability

Stereoblind subjects can display several difficulties, or even impairments, in visually-guided motor control for interaction with objects (for a significant review, see Grant & Moseley, 2011; Niechwiej-Szwedo 2019). These difficulties are usually due to poor depth scaling for spatial localization, and are not exhausted by simple motor acts, such as visually guided hand grasping, but can also show up in more complex actions, such as locomotion (for a review, see Drover et al., 2008; Birnbaum, 1974; Slavik, 1982; Levi, 2022; Niechwiej-Szwedo et al., 2019; O'Connor et al., 2010).

This reflects the evidence that monocularly guided action is massively less successful than binocularly (i.e., provided with stereopsis) guided one (Melmoth & Grant, 2006; Servos et al., 1992; see also Crawford et al., 2014). Not by chance, their (visuo-)motor strategies are different from those of healthy subjects (Niechwiej-Szwedo 2019; Levi, 2022; Barry, 2009; Webber, 2018), and they also have to find visual strategies (uncommon to healthy subjects) to manage the (missing) perception of space and depth, for action purposes (cfr. §3; see Ibrahimi et al., 2021, 2022; Mckee et al., 2003). Accordingly, there are specific and peculiar problematic effects of amblyopia in particular and stereoblindness in general on visually guided hand actions (Ibrahimi et al., 2022; Niechwiej-Szwedo et al., 2019). Restoration of stereovision shows, not by chance, massive improvement of visually guided motor performance (Webber et al., 2016).²⁵

However, they can, one way or the other (as some of the reports above show), carry out their actions in some manner, with the help of the strategies above mentioned.

²⁴ However, the peculiar and full sense of stereopsis is obtained in binocular vision of concrete objects. Cfr footnote 12.

²⁵ As anticipated in footnote 7, while in some of the reports discussed (cfr. §3), it may seem that they can always perform accurate action, this is, as this evidence suggests, not the rule, and they may display several problems.

That said, there is a crucial point, in this respect. When they have success in carrying out an action (before stereopsis is restored), it does not mean, under the definition endorsed in this paper (§2), that they visually experience possibility for *motor interactability*. A motor performance of interaction that can satisfy a goal does not always need visual experience of *motor interactability* (though, in standard cases, the latter will improve the capacity in the perceptual guidance of the action, in line with what said up to now; see Ferretti, 2016c, 2017, 2021a, 2021b; Ferretti & Zipoli Caiani, 2021, 2024).

Think about those subjects suffering from a common visual problem, such as for example astigmatism, acting on an object whose image is blurred, after taking off the glasses. The subjects can act upon the object, which is nonetheless poor in visual experience, especially concerning object contours, whose correct detection is crucial for *motor interactability*. Arguably, they will exhibit many problems in action guidance. But they can still, even if not smoothly, physically manipulate the object.

Now, similarly, most of stereoblind subjects may try to perform a visually guided action, and successfully carry out the action (sometimes, only after many attempts and online adjustments, especially when very young). For those more skilled, success may also be achieved at the first attempt (after a lot of learning, by trial and error).

However, whether or not success needs adjustments or is directly achieved, given their peculiar blindness, they act toward a two-dimensional visual stimulus which is, then, not experienced as displaying all the precious visuo-spatial characteristics related to action listed above. They do only experience a flat world (whether or not this world is composed of two flat images their brain cannot merge into one, or just one image, being the other one suppressed). They have, so to speak, a *flatland* visual experience.²⁶ They do not experience a world rich of spatial qualities for action. If we consider the visual experience of *motor interactability* a case of motor perception (and we have good reasons to do so, cfr. Ferretti & Zipoli Caiani, 2019), then, they may be considered as blind to these spatial aspects that recall motoric possibilities in visual experience. They are, so to speak, *motorically blind*. Indeed, if stereopsis is responsible for the visual experience of motor interactability, and if they display stereoblindness, this may count, *ipso facto*, as a *motoric blindness* (or *visuomotor blindness*).

This suggests that, in the case of stereoblind subjects, we should distinguish between the (i) possibility of *motor interactability* they can *physically respond to*, when dealing with objects (with or without problems in performing the action), and

²⁶ It is interesting to mention here, as a further argument, that we can't experience *motor interactability* with two-dimensional, pictorial objects (except for pictorial illusions *à la trompe l'oeils*, which deserve another treatment) (Ferretti 2016a, 2018, 2020a, 2020b, 2021c; Ferretti and Marchi 2024; Vishwanath 2014). However, while stereoblind have 2-D experience of the world, this may not be, *sensu stricto*, pictorial. Pictorial experience offers *seeing-in* as *twofoldness*: awareness of a surface and of a pictorial space marked on it (Ibid.). Stereoblind subjects just see a 2-D world, not a pictorial space across a surface. An experience, maybe, even less enhanced than pictorial seeing-in: a 2-D *onefoldness*. This point may deserve another venue for full treatment. See also the analysis on pictoriality, stereoblindness and derelization I've offered, in this respect, in (Ferretti 2024b).

the (ii) *visual experience of the impression of the possibility of motor interactability* they cannot entertain with these very same objects (that is, the visual experience of the possibility for motor interaction).²⁷ Of course, (i) can relate to motoric responses that are more or less adequate. Even in the best case, here, *motor success* concerning (i) does not entail (ii), even if (ii) for sure enhances the quality of (i), as well as the probability of motor success, in healthy subjects. The reader can now appreciate how here I am focusing on (ii), which is different from (i).²⁸

This connects to another important point. *Visual parallax* (i.e., the different spatial perspectives on an object from distinct points of view) can be reached in two different visual scenarios. When two different views of the object are simultaneously seen with each eye, as in *binocular parallax*. When, during self-motion, different views of the object are seen in temporal sequence, as in *motion parallax* (even monocularly). In classical vision science, these two forms of parallax were taken to be (sometimes equally) sufficient for stereopsis (for an historical analysis, see Vishwanath, 2014; Barry, 2009). Thus, monocular perception in motion parallax should have been sufficient for stereopsis. However, the recent literature, I've mentioned above, on stereoblindness and stereopsis, has shown that *motion parallax* cannot successfully provide stereopsis in the same way as *binocular parallax* does. In stereoblind subjects, indeed, which rely on monocular perception (in motion), *motion parallax* provides an almost absent sense of depth, not only of stereopsis. Thus, a stereoblind subject does not see as a healthy perceiver relying, momentarily, on monocular perception, i.e., closing one eye.

²⁷ The shrewd reader may wonder about the relation between (i) and (ii), on the one hand, and the famous notion of affordance by Gibson (1979), on the other. Here, I maintain a neutral terminology about possibility of interaction, and visual experience thereof, for behind the notion of affordance lie several conceptual, epistemological and experimental questions (Ferretti 2019, 2021a; Ferretti and Zipoli Caiani 2024). I am simply suggesting that peculiar spatial properties of objects, encoded via stereopsis, are responsible for the visual impression of motor interactability. Whether this counts for an affordance, or not, would deserve further treatment, in relation to specific theoretical commitments, arguably coming also from other regions of vision science and visual neuroscience. Of course, it would be interesting, within an ecological account *à la* Gibson, to understand how affordances relate to mind-independence of the external environment. Finally, note that the visual processes related to action may be, overall, both conscious and unconscious, and this counts also for affordances (Ferretti 2019, 2021a; Ferretti and Zipoli Caiani 2019, 2024). But here I am focusing on the visual experience (i.e., *conscious* visual experience) of the possibility of motor interaction. In this framework, the distinction between (i) and (ii) is very important (cfr. Ferretti and Zipoli Caiani 2024). I thank an anonymous reviewer for suggesting to explicit these points.

²⁸ Of course, one may argue that, in a given situation, they may *know* (or be aware by knowledge) that they can act upon the object they deal with, even if the object looks flat. My response is that this does not count as *experiencing motor interactability*. Independently of my motor success, *knowing* I can act on an object the visual experience of which is, however, very basic, and *having visual experience* of the object as displaying all the spatial qualities that usually recall action, in accordance with the evidence on stereopsis, are two very different things (cfr. the reports by Barry about the inferences on depth and the visual experience of depth, §4.2). Consider also that visual spatial experience is more reliable, than knowledge and inferences on space, on guiding action, as it is clear from the evidence above discussed. Imagine the following scenario. At t_1 I see an apple before my eyes. At t_2 I close my eyes, while still being in front of the apple. Now, at both t_1 and t_2 , I know I can interact with the apple. And, at both t_1 and t_2 , I can perform successful interaction with the apple. However, only t_1 provides me with the visual experience of *motor interactability* (cfr. Ferretti 2019; Matthen 2005; Nanay 2013).

Indeed, (and this is highly relevant here) monocular perception in stereoblind subjects is even less enhanced than monocular perception in healthy subjects (so that depth perception is problematic). This is also confirmed by the reports:

“Since motion parallax can be seen with one eye, I, like most other scientists, assumed that I had always obtained a good sense of depth through motion parallax. Then, (...) I learned that I was mistaken. I had based this assumption on the erroneous premise that a strabismic sees the world like a person with normal vision who has simply closed one eye”. (Barry, 2009, p. 125)

Accordingly, the depth impairment in stereoblindness is so enhanced that healthy, non-stereoblind subjects cannot generate the experience of stereoblind subjects, not even through monocular viewing²⁹:

“Just as I could not imagine a world in stereo depth, an individual with normal stereopsis cannot experience the worldview of a person who has always lacked stereopsis. This may be surprising because you can eliminate cues from stereopsis simply by closing one eye. What’s more, many people do not notice a great difference when viewing the world with one eye or two. When a normal binocular viewer closes one eye, however, he or she still uses a lifetime of past visual experiences to re-create the missing stereo information.” (Barry, p. 102).

This further suggests how stereoblind subjects cannot experience any sort of stereopsis, and thus any experience of *motor interactability*, even thanks to movement, i.e., self-generated motion parallax (for different aspects of this phenomenon, see Birnbaum, 1974; Drover et al., 2008; Levi, 2022).

Again, this is in line with the sets of evidence that not only is monocular perception insufficient to carry out vivid experience of *motor interactability*, provided by stereopsis, but it can also be, several times, inadequate to obtain motor success. Monocularly guided action may be, indeed, very problematic (Drover et al., 2008; Alramis et al., 2016; Birnbaum, 1974; Slavik, 1982; Levi, 2022;

²⁹ This counts also for cases in which monocular viewing is tested, with healthy subjects, via experimental practice, *as per* (Vishwanath and Hibbard 2013), see also (Vishwanath 2014, Uji et al., 2019a, 2019b; Ferretti 2016a, 2016b, 2016c, 2023). In healthy subjects, stereopsis can be reached in monocular static conditions, with pictures, but only in specific experimental settings (§4.4). However, as said, stereoblind monocular perception offer different perceptual scenarios. Moreover, the same difference should occur concerning the quality of temporarily induced *diplopia* (double vision) in healthy subjects, see (Barry 2009, p. 27). Therefore, in the light of this, it would be interesting to analyze whether this perceptual fact, about monocular perception in stereoblindness, implies that the experimental settings in which stereopsis is reached statically, monocularly, in front of a picture looked through an aperture (§4.4), counts only for healthy subjects (this confirming that stereoblind monocular perceivers cannot gain stereopsis), given the singularity of monocular experience in stereoblindness, not comparable to monocular experience of healthy subjects closing one eye. The reports discussed above, and evidence from ophthalmology coupled to visual neuroscience, especially about visual memories of depth, may offer several speculations.

Niechwiej-Szwedo et al., 2019; O'Connor et al., 2010).³⁰ It's not by chance that binocular vision and better stereovision result in better visuomotor guidance skills (Niechwiej-Szwedo et al., 2018; Rafique & Northway, 2015; Alramis et al., 2016; O'Connor et al., 2010). And that young subjects with impaired visuomotor functions may also display motor problems because of poor binocular vision (and stereopsis), as action performance and stereopsis go hand in hand (Alramis et al., 2016).

This is precious in the light of the distinction, above proposed, suggesting that not only most of stereoblind subjects, relying on monocular perception, exhibit problems with (ii) *visual experience of motor interactability*. Most of them also have, however, problems with (i) the possibility of *physical response to motor interactability*, e.g., in performing a smooth motor act, when dealing with objects.

Therefore, we may concede that, in relation to (i), depending on the different cases (of course, there may be huge sensory diversity among different cases, also in relation to the cause of each specific stereoblindness), stereoblind subjects (a) may successfully act upon an object, but they (b) act upon an object, in several cases, with attempts and online adjustments, and (c) their action may display several problems. That said, however, neither (a), nor (b), let alone (c), do entail that they obtain (ii).³¹ This suggests how my claim is about (ii), not (i), whereas (i) and (ii) are different, as shown.³² Thus, these subjects cannot enter (ii), even if, in some cases, they can (partially) overcome problems with (i).

NB. In line with what said up to now, when I say that stereoblind subjects lack the experience of motor interactability, I mean that they lack the visual experience of the impression of the possibility for motor interaction with objects. This is related to (ii), not (i); though also (i) is problematic, as seen.

There are, in these respect, further specifications about my claim, which I offer in the next section.

³⁰ In accordance with footnote 7.

³¹ Even in monocular conditions, you can act upon the world (which feels as a world outside, cfr. §6). But there is no vivid experience of it as offering *motor interactability*.

³² Here (ii) is not reduced to touching an object, merely, but concerns every action we can perform: it is about the visual experience of the possibility for motor interaction, overall. Again, this is a different notion, as we saw, from (i). When, in the paper, it is said that one can visually experience the possibility of touching or manipulating an object, this is just an example. Of course, however, this is not by chance, as also per the evidence above mentioned on hand actions: besides vision and its access to the world, touch is highly significant for humans, concerning action, and grasping in particular is peculiar of our motor relation with the external environment. That said, it would be interesting to investigate cross-modal matching, especially between sight and touch, with respect to motor interactability and mind-independence. Ideally, it would be interesting to consider whether, for example, a Molyneux's subject (Ferretti & Glenney 2024; Ferretti 2017) would also be stereoblind, and whether there could be a Molyneux's subject with derealization (Ibid.; I thank Shaun Gallagher for suggesting analyzing this second case during a conference). This would also clarify the relation between the access to the external world, by touch, and the experience of mind-independence, in both stereoblindness and healthy visual conditions (though, however, derealization would suggest that perception, per se, in each of its modalities, cannot grant the experience of mind-independence; cfr. Ferretti 2024b and §6.1). This investigation may wait for another occasion to be carried out. I thank an anonymous reviewer for suggesting to consider this point.

6 Physical encounter, visual experience of interactability and mind-independence

I've proposed a distinction between (i) *possibility of physically responding to motor interactability* and (ii) visual experience of *motor interactability*. I said that (i) does not entail (ii), though (ii) can help obtaining proper motor behavior in (i).

At this point, another clarification is needed here, on the relation between (i), (ii) and (iii) the experience of *mind-independence*.

6.1 The relation between these experiences

The main claim here is that (ii) and (iii) are not automatically coming together, as the experience of stereoblindness shows.

One may suggest that, independently of whether (i) is performed by a motor act leading to successful interaction (i.e., a proper way of manipulating the object), and even without (ii), there still is a physical encounter, via (i), between the subject and the object. Thus, the comment would go, (i) may help, in some manner, stereoblind subjects to (iii) become aware, in their overall experience, that there is an external, three-dimensional, mind-independent world. Now, note that an alleged relation between (i) and (iii) is not a problem for my view (cfr. indeed footnote 32 on possible related investigations). There are some considerations here, however, in this respect.

First, my claim is not about the relation between (i), independently of whether properly performed or not, and (iii), but about the relation between (ii) and (iii). That (i) may be related to (iii), and that (ii) may be related to (iii), are two very different claims. More so, as (i) does not entail (ii) (and vice versa, Ferretti, 2021c, 2024b). Suggesting that (ii) and (iii) are not necessarily related, with the important distinction between (i) and (ii), and the above considerations about the relation between (i) and (iii) is, thus, sufficient for my claim.

Second, even supposing that (i) leads to (iii), this clearly is not thanks to (ii), i.e., via (ii). Indeed, stereoblind subjects have never entered (ii), but can experience (iii). Thus, (iii) is not brought by (ii), as starting from (i). So, my claim is safe.

Finally, and this is a strong reason to suggest that my claim is safe, (i) does not even seem to be sufficient to obtain (iii), as confirmed by derealization (§4.3; cfr. Ferretti, 2024b). Indeed, derealized subjects can easily rely on (i) (and (ii)), and still exhibit lack of (iii). This clearly suggests that invoking (i) as a source for (iii) is problematic, and the burden of the proof is on those interested in this claim.

At this point, while I am not denying that, in everyday healthy experience (i), (ii) and (iii) may come together, nonetheless, it seems they can all be disjointed. Indeed, stereoblindness leads to appreciate that (i) and (ii) are different, and can be separated, and, most important, it shows that (ii) and (iii) can be disjointed, even when relying on (i). Derealization, as well, shows that (i) and (iii) – and accordingly (ii) and (iii), in complementarity to stereoblindness – can be separated.

NB. In accordance with footnote 8, (1) stereoblind subjects have a very basic perception of mind-independent objects, and do experience them as mind-independent, in relation to (iii), (2) they are aware (at some level) that they can act upon them, and they also may succeed in this action, in relation to (i), but (3) they cannot visually experience motor interactability with respect to them, in relation to (ii).³³ Conversely, derealized subjects can perceive mind-independent objects, but they cannot experience (meta-cognitively) them as such, as per (iii), though they can visually experience the possibility of motor interaction with them, as per (ii), and they are indeed successful in action, as per (i) (Ferretti, 2024b).

Summing up, my task was that of showing that (ii) and (iii) can be disjointed (for which clarifying the difference between (i) and (ii) was crucial). In doing so, however, I've also clarified the relation between (i) and (ii), between (i) and (iii), and between (ii) and (iii).

6.2 Some implications

This suggests, in turn, some important implications about the nature of these two experiences.

First, since (ii) is a very enhanced visual experience of the external world, a reasonable intuition may be, as we saw at the beginning, that (ii) is deeply related, one way or another, to (iii). After all, (ii) may be what brings about a world in all its spatial, three-dimensional vividness, immersivity, solidity, acuity, clearness; the visual experience of something physical, material, spatial, out there, in an external environment, i.e., what flags (iii). But, as I showed, stereoblindness (in comparison to derealization) crucially suggests that (ii) does not always occur along with (iii). Then, while the dimension of *interactability*, whether in the form of (i) or (ii), could be, apparently, considered crucial for (iii), we saw that neither (i) nor (ii) are necessary or sufficient for (iii), which can be dissociated from both.

Moreover, while (ii) is perceptual experience, depending on stereopsis, a visual mechanism, we may speculate that (iii) may be given by an experience that, in accordance with the cases discussed, is neither perceptual experience, nor does it strictly depend upon it. Indeed, (iii) may be attached to the objects of perception, even if it is not, per se, obtained perceptually, or directly dependent on perception. For example, it could be obtained by meta-cognitive feelings, or akin emotional evaluations (Bayne & Montague, 2014; Dokic & Martin, 2015; Lau, 2022; Proust, 2014; Ratcliffe, 2008; Teng, 2022), attached to the objects of perception (I've defended this claim when analyzing different mental phenomena, such as derealization, see Ferretti 2024b, stereopsis, see Ferretti, 2023, and dreams, see Ferretti 2024a). This would perfectly accommodate a unified description of the most relevant mental states at stake in the complementary cases of stereoblindness and derealization.

³³ For a distinction between awareness of the possibility of performing an action and visual experience of possible motor interaction, see (Ferretti 2019, 2021a, 2021c).

Accordingly, while, in standard cases (i), (ii) and (iii) would show up in parallel, this is not always the case. Otherwise, stereoblind subjects should exhibit not only a *visual impairment*, concerning (ii), but also, on top of this, a meta-cognitive, *mental disorder* similar to *derealization*, in which also (iii) is compromised.³⁴ But this is not happening. *Stereoblindness* and *derealization* do not go hand in hand.

Things being so, with stereoblind subjects, there is no loss of the experience of *mind-independence*, which may then depend upon a preserved meta-cognitive evaluation³⁵ of the environment, not on a perceptual experience. Conversely, in *derealization*, there is no visual impairment, but arguably a problem with this meta-cognitive evaluation, related to *mind-independence*.

7 Conclusion

The paper analyzed stereoblindness and suggested that, while in this case the experience of *motor interactability* is lost, there is, still, an intact experience of *mind-independence*. This offers a twofold contribution to the literature.

First, the paper shows that the experiences of *motor interactability* and *mind-independence* do not always correlate, though intuitively considered simultaneous in our experience of objects. Second, this is done by offering the first philosophical analysis of stereoblindness.

Thus, by showing that stereoblind subjects can rely on (iii), i.e., the meta-cognitive experience of *mind-independence*, notwithstanding their impossibility of reaching (ii), i.e., visual experience of motor interactability, I suggested something crucial about these two experiences: that they can be detached (though, in most of our usual experience of the environment, they march in step, so much that this ordinary experience may lead us to assume they always occur together), and that they have a different nature.

The analysis offered here complements, as already noted, the one on *derealization* I've offered elsewhere (Ferretti, 2024b). Here the focus is on a specific form of blindness; there, it is on a specific form of mental disorder. This interplay of different cases, on different levels of the mental, paves the way for a multi-levelled account of the possibility of disjoining the experience of motor interactability and the experience of *mind-independence*. Indeed, if the account offered in this paper, and the

³⁴ Vice versa, *derealized* subjects should exhibit stereoblindness, or at least other strong perceptual impairments (but this does not seem to be the case, see Ferretti 2024b). This is not trivial. In many cases, for example, experiences of perceptual isolation may lead to experiences of depression and anxiety. For an analysis of these cases, see (Gallagher 2024).

³⁵ Again, when, in the reports, subjects declare to *know* something, e.g., that the world outside is in 3-D and real (§4), this may be, sometimes, also a folk description for what actually is an experiential feeling, not just a doxastic state. Cfr. footnote 17. This mismatch, at the linguistic and/or experiential level, between the mental state that is actually experienced, and the description of it as being another kind of mental state, may also occur in experimental cases testing the intensity of stereopsis in healthy subjects (Ferretti 2023), in mental disorders, like *derealization* (Ferretti 2024b), and in dreams (Ferretti 2024a). Subjects are, clearly, not trained in phenomenology, and introspection is sometimes problematic (this may trivially happen also during a simple eyesight test).

one offered on derealization, (Ferretti, 2024b) are right, then, the experience of motor interactability is neither *sufficient*, as derealization shows, nor *necessary*, as stereoblindness shows, to obtain the experience of mind-independence. The dissociation seems to be reliable, as it is based on case studies where, respectively, either a feeling, or a perceptual state, are broken, without any loss of the other.

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Declarations

Conflict of Interest No conflict.

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