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On what people know about images on mirrors

Marco Bertamini[a,*], Theodore E. Parks[b]

[a]*Department of Psychology, Eleanor Rathbone Building, University of Liverpool, Bedford Street South, Liverpool L69 7ZA, UK*
[b]*Department of Psychology, University of California at Davis, Davis, CA, USA*

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Abstract

As observed by Gombrich [Gombrich, E. H. (1960). *Art and illusion*. Oxford: Phaidon Press], we confirm that most people are unaware of the size of their own image on mirrors. Specifically we have documented the knowledge that people have of the size of their own head and of the size of the mirror image of their own head. In addition we have explored naive beliefs about how the size of mirror images changes with distance. The main pattern of findings is consistent with a focus on target distance and a difficulty in factoring the observer's vantage point correctly when people reason about the problem. The issue of information about vantage point is discussed in relation to other literatures.

Keywords: Mirror; Naive physics; Imagery; Viewpoint; Spatial updating

> *I'm more like the monkey who firmly believed that he saw another monkey in the mirror…and discovered his error only after running behind the glass several times*. Galileo

1. Gombrich's bathroom mirror

There is a famous passage in Gombrich's (1960, p. 5) classic book *Art and illusion* about the perception of our own head in mirrors. Gombrich points out that we see

* Corresponding author. Tel.: +44 151 794 2954; fax: +44 151 794 2945.
E-mail address: m.bertamini@liverpool.ac.uk (M. Bertamini).

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ourselves in mirrors without any conscious awareness of the size of the image on the mirror surface. He suggests a little demonstration on the fogged up mirror of our bathroom. If we circle the outline of our own head we will be amazed to discover that it is much smaller than our head. Indeed, it is exactly half independently of distance. To Gombrich, this is an example of an illusion in the sense that we are only aware of seeing ourselves *face to face* and we stubbornly refuse to see the size on the mirror surface.

This important demonstration has been referred to by other authors (e.g. Gregory, 1997, 1999; Mackavey, 1980). Surprisingly, we could not find any empirical study based on this demonstration after more than 40 years from the publication of the book. In this paper we confirm the widespread lack of awareness about the size of the image on the surface of the mirror. However, establishing what people *do not* know is only a first step. We also tested what people *do believe* about the size of images on mirrors, similarly to other work in *naive optics* (i.e. work which tested what people know about what a mirror makes visible: Bertamini, Spooner, & Hecht, 2003; Croucher, Bertamini, & Hecht, 2002; or the belief about extramission: Winer, Cottrell, Fournier, & Bica, 2002).

Both the fact that our image is half the physical size, and the fact that this relationship is independent of how far we are from the mirror are counterintuitive. However, they become clearer as soon as we realise that a mirror is always located halfway between oneself and our virtual self, as shown in Fig. 1. But Gombrich's case is special in that it is concerned with our own image. When we judge the size of our face, we judge an object placed at the vantage point from which the mirror is viewed. It would be a mistake to think that what is true here, namely that the image of the face has constant size independently of distance, should be true in general. Therefore one difficulty that people encounter may be that of appreciating the differences between different viewing conditions. Fig. 2 illustrates three qualitatively different conditions in terms of image change. As the observer or target moves away from the mirror, the visual angle subtended by the image on the mirror decreases, as shown. However, the image on the mirror seen by the observer, as it would be outlined by a felt-tip pen on the glass or measured by a ruler taped to the glass and read out by the observer, stays constant when the target is also the observer, but gets smaller when the target moves away from the mirror, and increases when the target stays at a fixed distance from the mirror while the observer moves.

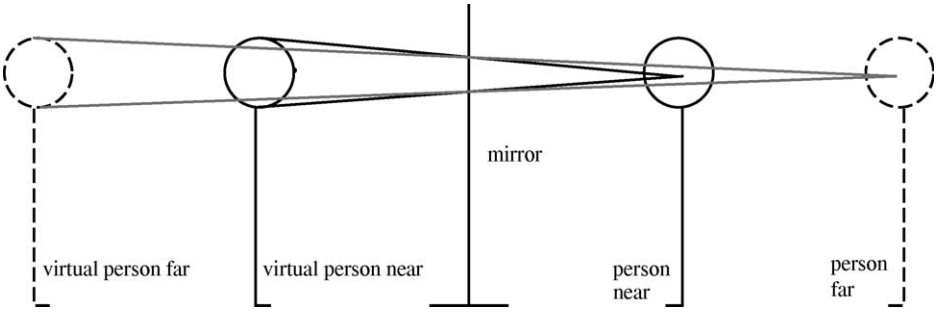

Fig. 1. Our own image size on a mirror stays constant, and is half the physical size. Consider the location of the mirror relative to the observer and the virtual observer in two cases, when the observer is near (solid line) or far (dashed line). The image on the mirror does not change.