Perception, 2012, volume 41, pages 991 – 993

doi:10.1068/p7261

SHORT AND SWEET

Are people adapted to their own glasses?

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Received 3 April 2012, in revised form 4 June 2012

Abstract. Negative lenses, either in the form of glasses or contact lenses, can correct nearsightedness. Unlike contact lenses, glasses do not only correct, but also induce optic distortions. In the scientific literature, it has often been assumed that people who wear corrective glasses instantaneously account for these distortions when they put their glasses on. We tested this assumption and found that, when people switched between their contact lenses and their glasses, they made the errors that one would predict based on the optics. This shows that people are not immediately adapted to their own glasses when they put them on.

Keywords: visuo-motor mapping, optics, adaptation

It is often assumed that people who are used to wearing corrective glasses can instantly account for the distortions of the visual field that are induced by their glasses when they put them on (eg Baraduc and Wolpert 2002). This assumption is supported by evidence that multiple sets of visuo-motor mappings can be acquired and can be accessed instantly: subjects no longer made the initial errors typically found when putting on or taking off prism glasses when they repeatedly threw tennis balls to each other with and without wearing 30 D prism glasses (5400 throws with and 6450 throws without over a 6 week period; Martin et al 1996).

Many people who own glasses do not always wear them. Some people mostly wear glasses but can also perform some activities without them. Others wear glasses when performing certain daily activities, such as making breakfast, walking to the bathroom, brushing their teeth, and turning the pages of a book they are reading, but wear contact lenses throughout the rest of the day. As all these activities require visuo-motor coordination, performing them should give people ample time to have learned both the visuo-motor mapping associated with their glasses and the one without them. But do people who wear glasses really have two sets of visuo-motor mappings between which they can switch instantly when putting on or taking off their glasses?

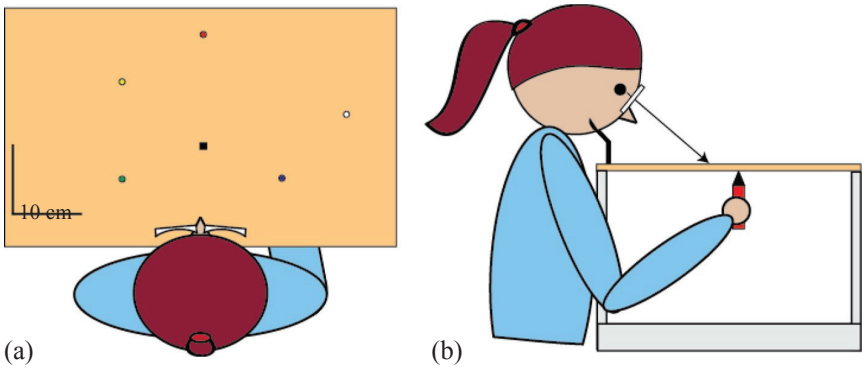

Figure 1. [In colour online, see http://dx.doi.org/10.1068/p7261] Experimental setup. (a) Top view; (b) side view. The dots in the top view indicate targets. The square indicates the approximate position at which the lines of sight when looking through the centres of the glasses (arrow in side view) intersect with the board (we refer to this point as straight ahead).

Nine subjects (age 25–54 years, 4 males) participated in an experiment to test whether they instantly compensated for the optics of their glasses, after giving informed consent. The average strength of their glasses was –6.9 D (–3.5 to –10 D) and they estimated that on average they had worn these specific glasses for between 30 min and 12 h per day for at least a year. To make sure that the subjects could see the targets clearly even when they were not wearing their glasses, we only recruited people who also wore contact lenses.

Glasses that correct for nearsightedness compress the image of the scene towards *straight ahead* (arrow in figure 1), so objects in the scene are shifted in this direction and they appear to be smaller. Because contact lenses are worn on the eye, these distortions are not present when one wears contact lenses. If subjects do not instantly account for the optics of the glasses they put on, they will judge targets to be closer to straight ahead (dashed arrows in figure 2a). They will also judge targets to be further away (along the line of sight, solid arrows in figure 2a) because objects that have a smaller retinal image tend to be judged to be further away (Sousa et al 2011).

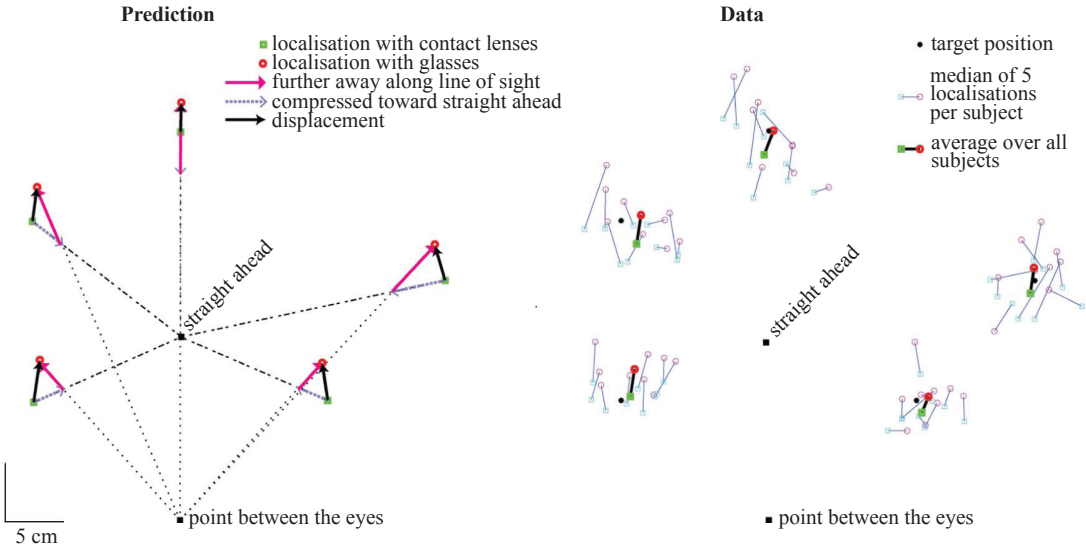

Figure 2. [In colour online.] Pattern of localization (a). Prediction assuming that the targets are judged to be 20% closer to straight ahead and 20% further away along the line of sight (b).

All subjects entered the experiment wearing their contact lenses. They were seated at a table with their head fixed with a bite-board to prevent them from turning their heads (and thereby the point seen through the centre of each glass). The targets were five coloured stickers on a wooden board that was a few centimetres below chin level (figure 1). Subjects held a felt tip marker in their right hand underneath the board. The experimenter called out targets in random order and the subjects used the marker to indicate the target location on a piece of paper that was taped to the bottom of the board. After each target had been localised five times, they took out their contact lenses and put on their glasses while the targets were covered. When the subjects' head was fixed again, the targets were uncovered and the subjects localised each target five more times using a different colour marker.

Subjects localised the targets differently when they wore their glasses than when they wore their contact lenses (figure 2b), in line with the predictions we made based on optics (ie inwards towards straight ahead and further away along the line of sight). We conclude that people are not immediately adapted to their own glasses when they put them on.

Acknowledgments. This research was funded by an NWO/MaGW grant (453-08-004) to JS and an FCT (Portuguese Foundation for Science and Technology) PhD grant to RS.

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