MIRROR AS STEREOSCOPE
Training in virtual free space

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Introduction:

Plane mirrors are flat reflecting surfaces. When people observe mirrors, their attention is locked in the virtual image so the reflected image is hard to be perceived on the mirrors' surface (Bertamini &- Parks, 2005). There are certain perceptual errors that people experience when they are asked about the reflected images on the mirror surface (Bertamini, et al 2008).

ERRORS

Two of the most common as shown in figure 1 are:

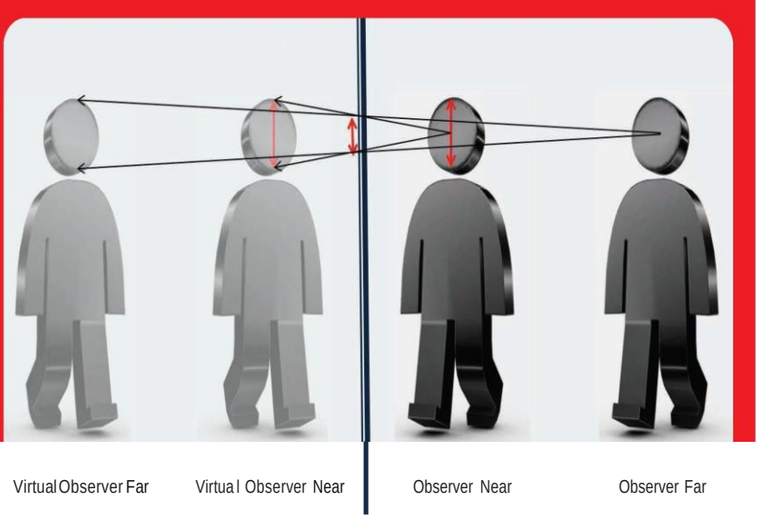

Figure 1. *Face reflection is half the size of the real one and stays the same despite the distance the observer has from the mirror.*

Overestimation Error:

People tend to believe that the reflection of their face on the mirror is about the same size of their actual face. The truth is that the reflection is half the width and half the height so quarter the area. This means that they tend to overestimate the perceived size. (Croucher, Bertamini &- Hecht, 2002; Bertamini, Spooner &- Hecht, 2003).

Distance Error:

People believe that the size of their reflection becomes smaller as they move further from a stationary plane mirror. The truth is that the size of the reflection always stays the same regardless the observer's distance (Bertamini &- Parks, 2005).

Mirror As A Stereoscope:

We can consider a plane mirror as a stereoscope. If we cover one eye we perceive a flat image with no depth, like a photo. If we cover the other eye we perceive another similar flat image of different perspective. *(Figure 2).*
But with both eyes open fusion normally takes place and the two uncrossed images become one.
A Base In effect is created which can explain the perceived depth in the mirror. As in any stereoscope projection, Base In demand can result in Large Out effect (according to **SILO/** Small In Large Out) *(Figure 3).* This can explain both errors:
Perceiving "Large" explains the overestimation of the size in the first error. Increasing distance, thus reducing Base In effect, has a perceptual result of decreasing size as expressed in the second error.

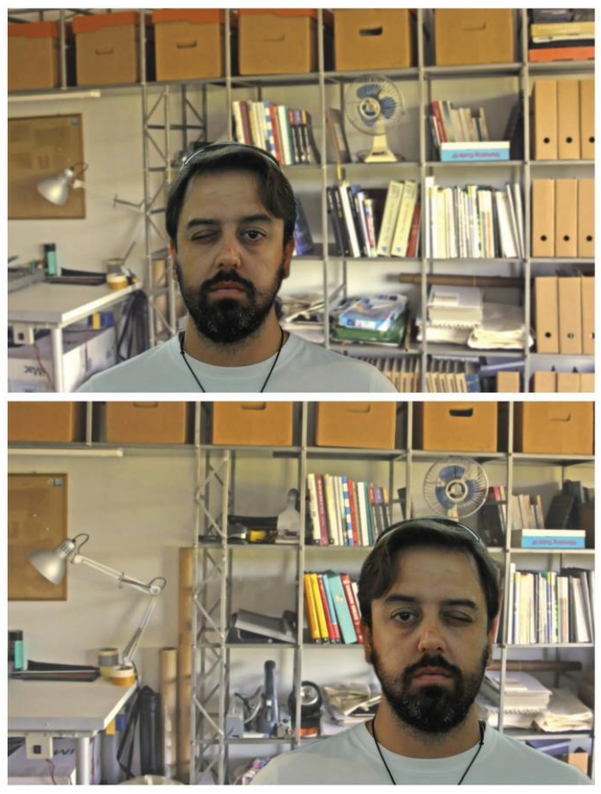

Figure 2

Su99ested VT Procedure:

For this procedure a big mirror would be ideal. A small round sticker with letter is placed on the mirror at subjects' nose level. Subject is about to stand in front of the mirror and look at the virtual nose image. Under these conditions, eyes are fixating at the double distance in the mirror, while accommodation is placed somewhere closer to the mirror plane. Research has shown that accommodation is affected by knowledge of distance clues (Rosenfield &- Ciuffreda, 199 1) thus accommodation is guided by the real distance of the mirror. Each eye views an image formatted in the mirror through a different angle and two stickers are perceived normally as a result of physiological diplopia. Then, attention is placed on the sticker, so now the person's image is perceived as double according to physiological diplopia. *(Figure 4)* In both cases, accommodation is not significantly different, so attention should be also paid on keeping the letter on the sticker clear, as much as possible.

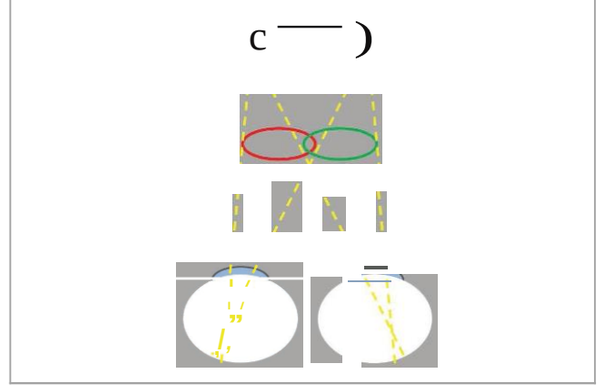

Figure 3. *Fusion of uncrossed images (Base In) and the resulted Large Out effect.*

Application:

When subject shifts attention from the sticker towards the virtual image in the mirror is like working small amounts of Base In. It's like practicing physiological diplopia with Base In effect in a virtual space. Subjects can be asked to make jumps from their self-image to the sticker and back or change fixation slowly feeling the virtual space created by mirror and using physiological diplopia as a clue.
This technique can be used before exposing patients to B.I. stereograms at distance, facilitating in transferring their perception to something further away from the projected surface. It can be also helpful especially when refining Base In flexibility and can be proved very useful in cases like sports vision training, when attention flows between different planes.

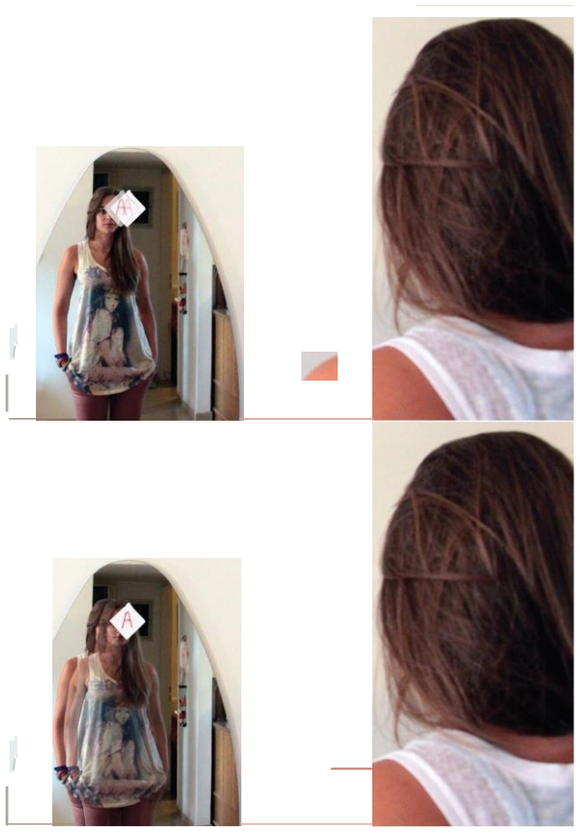

Figure 4. *In the upper photo attention is placed on the virtual self-image and the sticker is perceived as double. In the photo below attention is placed on the sticker, so the self-image is now perceived as double.*

Reference:

1. *Bertamini M, Parks TE, (2005) On what people know about images on mirrors. Cognition 98; 85- 104*
2. *Bertamini M, Spooner A, Hecht H, (2003b) Naive optics: Predicting and perceiving reflections in Mirrors. Journal of Experimental Psychology: Human Perception and Performance. 29; 982- 1002*
3. *Croucher CJ, Bertamini M, Hecht H, (2002) Naive optics: Understanding the geometry of mirror reflections. Journal of Experimental Psychology: Human Perception and Performance 28; 546-562*
4. *Rosenfield M, Ciuffreda KJ, (1991) Effect of surround propinquity on the open-loop accommodative response. Invest Ophthalmol Vis Sci 32(1): 142- 147*

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Innovative characteristic:

- ➔ This technique utilizes a simple mirror as a stereoscope for refining Base In flexibility in a virtual free-space environment.
- ➔ It can be used also in transferring skills from in-insturment to free-space environment.
- ➔ Simplicity of the technique and anti-suppression control allows to be prescribed as a home procedure also.