Prism adaptation - Why doesn't the world look upside down?

We have known for a very long time that the image on our retinas is upside-down, but even the great Rene Descartes believed our picture of the world must be turned back the right way up by our brains. But is this necessary? Could it be that we have just got used to things being the wrong way up? Today we are going to do an experiment to answer this question!

Let's consider the 2 possibilities.

- our brains are 'hard-wired' to turn the upside-down image on our retinas back the right way.
- it really doesn't matter which way up the world is, what matters is that we calibrate, by experience, our sense of vision with our proprioception (i.e. where our limbs feel to be).

If we wore distorting glasses that turned the world the other way up (the right way, you might call it) would we recalibrate our senses in time so that the world looked normal again? And what would we expect to happen when we took off the inverting glasses?

To investigate this we are going to upset the relationship between what we see and what we feel by wearing glasses that distort the world, not by turning it upside-down but by shifting it to one side. We can then investigate if we can recalibrate our senses; what sort of information is necessary to do the recalibration; and what happens when we take our distorting glasses off.

You are going to work in groups of 3 or 4; one person in each group is going to be the subject that wears the glasses, the others the experimenters and helpers. This experiment could be dangerous if it were not for the fact that the experimenters are going to make sure that the subject is not going to fall over, plunge down stairs, walk into the walls, fall into the lake etc. Choose a subject who is not sick easily!

1. The experimenter gets a piece of clean graph paper, places it in 'landscape' orientation and draws a line down the middle of the graph paper. Make subject comfortable at desk no glasses at this stage.
2. Sit subject down in front of desk and ask them to close their eyes. Place graph paper in front of them, try and line up centre of paper with their nose. On instruction the subject opens their eyes, looks at the line for 3 seconds, closes their eyes and points to where they think the line is with a pointer (closed pen - no feedback). The experimenter measures (in mm) how far the pointed position is from the line and which side of the line it is (left is –ve, right +ve). Do not reveal to the subject how close they were (feedback). The subject can now withdraw the pointer, we will do this three times and take the mean of these 3 measures to counteract any wayward measures. Remember, they don’t open their eyes until you have collected all 3 measures. You might like to consider why keeping eyes closed is critical.

To ensure we are all doing the same thing we have standard instructions that the experimenter gives to the subject (slowly) starting with their eyes closed.

`open your eyes, look at the line, … close your eyes, point and hold, … withdraw.`

Repeat this procedure 3 times. The mean of these 3 measures is measurement A.
Now we return to repeat the measures, sit the subject down and make them comfy, ask them to close their eyes. Remember that they will have their eyes closed all the time apart from when looking at the line.

4A. ACTIVE GROUPS ONLY
The subject now is free to wander around with the glasses on, under the close supervision of experimenters. Try to engage in as many activities as possible that require high levels of hand-eye coordination. We have supplied several games that should help with this. Try throwing and catching balls, throwing darts (it's OK they don't have sharp points). Try netball and swingball outside as well. If you feel sick please avoid vomiting on soft furnishing, behind radiators, onto computers or keyboards or even your friends. Just take the glasses off!  

*Do this for 30 MINS!*

4B. PASSIVE GROUP ONLY
The subject sits in a wheelchair, and is covered so that with their hands hidden. The important thing is that the subject should have visual feedback but no feedback of vision with proprioception, that is they can see everything in the world but they can't interact with the world in an active way. The experimenters may now wheel the subject around the campus. Do not push the wheelchair into the lake, there is an old lady who needs it back this afternoon. Do not run over any ducks or geese. If the subject feels sick, stop the experiment.

*Push your victim around for 30 MINS*

5. With the glasses still on repeat stage 2 exactly as before. **This gives measurement C.**

6. With eyes still closed, take the glasses off and immediately repeat stage 2. **to get measurement D.**

7. This one is a bit of fun for the subject, they will point with their eyes open in a ballistic movement (as fast as possible). So move the paper slightly, and say “open your eyes, point “ What happens? How did it feel? How long does the effect last ? What happens if they try it again ?

Enter your data into the table below and ensure all your measurements are entered into the class data table on the board. Use the graph below to plot your results, group results and the passive group results.

<table>
<thead>
<tr>
<th>RESULTS TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glasses</strong></td>
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<td>---------------</td>
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<tr>
<td></td>
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<tr>
<td><strong>Trial 1</strong></td>
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<td><strong>Trial 2</strong></td>
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<td><strong>Trial 3</strong></td>
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<tr>
<td><strong>Mean</strong></td>
</tr>
</tbody>
</table>

Measure in mm (-ve to left of line, +ve to right)

Results Graph:

What do our results tell us? Have we adapted to the new alignment of vision and touch? Compare the active group results with the passive wheelchair subject. What does this tell us?

Let the experimenter have a go at adapting to the glasses & experiencing what happens as they adapt and when the glasses are removed.

*We hope you have enjoyed this experiment and now understand a little about psychology.*