Experiment plan and Documentation.

Introduction:

Hemianopsia is a visual condition where in a section of one’s visual field is blank or blurry.

In this experiment we develop and test a program that streams video live to the user, transforming it to adapt it to their visual field.

Setting up. Establishing terminology.

To make it easier to talk about the subject of perception and VR.   
- The object of perception.

* The object(s) of perception. They are what the user is looking at outside of his or herself. This would be the physical world that is being streamed to the user, all of it or parts of it or objects in it.
* Mental content. The final visual experience the user has in his or her head.
* The screen(s). The visible layer in between the user and the external world, which we create for the user.
* Field of view. A measurement of the vertical amplitude of the lens of a VR headset.
* Visual Field. A measurement of the area that a user is able to see. Someone with Hemianopsia would therefore have a field of view that is different from people without it.
* Types of Heminopsia:homonymous left, homonymous right, binasal, bitemporal

Objectives

1. Ideal outcome: Rearranging images in such a way that the user with Hemianopsia has a mental content identical or akin to the mental content someone without it would have when looking at the same images.
   1. I can only speculate about the possibility of doing this. It may be possible for the brain to adapt the image into a representation that is more uniform. From a naïve perspective it would not be impossible. From a naïve perspective the parts of the brain intended to receive information from neurons in the parts of the primary visual cortex that are no longer usable could now be connected to the the parts that still are. Thus the visual pathways could be in a sense complete.
   2. Alternatively all the image processing could occur in the pathways that are not impaired of disabled and these could merely adapt to be able to process the compressed image.

A’. Alternative goal: Rearranging images in such a way that is useful for the user but is not necessarily akin to the mental contents someone without it would have.

1. Making VR accessible to people with Hemiaopia.
2. Making digital tools more accessible to people with hemiaopia. VR environments designed as workspaces may provide accessibility to people with hemiaopia.



Figure 1. Virtual Reality Worspace

**Requirements**

IOW: ’In Other Words’

**Functional Requirements**

The program MUST, stream live images into the head mounted display (HMD) at a reasonable speed (not less than *one[[1]](#footnote-1)* second of latency)

The program MUST, transform frames before displaying them in the HMD.

The program MUST, have a perimetry reading functionality that locates the unusable area of the user’s visual field.

The program SHOULD, have a setup protocol for new HMD’s that requires little or no manual input.

The program CAN, have an initial menu window that allows users to select their profile with their details stored in it.

**HCI requirements**

Using the program MUST not be exceedingly dizzying.

The program SHOULD be helpful to users with homonymous hemianopsia.

The program SHOULD improve the user’s ability to perform tasks.

**Experiment requirements.**

The experiment MUST demonstrate the potential usefulness of the ‘remapping’ of images on an HMD in the manner the program does it for people with hemianopsia.

IOW. The experiment MUST show evidence for or against the usefulness of the program and programs like it.

**Experiment**

**A-priori Challenges**

Subjects will need time to adapt.

Subjects will need time to adapt to the way in which images are presented to them. It’s important to distinguish the cases where the program does not work from the cases where the user just needs more time to adapt.

It will be overwhelming at first, for some participants.

VR often is, and putting more information into less space is likely to make it worse. This makes the experiment longer because participants need time to adapt before we can tell if they can use technology.

This presents an ethical concern because participating in the experiment can cause the patients distress.

Current VR headsets may not be suitable.

Although modern VR headsets have high resolution, most of it is focused on the center, which presents a problem of packing content on the sides.

Modersn VR sets provide a screen that is very narrow, this makes out job harder because it reduces the screen space we have to work with.

**Methodology.**

**Variables**

Dependent: The ability of the participants to perform tasks on the VR headset.

Dependent: Whether the participant can ‘see normally’ using the headset.

Dependent: Whether the participant can ‘see fully’ using the headset.

Independent ‘Adapted VR display’:Variations in the display of images in the VR headset.

Level 1. Compressing the whole FOV of the VR set into the participants visual field

Level 2. Compressing the whole FOV of the VR set into the participants visual field and blur out peripheral sections.

Level 3.Compressing part of the whole FOV of the VR set into the participants visual field.

Independent: The kind of hemianopia of the participant.

Level. Homonymous

(excluded) Level. Bitemporal

(Excluded)Level.Binasal.

*See the appendix for illustrations.*

Constant: Participants have full (not partial) vision loss of part of their visual field.

Control Variable: Participants are not feeling overwhelmed when the experiment is under way.

**The interface**

Old version, this interface will no longer work.

The interface will be identical to a regular VR interface (if there is such a thing) with two degree movement of the head and controllers for grabbing and moving things. There will be a 3d interactive environment consisting of a room and some props.

Images will be displayed in the lense of the headset adapted as explained.

There will be two games (game1(easy), game2(hard)) designed using the props, whose success will be measured by the program. Thus the program will have a database or some other method for the program to store the data in.

Adjustments should be made in pretesting to make the program as pleasant as possible (i.e. adding transitions, soft sounds, etc).

A measurement interface is used in pretesting to measure the coordinates of the visual field of the participant.

**Testing on participants.**

Participants begin their participation by registering and completing the GUI test of their visual field. After that they should be introduced to the VR setup with the adapted display to allow them to get used to it.

Option 1. The simplest version. Duration: one day.

This is the simplest and fastest option.

Participants play game 2 twice. One time using the Adaptation, another without it. The order is randomized.

**If** the participants perform better in the game while using the adaptiation, that would be evidence of it’s usefulness.

Option 2. Extended experiment.

This option gives participants all the time they m ay need to get used to the VR environment. It is the preferred option because it minimises the possibility of false negatives since it could be that participants are unable to use the VR set not because it cannot be useful but because there is a learning curve.

Participants play game one every day for a period of one week.

After the week of practice, Participants play game 2 twice. One time using the Adaptation, another without it. The order is randomized.

**If** the participants perform better in the game while using the adaptiation, that would be evidence of it’s usefulness.

**The questionnaire(draft)**

\*The questionarire is meant to (i) measure the dependent variables that do not have to do with ability but with the visual experience of the user.(ii)Measure control variables that could produce false negatives like stress, confusion and inexperience with technology.

**Question 1.** *Which one of these pictures represents what you were seeing while you were using the adapted display most accurately?*

1. *A picture of the display as it is shown, with blank areas and the images compressed into the visual field.*
2. *A picture of display as it would be without the adaptation (ie. A full visual field).*

**Question2.** *When I first put on the VR headset I felt\_\_\_\_.*

*a.Shoked*

*b. Dizzy*

*c. All of the above*

*d. None of the above.*

Appendix



Homonymous left

<https://en.wikipedia.org/wiki/File:Paris_as_seen_with_left_homonymous_hemianopsia.png>

A picture containing text

Description automatically generated

Binasal

A close-up of the earth

Description automatically generated with medium confidence

Bitemporal

1. Subject to change [↑](#footnote-ref-1)