MILS: Module 6 - Eye-tracking
July 2024

Contact information

Name: Esperanza Badaya
Email: esperanza.badaya@ugent.be
Name: Mariia Baltais
Email: mariia.baltais@ugent.be

Class Information

Time: 09:00 - 12:30, with a 30' break at 10:30
Classroom: Campus Mercator, Building A, Aula A4.09 (Abdisstraat 1, B-9000 Ghent)
Course website: GitHub Repository

Note that on Thursday 18th, the course will take place at Henri Dunantlaan 2 from 9:00 to 12:30 (Faculty of Psychology and Educational Sciences). We will meet at the main entrance, then one group will go to the eye-tracking lab (everyone will be able to act both as a researcher and as a participant). In the meanwhile, the other group will have a study session about data pre-processing in classroom 2.3. After that, the groups will change places.

Course Description

Over the last decades, eye tracking has become a widespread technique to understand how people process and learn language. In this course, we will cover a basic introduction to eye-tracking techniques in language science. More concretely, the following aspects of eye-tracking will be discussed:

- How do eye-trackers work and what has their scientific impact been on our understanding of language processing? Here, we will discuss the link between visual attention and the processing of (linguistic) information (the eye-mind hypothesis): Why is it interesting to look at eye movements when we study language?
- What kind of questions about language can be studied with eye-tracking, and which experimental paradigms are out there to answer these questions? In this discussion, we will cover the Visual World Paradigm and eye-tracking-while-reading, with a hands-on approach. We will briefly discuss alternative approaches, such as mouse tracking and web-based experiments.
- How do you set up an eye-tracking study, and what kind of data does an eye-tracking experiment give? In this part, data processing and analysis will also briefly be discussed. At the

same time, do note that this is not a course on data analysis: The aim is to give an idea of the output of an eye-tracking experiment.

Materials

All the course materials, including slides, experimental scripts (in all software), cited and recommended articles, as well as mock data and analyses can be found in our GitHub website. On its main page, you can find the index, but please email us if you find it hard to navigate.

Additionally, in this course, we will use different software for creating our experiments and for processing and analysing data. Specifically, we will cover one software for coding an experiment: OpenSesame. The main reason behind this is to equip you with knowledge of open software, as opposed to licensed software (such as Experiment Builder by SR Research). Another reason is that OpenSesame is compatible with different eye-tracking systems. However, you can choose yourself which software you want to code: We will be happy to assist you with either (e.g., Experiment Builder, PsychoPy).

Unfortunately, while there are few open-source resources for data pre-processing in the Visual World Paradigm, this is not the case for reading data. Therefore, we will work with SR Research's Data Viewer. Data Viewer is licensed, but SR Research provides a 30-day trial period, which you will be taking advantage of in the course. We will share the file for installation with you on Wednesday. Note that while the implementation can differ from the one you have in your home institution (e.g., you have a Tobii tracker), the steps that will be described still apply.
] This is the list of software to download for the course:

- OpenSesame (Days 2 & 3)
- Data Viewer (Day 4)
- R & R Studio (Day 5)

  We will be using the following packages in R, please install them (via *install.packages("name of the package")*).

  tidyverse

  lme4

Outline of the Course

We have organised the days around the two main paradigms covered in this course. Except for Monday, the 15th, we will use different software throughout the course.

Day 1: Introduction to eye-tracking

- What is eye-tracking, and why are we doing it?

  We will briefly discuss how our visual system works and the mind-eye hypothesis.

- How do eye-trackers work?

  We will briefly cover the history of eye-tracking. From there, we will discuss how modern eye-trackers work. We will cover what an eye-tracking lab looks like and the different kinds of eye-trackers that are in the market.

- What can we measure with an eye-tracker?

  In this part, we will discuss the different measurements (e.g., fixations, saccades) that we can obtain from an eye-tracker. This will help us understand how each measurement is informative in different paradigms.

- Common set-up of any eye-tracking study.

  In this section, we will cover the elements that are shared by all eye-tracking experiments. Specifically, we will discuss the lab and camera set-ups, as well as different tips for conducting an eye-tracking experiment.

- Eye-tracking in language research.

  We will explain what eye movements can tell us with regards to language processing. We will also discuss whether eye-tracking is suitable for us.

- Visual World Paradigm.

  We will introduce the Visual World Paradigm, the focus of day 2, by discussing an experiment.

- Reading Paradigms.

  We will introduce the tracking-while-reading paradigm, the focus of day 3, by discussing an experiment.

Day 2: Visual World Paradigm

- Visual World Paradigm

  We will cover the history of the Visual World Paradigm. Following this, we will discuss the different uses of the Visual World Paradigm (i.e., what kind of research questions can be answered). The focus will be on speech comprehension, but we will also cover examples from language production. From there, we will discuss the trial sequence of these experiments, as well as the different factors to control for when conducting them. Finally, we will discuss alternatives to eye-tracking with the Visual World Paradigm (i.e., mouse tracking), and discuss the pros and cons of this paradigm.

- Creating a Visual World Paradigm experiment in OpenSesame.

  In this section, you will be coding an experiment in OpenSesame. There will be walk-through prior to this. You can either try your own idea, or replicate the experiment described.

Day 3: Reading Paradigms

- Eye movements during reading.

  We will discuss the types of eye movements we are interested in when we study reading and their characteristics as compared to looking at a visual scene. Furthermore, we will introduce the most common reading measures (first fixation duration, gaze duration, etc.) and discuss how they are assumed to be linked to linguistic processing.

- Reading paradigms.

  In this part, we will briefly discuss the different uses (i.e., what kind of phenomena can be studied) and different variations of reading paradigms. We will also talk about pros and cons of using eye-tracking for reading research.

- Single sentence reading paradigm.

  We will go back to the experiment we discussed during day 1 and go over the general procedure and trial sequence of such studies, as well as the different factors to control for when conducting them.

- Creating a reading study script in OpenSesame. There will be a walk-through before this. You can either try your idea, or replicate the experiment that we used as an example.

Day 4: Data Processing

- "Raw" eye-tracking data.

  First, we will discuss different stages of data processing and what "raw" eye-tracking data consists of, and introduce the Data Viewer software.

- Data cleaning.

  In this part, we will begin with the visual check of our data. This step is especially important for reading studies. Afterwards, we will discuss automatized cleaning procedures inherent to Data Viewer that remove eye movements we don't want to analyze (too short/long fixations, fixations outside of Areas of Interest etc.).

- Exporting data.

  We will cover the types of reports that are relevant for Visual World and reading studies and can be exported from Data Viewer; these reports represent the data that we will further analyze with statistical software (day 5). We will also provide you with some mock data to practice data pre-processing. The goal is to be able to pre-process the data you collected in the lab and to generate a report (you can try it later at home; we will also have some time for that in the beginning of day 5).

Day 5: Data Visualization and Analysis

- Data Visualization.

  We will start by discussing why it is important to visualize our data. We will then show and explain data from the Visual World Paradigm and the tracking-while-reading paradigm.

- Data Analysis.

  We will discuss the different approaches to data from the Visual World Paradigm and the tracking-while-reading paradigm, as a function of the research question.