Københavns Universitet

Doing smooth pursuit paradigms in Windows 7
Wilms, Inge Linda

Publication date:
2017

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Doing Smooth Pursuit Paradigms in Windows 7

~Challenges and Limitations~

Inge L. Wilms, Ph.D.,
Associate Professor and Leader of Brain Rehabilitation and Technology Laboratory
Contact: inge.wilms@psy.ku.dk

Abstract

Smooth pursuit eye movements are interesting to study as they reflect the subject’s ability to predict movement of external targets, keep focus and move the eyes appropriately. The process of smooth pursuit requires collaboration between several systems in the brain and the resulting action may predict strengths or deficits in perception and attention. However, smooth pursuit movements have been difficult to study and very little normative data is available for smooth pursuit performance in children and adults. This poster describes the challenges in setting up a smooth pursuit paradigm in Windows 7 with live capturing of eye movements using a Tobii TX300 eye tracker. In particular, the poster describes the challenges and limitations created by the hardware and the software.

Background

In the clinical world, smooth pursuit eye movements are usually assessed using a so-called Wolff wand (figure 1). The clinician will ask the subject to keep his or her head still and focus on the golden top of the wand while the clinician moves the wand. The movement of the wand differs depending on the assessment but common practise is that the wand is moved in a wide circular pattern or a horizontal or vertical pattern (1). This is a rather imprecise way of assessing smooth pursuit ability for two reasons: 1) it requires that the clinician is able to move the wand in a speed and manner within the limits of the brain’s ability to predict the movement and 2) it is almost impossible for the clinician to reconstruct the same movements repeatedly. This prevents the assessment of smooth pursuit before and after an intervention and confounds the reliability of the assessment of intervention induced changes in smooth pursuit ability.

Since we wanted to study the development of smooth pursuit eye movements in children, we therefore needed to create a computer-based assessment tool to reliably track and record smooth pursuit eye movements. However, we soon realized that none of the commercial providers of eye tracking equipment offer a smooth pursuit paradigm which would allow you to control the displayed movement. The only available solutions required you to use video material of moving targets. Since we needed to know exactly when a movement started and ended to ascertain smoothness and responsiveness, we had to get our own animation software and use the SDK to communicate with the eye tracker.

Challenges in software

The animation program for the study was written by the author in C# in order to utilize the SDK interface to the eye tracker provided by TOBII (2). There were two major requirements. We needed to log every eye tracking event and we needed to insert our own task related events using a synchronized timestamp that would later allow us to match eye movements with the activity on the monitor. This was needed to measure how precisely the subject were able to follow the movement of the target and how fast they reacted to changes in movements.

We therefore captured and queued the eye tracking data passed every 3rd millisecond and inserted our own event markers into the stream of events using a synchronized timestamp to ensure we could establish the correct order later on. The writing of the queue to a data set was done asynchronously. The smooth pursuit paradigm consisted of three different tasks where the main objective was to follow the movement of a small beach ball: 1) moving horizontally back and forth at three different speeds, 2) moving in a circle at three different speeds and 3) moving in a small or large rectangular shape (Figure 4a, 4b). When a software program displays an item on a PC monitor there is a slight delay between when the command to display an item is issued until the item actually appears on the screen. The monitor is only able to display new items 60 times per second. This may sound fast, but if you want to make the illusion of movement, you actually need to be able to display the item in a new position every 60th of a second. The animation was done by writing and deleting the image of the ball on the monitor and inserting our own task related events using a synchronized timestamp that would later allow us to match eye movements with the activity on the monitor. This was needed to measure how precisely the subject were able to follow the movement of the target and how fast they reacted to changes in movements.

When the computer performs a move, it will always do so at the next opportunity. For example, if the movement is a circle and the monitor can only display new items 60 times per second, the computer will never display the item at a 60th of a second interval. Instead, the computer will wait until the next opportunity, e.g., the next item to be displayed is a new one. This is why the movement of the eye tracker will be a little smoother than the movement of the object on the screen.

Equipment used

The eye tracker used in the study was the Tobii TX300 which tracks both eyes with a sampling rate of 300hz. The screen unit is a 23 inch TFT monitor with a resolution of 1980x1080 pixels. Vertical sync freq. is stated as being 49-75 ms with a typical response time of 5 ms (4). The PC was equipped with Intel (R) 6700K 4 x 4.0 GHz processor with 8MB cache, 32 GB DDR4-2666 RAM and a GeForce GTX970 4GB Graphics card.

References

(2) TOBII Analytics SDK Developer’s guide Release 3.0
(4) TOBII TX300 Eye Tracker User Manual Revision 2