

# Using heat maps from eye tracking in stimulated recall interviews

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*This presentation discusses students' interpretations of heat maps from eye tracking. Heat maps are often referred to as 'just' eye candy because of their appealing nature and the somewhat 'hidden' data. Undoubtedly, there is valuable information in these visualisations and if attention is paid when conclusions are drawn, the data is a useful complement to quantitative measures. We explore pros and cons when using heat maps in stimulated recall interviews and contrast this method to stimulated recall using videos or the use of think aloud protocols. A conclusion is that the heat map can attract attention to what actually happened and thereby evoke valuable references to thought processes, but at the same time it may draw attention to actions instead of to reasoning and thoughts because the image represents the reader's activity ("I looked at...").*

## **Background**

In studies about, for example, the reading process or strategy use when solving mathematics tasks, different methods are utilized to gain insights into decision making or potential struggles. For example, thinking aloud protocols have been used to analyse spontaneous use of metacognitive skills (Van der Stel, Veenman, Deelen, & Haenen, 2010). Thinking aloud protocols have the benefit of being collected simultaneously as the solution process but because the experimenter may need to encourage the students to speak (ibid.) this method can potentially disturb the solution process. The use of video in stimulated recall interviews (SRI) is well established, and has also been combined with eye tracking stimuli. For example, the creative process during work with mathematics tasks was analysed by Schindler and Lilienthal (2019), using eye-tracking stimulated recall aided by recorded gaze-overlaid video, which displayed the student's gestures, writing, drawing, and eye movements, as stimulus. Schindler and Lilienthal (2019) stress the advantages with SRI compared to, for example, thinking aloud methods since with SRI it is possible to avoid requirements on interaction and strict time constraints present when thinking aloud methods are used. Other methods that are used to, from different perspectives, analyse students' reading or solution process are to capture the emerging solution using digital devices, sometimes in combination with sound recordings or, not at least, solely interviews. Every method has unique advantages, and because the scope of studies varies so do also methods.

### **Example from practice - heat maps in stimulated recall interviews**

In a study about dynamic functions in mathematics items in a digital environment we use eye tracking to gain insight into students' reading and solving. Stimulated recall interviews are used as a complement to quantitative measures. Because quantitative measures can never reveal why a participant reads in a particular way, these interviews add important data. Heat maps are used as memory cues instead of gaze plots because a gaze replay risk disrupting the report due to fascination with the jumpiness of eye-movements and with an intention to avoid such the high amount of information (e.g., see Bojko, 2013).

A pilot study has assured that the stimulated recall interviews contribute valuable data, but some difficulties related to the method were also revealed. As expected, the interviews nuanced the quantitative data. For example, descriptions about whether an intense gaze point reflected a perception of something difficult or important and whether central mathematical expressions do not gain visual attention because they are judged as unimportant or because they are very easy to instantly grasp the meaning of. In some interviews there were tendencies among the participants to please the experimenter which they knew were the designer of the items. The heat maps played an important role as valid data in relation to such a bias. Some important difficulties or deficiencies related to the method also became apparent. First, the heat map may steer students' attention to what they do instead of how they think, something that may not appear if videos were used. Second, the heat map may be given too high truth value, because students are not skilled interpreters of these data. For example, visualisations include areas where no data is displayed (ibid.). This issue can be addressed by also showing gaze plots in the interviews, which may enhance the participants' chance of interpreting the data correctly. Information about how to interpret the heat maps is also important. There is however a risk of adding too much information, because the participants may get exhausted. The problem with utterances about actions instead of cognitive processes will in our future studies be addressed by refining the interview guide. In summary, the pros of using this method in our research is larger than the cons, but it must be emphasized there are issues to be aware of when interpreting the data.

### **References**

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