

L TJ_30_4_Eye_Tracking_Studies

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Interviewer: From the University of Leicester in the United Kingdom, this is Glenn Fulcher with another issue of Language Testing Bites. In issue 34 of Language Testing, we publish a paper on the use of eye tracking studies in understanding cognitive processing and reading tests. This is the first paper on eye tracking that has been published in the journal, and so we invited the author to talk to us about this methodology and its potential use in the field. Steven Backs is professor of applied linguistics at the University of Bedfordshire in the United Kingdom where he works in the centre for research in English Language learning and assessment. Welcome to Language Testing Bites, and thank you for agreeing to talk to us about eye tracking studies.

Respondent: Well thank you for inviting me.

Interviewer: Let's assume first of all that many of our readers won't actually know what eye tracking is, or how it is done. So perhaps you could start off by explaining just what you do in an eye tracking study. Perhaps the best way to do this is to tell us what equipment you need and precisely what a test taker would experience during the study?

Respondent: In the old eye tracking studies which investigated reading, the reader had to wear a clumsy headset or heavy glasses attached to a computer of some sort, which made the experience rather unnatural. But luckily modern equipment has done away with that, so the reader now can sit in front of a computer screen which has hidden cameras in the casing. As the reader reads on screen these cameras track eye movement with great accuracy, without the reader noticing, the reader can continue as normal. And it was partly because of this advance in technology, the fact that we can now research reading and reading tests in a very natural way, that I was keen to embark on this project in the first place.

Interviewer: That seems fairly clear. So the machine is measuring eye movements during reading. Can you explain what eye movements are recorded and what the measurements are for each of these movements?

Respondent: Yes, in simple terms there are essentially two main elements, a fixation which is when the eye focuses for a period of time on one area, and a saccade which is where the eye moves rapidly across the page between fixations, perhaps to find another area of interest. The technology can then represent that in the printout as a set of dots and lines, each dot larger or smaller to represent the length of time the eye stayed on that point, the fixation. And the lines represent the distance that the eye travelled between fixations. So the software then allows you as well to get very precise statistical data about when each person has looked at a particular word or section, for how long, how often, when they moved away to another part of the text, and so on. So you can statistically compare strong readers with weaker readers. For example, an important further element in my research was the post-doc interview in which with research assistants from the University of Bedfordshire, we showed participants a video of their own eye activity immediately after the test they had just taken and asked them to explain what they were doing at significant points in a kind of running commentary. And this was valuable because it often helped to elucidate exactly why they focused on particular areas, or searched through particular parts of a text. And that gave us important information to help us explain the eye tracking images and statistics themselves.

Interviewer: And now we have established the basic methodology, and set out the eye movement data that is collected, researchers claim that types of eye movement of certain lengths are associated with cognitive processes engaged in reading. Can you just spend some time saying what these claims are, and what the evidence is to support them?

Respondent: Well it is difficult and risky to claim a direct link between eye movements and cognitive processes. But it appears from research evidence that there is a relationship. For example, to put it simply again, we can show that there is a link between the amount of time a reader fixates on a word in a sentence, and the amount of information which readers can recall

afterwards. In other words if they skim over a word quickly they are less likely to recall it accurately, which is perhaps obvious but it allows us to say that fixations are a key element in the process of getting information from a text. Whereas saccades have other functions, perhaps more strategic such as checking or moving forwards through a text, so we can infer certain relationships between eye movements and cognitive processes. But we have to do it cautiously, and of course interview data can be a big help in explaining what readers were doing at any particular point in time.

Interviewer: Okay, so let's come to your study. I'd like to tackle this in two ways if you don't mind. One of your research questions considered whether the eye tracking data could help distinguish between more and less successful readers, in terms of the cognitive processes. What is the answer to this question, and how did you go about answering it?

Respondent: The items we chose to focus on in this research basically tested reader's abilities at the lower end of the scale of cognitive complexity. In other words their abilities at a lexical and grammatical level, not at sentence or whole text levels. So that is a limitation which needs to be noted. But at that level on five of the ten items we found that students who got the answers correct on each item appeared to do so because of better abilities to find the correct part of the text where the answer was located. And then to identify the lexical and grammatical elements which gave them the correct answer. By contrast, students who failed to get the answers tended to be poor at locating the correct part of the text, and also poor at spotting the correct lexical or grammatical elements which would have given them the right answer. For example, we saw some students scanning over masses of text fruitlessly, while others honed in almost immediately to the area of the correct answers. That is very clear from the eye tracking printouts.

Interviewer: Thanks. Now my second question is related specifically to test format. Your study is different from other eye tracking studies in that you included the test question, in this case sentence completion and multiple choice, as well as the text. What does your study suggest that eye tracking can contribute to understanding how test takers of different ability levels process certain item types?

Respondent: Indeed, we first identified an [unintelligible 00:06:43] reading test appropriate to our needs, and we then analysed each test item closely to identify what the reader would minimally have to read in the text in order to get the correct answer. And that allowed us then to compare successful and unsuccessful reader's eye movements on each item. For example, we could examine whether successful readers fixated significantly more on the key words or sentences, whether they managed to find them more or less speedily and efficiently, whether they spent more or less time on the text as a whole, and so on. In the event on half of the test items there was no discernable difference in the eye activity of successful and unsuccessful test takers, which is interesting in itself because it presumably means that successful readers, those who got the answers correct were using other abilities to get those answers. For example, successful students might have been using better memory or better lexical knowledge, and that would not show up in the eye movement. Of course that shows a limitation in what eye tracking can tell us. But more interesting for us is that in the other half of the test items there were significant differences between the eye activities of successful and unsuccessful test takers. As I suggested earlier, in some items taking account also of the interview reports of what they had done, the successful students had clearly been better at lexical matching, at identifying synonyms and also at disambiguating elements of syntax as a means of getting to the answer. This was reflected in the relative times they had fixated on the relevant areas. So we could infer from that their success was probably due to their cognitive mobility's in those areas. Another interesting finding was in several items, as I mentioned before, the successful students had been able to find the relevant part of the text far more efficiently, or expeditiously, and not wasted time searching through the text, as some unsuccessful students had done. And this ability to find the correct part of the text expeditiously, seemed to be advantageous to those readers.

Interviewer: What, in your view are the possible implications of your research for language test designers, and also for teachers preparing students for reading tests?

Respondent: I would say that it is useful for those designing reading test items to think about the levels of processing set out by [unintelligible 00:09:00] and Weir in their 2009 book, *Examining Reading*, because my eye tracking research shows that successful readers do perform better in some of the areas which [unintelligible 00:09:09] and Weir identified. It is therefore useful for a reading test to try and test those areas, for example lexical matching, lexical synonymy, aspects of syntax and so on. That forms a really nice structure for a reading test designer to think about whether they are targeting key areas which they wish to target to test, or to distinguish between successful and unsuccessful readers. In terms of teaching, it was clear to me that those candidates were more successful who made use of expeditious reading strategies, especially to locate in the text the possible site of the correct answer as speedily as possible. So I do feel that getting students to practise expeditious reading, and to develop their abilities to read a text and then locate particular areas of that text can be useful, and that perhaps implies activating better memory strategies as well. Besides the value of this in real world academic tasks, I do see it as beneficial for reading tests of a kind that we were looking at. Successful students also show better abilities in terms of dealing with Lexus, so I feel that a teacher could usefully concentrate on developing lexical competence, as good teachers already do of course. But my research did suggest that this area would help students to do better in readings tests. The same for syntactic ambiguities. It was clear from my research that successful students were able to identify and deal with syntactic ambiguities very effectively, so that is another possible area for teachers to focus on.

Interviewer: Before we come to the end of the podcast, perhaps I can ask you to do a little crystal ball gazing. Where do you think eye tracking studies might take us in language testing, and what are the kinds of research questions that they might help us to address in the future?

Respondent: As you implied in the last question, I do feel that eye tracking will be an important tool for examining in greater detail how users deal with different test formats and task types. That is one area where, perhaps in ten years' time, eye tracking research could significantly impact on the kinds of reading test tasks which test designers choose in future. It might also become a tool routinely used by large testing boards say, to trial their reading test items and even to trial reading texts which they plan to use. As the technology becomes cheaper and better known I can see it becoming an important part of the overall test validation tool kit. I can also see it used for looking at onscreen writing, possibly as a way of understanding better the cognitive processes used by writers as they complete, for example, essay tasks. But it can be difficult to eye track people writing on screen because they often look down at the keyboard, so the data is a little bit more irregular. But nonetheless I feel in general eye tracking technology does have interesting possibilities beyond research into reading, and could well be used in other areas of researching language testing.

Interviewer: Well many thanks for joining us on Language Testing Bites. I'm sure that your article will attract a great deal of attention and lead to further consideration of how this methodology might be used in future studies.

Respondent: Well thank you once again for inviting me.

Interviewer: Thank you for listening to this issue of Language Testing Bites. Language Testing Bites is a production of the journal *Language Testing* from Sage publications. You can subscribe to Language Testing Bites through iTunes, or you can download future issues from ltj.sagepub.com or from languagetesting.info. So until next time we hope you enjoy the current issue of Language Testing.

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