‘Eye Tracking as Process Data’

CEMO Lecture Series on *Process Data in Educational Assessment*

Lecture 4, January 13th, 2023.

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UiO : University of Oslo

Assessment MicroAnalytics™

DIGITAL EDUCATION FUTURES INITIATIVE CAMBRIDGE

University of East Anglia

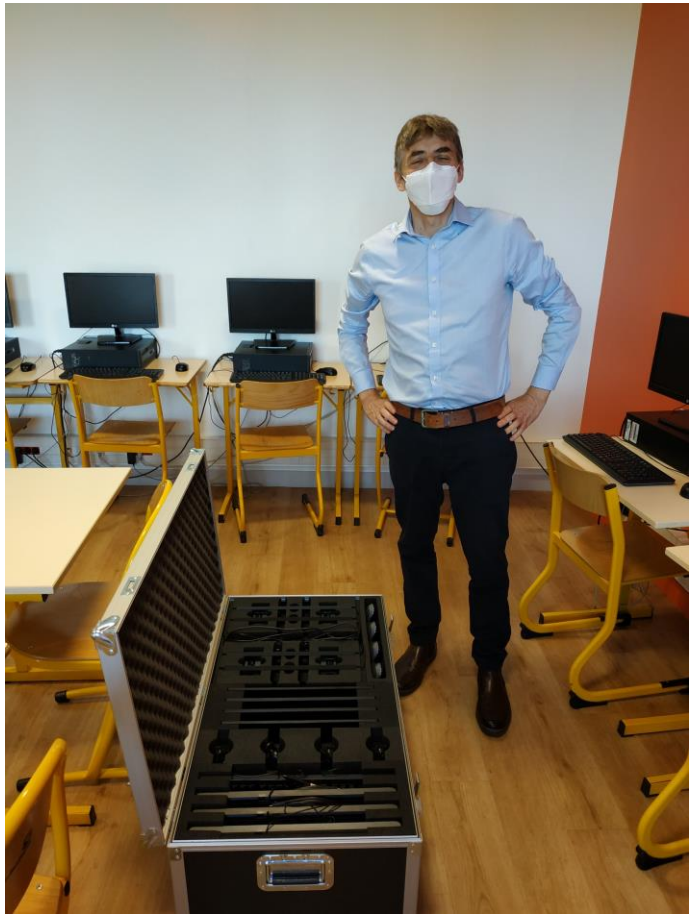

Validation precision (SD)
Validation precision (RMS)
Data loss
Recalibrate all points
Revalidate all points

Eye Tracking Technologies

Tobii spectrum

Tobii Fusion

See Tobii.com



Discussion Question

What might be the advantages and applications of eye tracking in assessment?

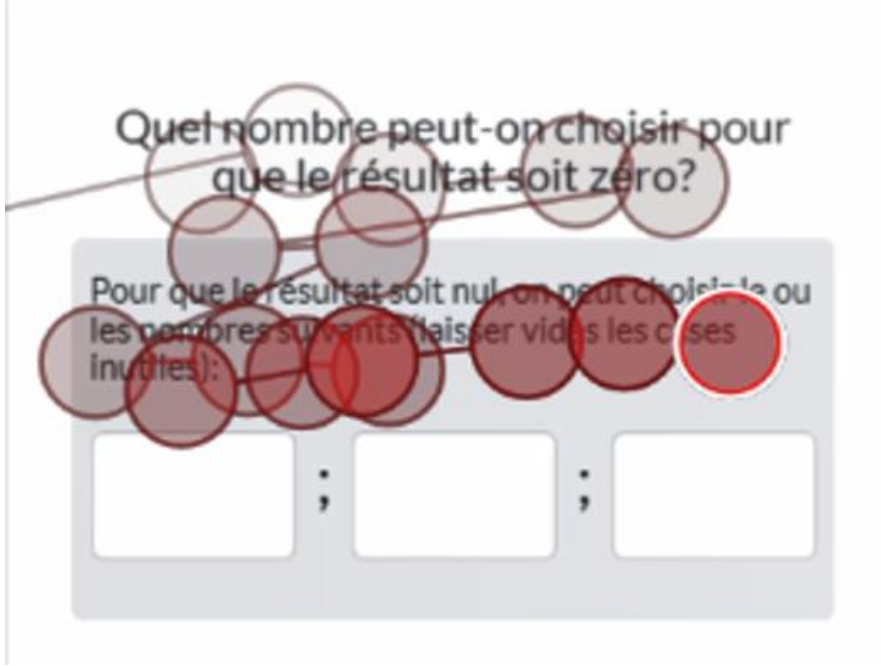
Fovea, vision and perception

- The fovea is the small part of the retina that provides sharp vision. The fovea enables the kind of focus necessary for reading and perception of visual detail (high acuity).

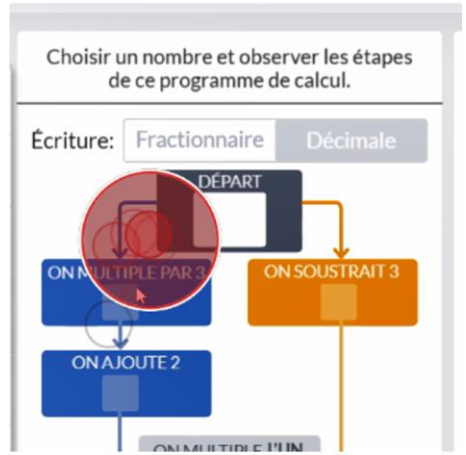
- Outside that area, immediately around the fovea we see less sharp image images (para fovea – fewer cones). The inner parafovea can help with reading, but the outer fovea does not provide enough information.

- When we ‘perceive’ a scene, our mind assembles it from multiple gaze movements. But if we do not look at part of the scene in the area of fovea/parafovea, we have not actually seen it. Hence the importance of studying gaze.

Gaze, attention and information processing..



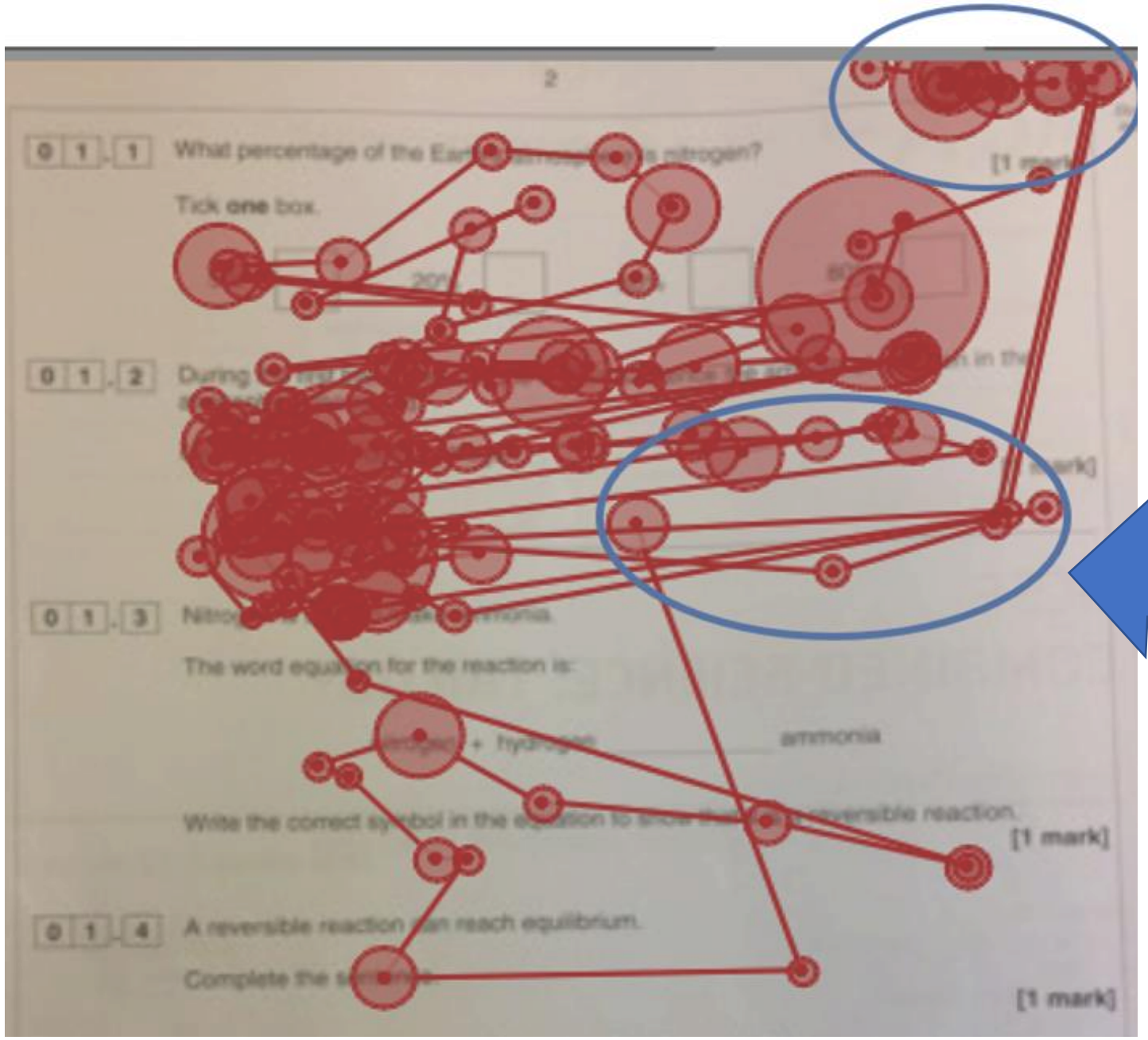
Calibration is necessary to ensure that the fixation images are precisely matched to the screen. To avoid ‘offsets’



Gaze is not the same thing as attention. In this case, the long fixation reveals thought, rather than attention to the image detail.

Threats to the quality of eye tracking data

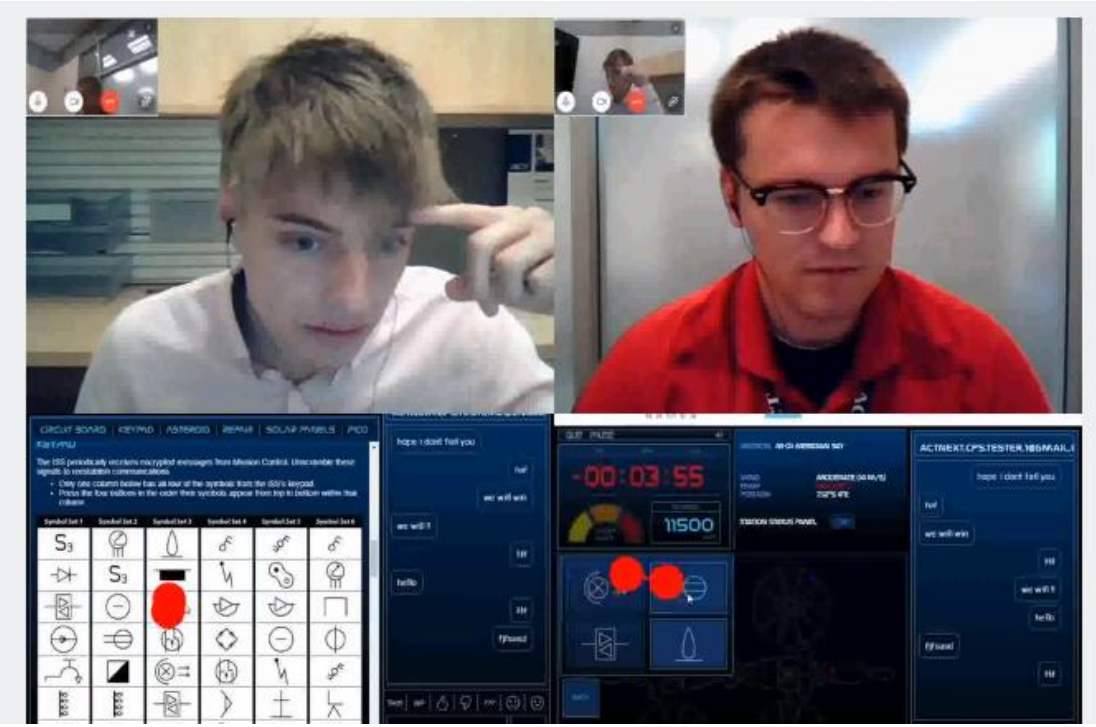
- Off screen activity (if there is a lot, then eye tracking glasses are preferrable). Though use of video can compensate.
- Sunlight – bright/direct sunlight prevents tracking because the eye tracker uses near infrared technology in its sensors.
- Other disturbances.. Thick lenses in glasses, and glasses worn low on a persons' nose. Mascara! and eye shape ('sleepy' eyes).



Space to ‘THINK’

Maddox and Stephenson (2021)

Joint attention in Collaborative Problem Solving



‘The digital collaborative assessment measures behaviors indicative of CPS skills that are captured in multiple modalities including video, audio, and eye tracking recordings which are analyzed using machine learning techniques.’

ACT Website

https://www.kcrg.com/content/news/ACT-asks-students-to-solve-crisis-in-space-video-game-as-part-of-collaboration-study-509924761.html

‘From Game to Data: Multimodal Analytics

‘After synchronizing the multiple data streams and stitching the individual videos together into a “dyadic” video, we use the annotation software ELAN to create multimodal tagging of the content’

Andrade, A., Maddox, B., Edwards, D. Chopade, P. & Khan, S. (2019)

Table 3. Excerpt 1. A dyad solving the Keypad task.

Turn	Time	Speaker	Utterance	Task	Evidence
1	177.32	Operator:	So, now, there should be a bunch of shapes somewhere.	1 2.a	Click on keypad window State “shapes”
2	174.771	Engineer:	Okay. So, should I just press quit?	II	Facial valence increase
3	183.88	Operator:	Uh... No.	II	Facial valence increase
4	185.48		So... There should be a section with a bunch of shapes.	2.a	State “shapes”
5	184.49	Engineer:	Okay. Yes. I do see it. Okay.	2.b	Gaze on Keypad tab and verbal acknowledgement
6	191.8	Operator:	So, I have four shapes. I'm not entirely sure what I need to do with it but I should be able to tell you them, and you have to tell me which one to click on. Does that make sense?		
7	204.57	Engineer:	Okay.		
8	206.64	Operator:	So, I have one that's like a play triangle on top of a semicircle. But it's like… [left hand crosses the screen]	3.a	Verbal description Gesture a keypad symbol
9	217.21	Engineer:	Hmm. I don't see it.	3.b	Ask for clarification
10	219.96	Operator:	Okay. Um, I have one that looks like a key. It's like…	3.a III	Describe a keypad symbol Facial valence increase
11	220.25	Engineer:	Oh, I see the one with a semi-circle and a triangle on it. Yes, I do see that one.	3.b	Acknowledge symbol
12	229.84	Operator:	Okay. I have one that's a key. So... It's a circle and then there's an F coming off of it. Looks like a key. [gesture]	3.a	Describe a keypad symbol

Source: Andrade, A., Maddox, B., Edwards, D. Chopade, P. & Khan, S. (2019) ‘Multimodal Interaction Analysis for the Assessment of Problem-Solving Skills in a Collaborative Online Game’. In B. Eagan., M. Misfeldt., A. Siebert-Evenstone (Eds.) *Advances in Quantitative Ethnography* First International Conference, Madison, USA. Springer. pp281-290.

Self Report vs empirical data in eye tracking.

The Accessibility and User Experience of a Pearson Digital Assessment Platform for GCSE Learners with Special Education Needs and Disabilities (SEND)

A Short Report

December 2021

Pearson

AMA Assessment MicroAnalytics

User Experience, Scene Perception – Significance of Neurodiversity and disability.

- Neurodiversity and disability mean that there will not be standard ways that students perceive and engage with assessment items and platforms. Implications for test development and validation.

- Certain groups are more likely to engage with items in ways that are unanticipated by test designers. i.e. missing out key information (such as instructions), distracted by images, difficulty in dealing with ‘busy’ images due to reduced working memory.

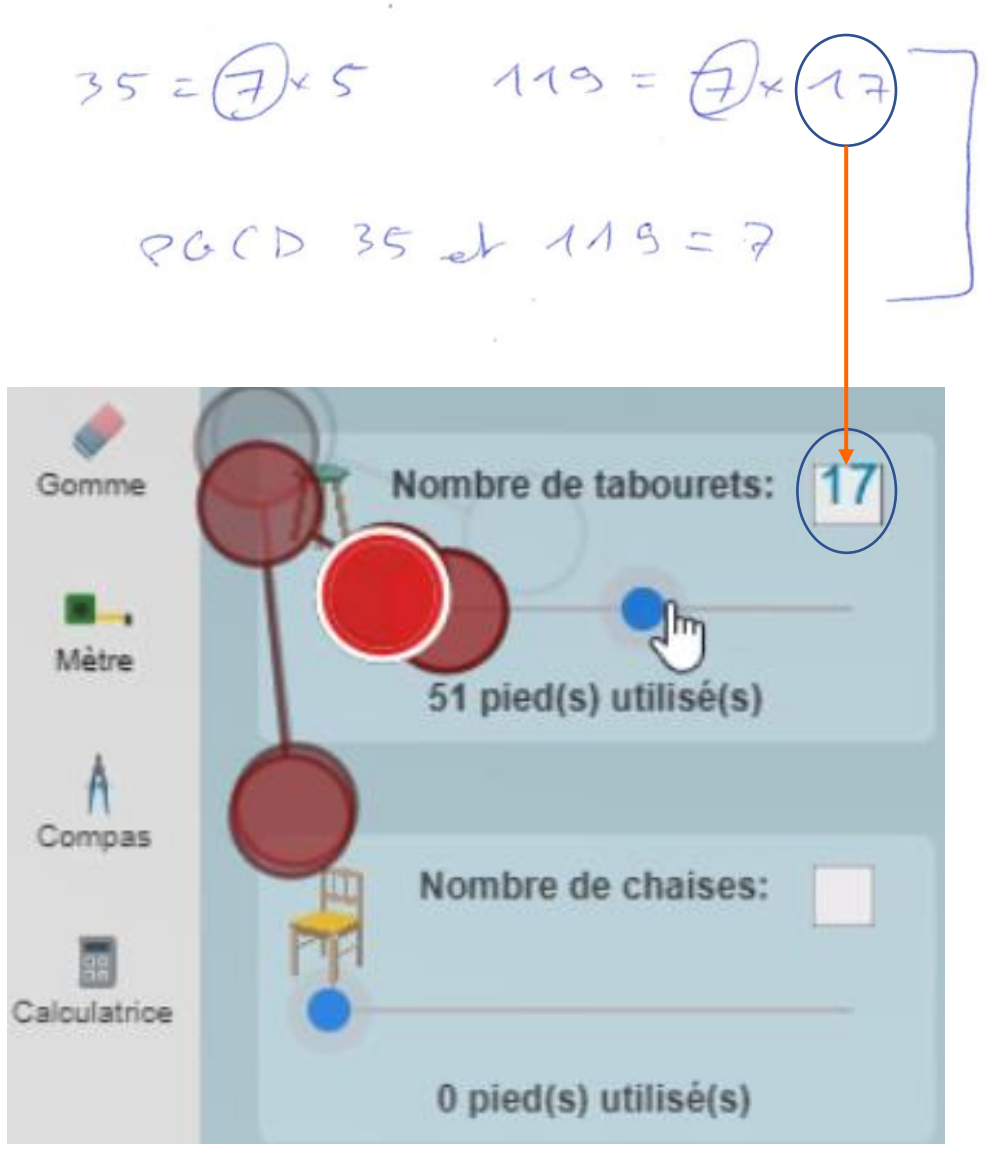
User Experience Development and Item Design (France)

<u>Transcript</u>

The respondent tries to work out the answer using only pen and paper. <u>He does that for the first 156 seconds.</u>

Perhaps he did not realise that the slider can move?

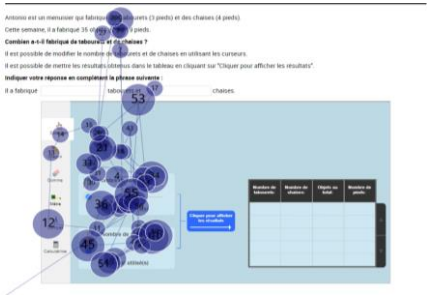
He then discovers the slider function, and rapidly tries out multiple possible solutions before returning to pen and paper and finding the answer.



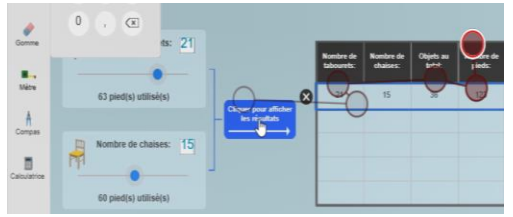
Example: Investigating Student Response Strategies

Step 1: Reading the instructions

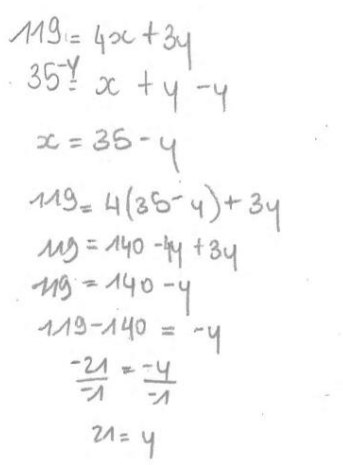
Step 4: Uses the calculator



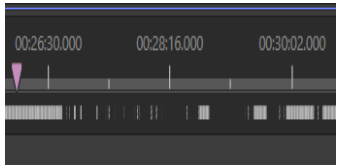
Step 2: Exploring the item and slider.

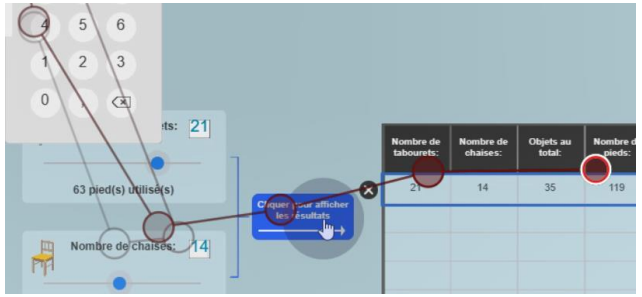


Step 5: Trying out a couple of combinations. Including use of pen and paper.



Step 3: Algebra, <u>using pen and paper</u>, occasional looks back to the instructions.





Step 6: Finds the answer.

Readings on Eye Tracking and Assessment

Biza, I., Hewitt, D., Watson, A & Mason, J (2019) Generalization Strategies in Finding the nth Term Rule for Simple Quadratic Sequences. International Journal of Science and Mathematics Education.

Maddox, B., Bayliss, A., Fleming, P. and Borgonovi, F. (2018). The use of Eye Tracking Data in Large-Scale Assessment. *European Journal of Psychology in Education*.

Maddox, B. & Stephenson, C. (2021). White space in assessment materials – 'space to think' or a 'waste of space'? AQA Research Report.

Lindner, M.A., Eitel, A., Strobel, B. & Koller, O. (2017). 'Identifying processes underlying the multimedia effect in testing: An eye-movement analysis Learning and Instruction'. Vol. 47, 91-102

Linder, M. Strobel, B., Saß , S. & Köller, O. (2018) Task-irrelevant data impair processing of graph reading tasks: An eye tracking study. *Learning and Instruction*. Vol. 55. 139-147.

Yaneva, V., Clauser, B.E., Morales, A. & Paniagua, M. (2021) 'Using Eye-Tracking Data as Part of the Validity Argument for Multiple-Choice Questions: A Demonstration', Journal of Educational Measurement.