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EXPLORING GRAPHING MEANINGS USING EYE-TRACKING

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Individuals' quantitative and covariational reasoning form a critical foundation for their construction of STEM concepts and their ability to make critical, data-informed decisions (Karagöz Akar et al., 2022; Yoon et al., 2021). Graphs form a linchpin representation for quantitative and covariational reasoning (Moore et al., 2022). Moore and Thompson (Moore, 2021; Moore & Thompson, 2015) introduced *static* and *emergent* (*graphical*) *shape thinking* to distinguish between students' ways of reasoning for graphs. They described emergent shape thinking to involve understanding a graph as both the process by which it is made (coordinating quantities' covariation) and the product that is made (a trace of that covariation). A student who reasons about a graph emergently can imagine the reconstruction of a graph as a trace in progress, where the trace records the values of the two covarying quantities at different moments. Static shape thinking involves conceiving a graph as an object in and of itself, imagining the graph to be a piece of wire with particular perceptual characteristics (Moore & Thompson, 2015). Static shape thinking involves indexical associations between particular shapes of graphs and learned facts, and thus can imply properties about relationships that those graphs represent. Those relationship properties are not organic to the graph's emergence (Moore, 2021).

Eye-tracking technology is a tool whose use has grown in the past decade, and it has recently shown promise as a tool to gain insights into the phenomenon of the teaching and learning of mathematics (e.g., Brunner et al., 2024; Seidel et al., 2021; Haataja et al., 2021; Roy et al., 2017). Providing inspiration for the presently proposed approach, both Thomaneck et al. (2022) and Waters (2019) used eye-tracking to investigate participants' covariational reasoning in the context of graphing, with Waters and colleagues drawing on the constructs of static and emergent shape thinking as well. Extending this work, we pair eye-tracking technology with the generalized models of static and emergent shape thinking to address the following research questions: *(a) In what ways are eye movement patterns related to students' graphing meanings? (b) In what ways can the use of eye-tracking technology complement current methodologies (e.g., teaching experiments) for exploring and supporting students' graphing meanings?* We are currently designing and conducting interviews to compare eye movement patterns between instances when participants are reasoning statically versus emergently. If the eye movement patterns associated with particular ways of reasoning are understood to some confidence, then eye-tracking data could be used as evidence for (or as a contraindication of) hypothesized meanings. We also envision eye-tracking technologies as contributing to innovative interventions during a teaching experiment. For example, a researcher might show participants videos from their own teaching sessions. Rather than asking them to solely recall their previous thinking as in stimulated recall interviews, researchers could prompt them to discuss how they might have been thinking during the task and how that relates to any observations they make regarding their attentional focus. We envision such an intervention could prompt rounds of focused reflection, which is critical to mathematical development (Ellis et al., 2024). In our poster, we focus on our

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methodological design and our preliminary findings, and provide examples of eye movement patterns consistent with both static and emergent shape thinking.

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