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EMBODIED DESIGN OF PROPORTIONAL REASONING

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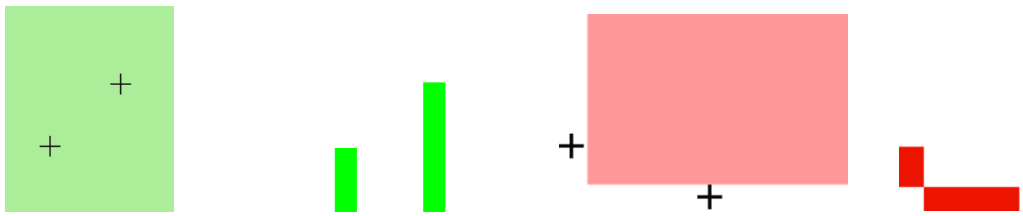
It is becoming increasingly clear that conceptual development, even in the abstract domain of mathematics, can be constituted by particular engagement of the body with its environment. This thesis has been central to the work of design-based researchers influenced by embodiment theories (e.g., Nemirovsky, 2003). The general goal of this lecture is to show what mathematics education can learn from research on embodied cognition. The specific goal of the lecture is to illustrate the type of learning that can take place as a result of *embodied design*. The story begins with the Mathematical Imagery Trainer for Proportion (MIT-P) as developed and researched by Abrahamson (2012) and colleagues: students have to move two vertical bars until these become green (Figure b). These do so when they are in the correct proportion, but students do not know this in advance. In subsequent research, MIT-P was redesigned so as to include new variants, including orthogonal bars, resulting in the MIT-Ext (Figure d).



a. Parallel Pluses b. Parallel Bars. c. Orthogonal Pluses. d. Orthogonal Bars.

The study presented here analyzed how students (N = 76, aged 9-14) coordinated action, perception and cognition when solving proportional tasks in interaction with MIT-Ext. With the help of eye-tracking technology we were able to identify emerging patterns in students' hand movements, eye movements, and reasoning when solving proportion tasks (Abrahamson, Shayan, Bakker, & Van der Schaaf, 2016). The multimodal data collected in this study provide an opportunity to corroborate and expand on processes that Piaget would call reflective abstraction.

References

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