

INSTRUCTOR GESTURES IN PROOF-BASED MATHEMATICS LECTURES

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There is a growing body of research demonstrating that teachers regularly make gestures along with their speech during instruction (e.g., Alibali & Nathan, 2007). Yet, there is little research describing how non-verbal communication might influence students' opportunities for learning mathematics. The goal of the study described here is to begin to address this by describing the ways instructors' gestures are used to communicate mathematical ideas.

Using Arzaello's (2006) idea of a "semiotic bundle," and McNeill's (1992) classification of gestures, we describe each semiotic set of gestures as part of a larger *gesture space*. Our framework is focused on classifying the *use* of the gesture within the context of the gesture space, the semiotic bundle, and the entire lecture itself. We broadly classify gestures as: Indexical (used to indicate the position of an object or idea), Social (used for emphasis or to increase the instructor's immediacy), and Representational (used to represent a mathematical or non-mathematical object or idea). Each category is further described by sub-categories that align with communicational aspects of the lecture.

Our data corpus consists of six videotaped lectures of a standard junior-level abstract algebra class at a large university. Our findings include: (1) the meaning of a gesture depends on the semiotic bundle; (2) the components of gesture spaces take on a wide range of meanings; (3) indexical gestures can have complex referents; (4) temporal-spatial aspects can contribute to the complexity of referents of indexical gestures; (5) making indexical gestures from far away introduces ambiguity; (6) it can be difficult to distinguish between mathematical and non-mathematical gestures; and (7) gestures can be ambiguous, even to expert observers.

Our work adapts and extends McNeill's (1992) framework to be appropriate for advanced mathematics classes; it expands the range of indexical gestures, and focuses on communicational use rather than individual cognition. The analysis of the data reveals that even apparently simple gestures may require complex interpretative acts in order to decipher their meaning. In addition, many gestures are difficult to interpret, even for expert observers. These results add to our understanding of students' opportunities for learning from mathematics lectures.

References

- Alibali, M. W., & Nathan, M. J. (2007). Teachers' gestures as a means of scaffolding students' understanding: Evidence from an early algebra lesson. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences* (pp. 349–365). Mahwah, NJ: Erlbaum.
- Arzaello, F. (2006). Semiosis as a multimodal process. *Revista latino americana de investigación en matemática educativa, vol. Especial*, pp. 267–299.
- McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago, IL: University of Chicago Press.