# Teachers' talk and gestures in online teaching videos about graphs

## Conference or Workshop Item

# Teachers' talk and gestures in online teaching videos about graphs

Elizabeth Kimber and Cathy Smith

The Open University, UK; elizabeth.kimber@open.ac.uk; cathy.smith@open.ac.uk

*Keywords: Language, gestures, graphs.*

## Study background

Developing understanding of graphs and change involves alteration in students' mathematical discourse and teachers play a critical role in developing this through their own language and gestures and their responses to students (Schleppegrell, 2007). Prediger and Şahin-Gür (2020) have explored changes in students' language as they worked on qualitative calculus tasks involving complex situations such as decreasing positive rates. In pre-calculus contexts, research has found persistent difficulties with students confusing high rates with high values and in grasping that a graph represents a relationship between variables (Watson et al., 2013). In this pilot study we combine techniques from Systemic Functional Linguistics (SFL) and gesture analysis to explore teachers' discourse in online teaching videos about graphs. Our research question is 'How are graphical concepts constructed through teachers' choice of language and gestures?'

## Theoretical Framework

SFL characterizes written or spoken text as the product of choices in a system of language and practice (Halliday & Martin, 1993). SFL techniques permit analysis of the ideational, interpersonal and textual functions of a text. In our context, these functions tell us, respectively, about the nature of graphs, and how teachers and students interact around that knowledge, via discrete texts. SFL is a way to identify features and functions of the mathematical register, such as characteristic grammatical structures and technical terms (Halliday & Martin, 1993), and to analyze school texts (Morgan, 1998).

Mathematics teaching videos combine language, diagrams, symbolism and gesture and can therefore be viewed as multimodal, dynamic texts. We are interested in how moving between modes supports use of different representations in building mathematical arguments. We are also exploring types of gesture to help analyze mathematical reasoning, particularly pointing, depictive gestures and tracing gestures (Alibali et al., 2013) and how language and gestures together contribute to the ideational, interpersonal and textual functions of these multimodal texts.

## Method

Even before the rapid growth in online teaching due to COVID-19, there was a growing phenomenon of online videos published by mathematics teachers and watched by thousands of teachers and students. These videos offer an opportunity for researchers to explore teachers' language and gestures when introducing particular topics or presenting worked examples in a planned environment. The videos provide information about what the teachers deem important in explanations and may indicate what difficulties they anticipate students might have.

Two teachers gave consent for us to study five of their published videos in pre-calculus and calculus courses. The videos provide simultaneous access to speech, gestures and annotations. We used SFL

to analyze transcripts alongside the videos to retain their multisemiotic nature. We then analyzed gestures accompanying each clause and how they related to diagrams or annotations. Here we present our approach to analysis, with examples from a video about estimating the gradient of a curved graph.

## Preliminary findings

From the video transcript we identified participants and processes, which contribute to the portrayal of mathematics. The teacher's language choices interweave mathematics as human activity, such as *We want*, *Do you remember…?*, *Let's pick* (in which humans participate in mental or material processes), with mathematical objects participating in material and relational processes: *a line which touches the curve*, *the gradient's becoming quite steep*. We conjecture that changes from human participants to mathematical objects mark shifts from episodes of demonstration to mathematical argument and vice versa. We also found human activity and explanation interjected within relational processes concerning mathematical objects: '***the gradient*** *// which we sometimes use m to denote //* ***is going to be the change in y*** *// so these are the y values //… //* ***over the change in x*** *//…*' This may be a feature of a *teaching register*, concerned with connecting what the teacher is doing to the mathematical register, since this episode concludes with a densely-packed nominal group '*So [the gradient at [this particular [point on this curved graph]]] is 3*', which is more typical of the mathematical register.

Gestures can expand the meaning of text. Here we noted their use alongside repeated speech. For example, '*x is 2*' accompanies pointing to an equation and is repeated while pointing at 2 on the *x*-axis and tracing vertically up to the curve. This may emphasize the shift in representation as well as creating a point on the curve from a correspondence perspective, so has ideational and textual functions.

Our poster will elaborate our analysis of teachers' multimodal discourse on graphs.

## References


Alibali, M. W., Young, A. G., Crooks, N. M., Yeo, A., Wolfgram, M. S., Ledesma, I. M., Nathan, M. J., Breckinridge Church, R., & Knuth, E. J. (2013). Students learn more when their teacher has learned to gesture effectively. *Gesture, 13*(2), 210–233.

Halliday, M. A. K., & Martin, J. R. (1993). *Writing science: Literacy and discursive power*. Taylor & Francis Group.

Morgan, C. (1998). *Writing mathematically: The discourse of investigation*. Routledge.

Prediger, S., & Şahin-Gür, D. (2020). Eleventh graders' increasingly elaborate language use for disentangling amount and change: A case study on the epistemic role of syntactic language complexity. *Journal Für Mathematik-Didaktik, 41*, 43–79. https://doi.org/gvxp

Schleppegrell, M. J. (2007). The linguistic challenges of mathematics teaching and learning: A research review. *Reading & Writing Quarterly, 23*(2), 139–159. https://doi.org/bqmcwq

Watson, A., Jones, K., & Pratt, D. (2013). *Key ideas in teaching mathematics: Research-based guidance for ages 9-19*. Oxford University Press.