

Bodily cues of children's learning-related experiences during mathematics problem solving

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We are developing technology under the weDraw project (<https://www.wedraw.eu/>) to support children's exploration of mathematical concepts. Based on understanding that body movement is critical in interactions in the classroom (Goldin-Meadow, 1999), we sought to understand movement cues that technology can leverage to enrich the learning experience, as humans naturally do.

To investigate this, we analysed textual data in (Kim et al., 2010) based on classroom observation, and a new set of videos of children (N=13) during bodily exploration of angles with visual feedback of angle representations provided by technology. While Kim et al. examined how mathematics understanding develops in children in relation to their gestures use, our analysis focused on what any bodily expression may betray of critical learning-related moments and affective experiences.

We found that their orientation showed the target of their attention, usually the teacher/instructor (for instruction or support) or the visual feedback (in solving given problems). Where there is a change in orientation, the parts of the anatomy involved provide cues about their cognitive processes and/or affective experiences. For example, turning all of the head, eyes, trunk, and limbs, suggests full and definite attention in the new target. In contrast, turning the eyes alone may indicate temporal and reluctant change, perhaps due to continued interest in the current target. The transition time between targets (instructor and visual feedback), different even within children, is additionally informative. Longer periods may indicate stronger reluctance to change targets. On the other hand, such moments may be buffer periods where the child is reflecting on new instruction (changing from instructor to visual feedback) or challenge faced in the current task (changing from visual feedback to instructor).

Our findings suggest that orientation behaviour in learning settings may betray critical moments that technology may need to be aware of and address.