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Learning variations in children's multimodal cues of uncertainty during a math-related numerical discrimination task

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Abstract

Detecting young learners' internal uncertainty is key for understanding underlying cognitive processes and designing Intelligent Tutoring Systems (ITS). Although young children may experience more uncertainty and learn faster, they are also more limited in the ability to express themselves verbally. Therefore, it is important to understand how uncertainty can be expressed in different ways. In this work, for the first time, we annotate and model different levels of uncertainty in young children performing a numerical discrimination task. We identify potential cues of uncertainty presented in different modalities (e.g., spontaneous verbal responses, hand gestures, facial expressions) and specifically examine the relationship between task difficulty, task performance, and exhibited levels of uncertainty. Our results show a positive correlation between the level of uncertainty expression across all modalities and task difficulty. This work informs research on cognitive coordination between human-human and human-AI collaboration and the design of personalized ITS systems.