Brain-to-Brain Synchrony Between Students and Teachers Predicts Learning

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We often speak with the goal of “getting on the same wavelength.” Research on brain synchrony suggests that this familiar saying may be especially relevant to learning. Monitoring of students’ brain activity shows that brain-to-brain synchrony (BBS) within groups of students, as well as between students and their teacher, is predictive of learning outcomes, according to Ido Davidesco (University of Connecticut) and Suzanne Dikker (New York University).

The new research, published in *Psychological Science*, is based on electroencephalography (EEG) monitoring of 31 college-aged participants and two teachers. “The current study substantially extends previous fMRI/fNIRS [functional magnetic resonance imaging / functional near-infrared spectroscopy] research by demonstrating that BBS between students and teachers, measured at the millisecond level, captures student learning,” Davidesco, Dikker, and colleagues wrote. In this context, Dikker explained during a later interview, “synchrony” refers to the way in which people’s brain activity can become more similar in response to an external stimulus rather than to a perfect overlap in activity.

Davidesco, Dikker, and colleagues examined the link between BBS and learning by analyzing EEG data collected from the students and teachers in a simulated classroom at the researchers’ lab. During each

session, one teacher gave a series of four short science lectures to a group of up to four students while the researchers used EEG to monitor the brain activity of all participants. The students completed a 10-question quiz on their knowledge of the science topics one week before, immediately after, and one week after hearing the lectures.

When the researchers compared the EEG data of pairs of students from the same group, their BBS was higher when they were listening to the same versus different lectures. Higher BBS between students listening to the same lecture also predicted a greater improvement in their quiz scores, and higher BBS during specific sections of a lecture was associated with answering questions about those sections correctly.

“Our research suggests that there is some similarity in our brain activity, and this is indicative of how engaged students are and how effectively they learn,” Davidesco said.

Similarly, when the researchers compared teachers’ EEG data with that of the students listening to them, but with a 300-ms lag in the student data to account for language processing time, the time-lagged BBS between teachers and individual students predicted improved quiz performance.

“The lag of 300 ms corresponds to decades of research on how we process speech and language, so the better students are locked into what the teacher is explaining the more their brainwaves follow the structure of speech,” Dikker explained.

Davidesco, Dikker, and colleagues’ analysis specifically identified the BBS of alpha waves in the central area of the brain as relevant to student learning. By comparison, theta and beta waves in all brain areas, and alpha waves in the brain’s posterior and frontal areas, were not found to significantly predict quiz performance.

“Although the phenomenon of BBS is not yet fully understood, it is thought that when task engagement increases, students’ alpha oscillations are attenuated [decrease] but become more phase entrained [aligned] with the external stimulus (in this case, the lecture), leading to higher BBS across students,” the researchers wrote.

Advancing our understanding of how BBS supports learning will require a combination of real-world and laboratory studies, Dikker said. Although real-world studies can provide valuable insight into how learning takes place in actual classrooms, a controlled laboratory setting allows researchers to use higher-grade equipment to identify effects that may be less visible but still present to some degree in more chaotic classroom settings, she explained. Davidesco added he would also like to explore the effects of more collaborative and interactive forms of learning on BBS, as well as how these effects may differ when learning takes place face-to-face versus online.

Reference

Davidesco, I., Laurent, E., Valk, H., West, T., Milne, C., Poeppel, D., & Dikker, S. (2023). The temporal dynamics of brain-to-brain synchrony between students and teachers predict learning outcomes. *Psychological Science*, *34*(5), 633–643. https://doi.org/10.1177/09567976231163872

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