

## Accepted Manuscript

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Samantha S. Cohen, Jens Madsen, Gad Touchan, Denise Robles, Stella F. A. Lima, Simon Henin, Lucas C. Parra

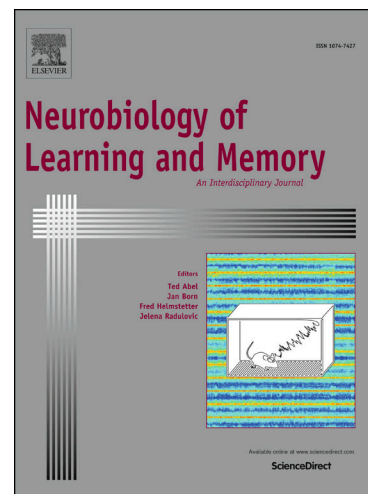
PII: S1074-7427(18)30148-5  
DOI: <https://doi.org/10.1016/j.nlm.2018.06.011>  
Reference: YNLME 6892

To appear in: *Neurobiology of Learning and Memory*

Received Date: 24 January 2018  
Revised Date: 5 June 2018  
Accepted Date: 21 June 2018

Please cite this article as: Cohen, S.S., Madsen, J., Touchan, G., Robles, D., F. A. Lima, S., Henin, S., Parra, L.C., Neural engagement with online educational videos predicts learning performance for individual students, *Neurobiology of Learning and Memory* (2018), doi: <https://doi.org/10.1016/j.nlm.2018.06.011>

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## **Neural engagement with online educational videos predicts learning performance for individual students**

Authors: Samantha S. Cohen<sup>\*1,2</sup>, Jens Madsen<sup>\*2</sup>, Gad Touchan<sup>2</sup>, Denise Robles<sup>2</sup>, Stella F. A. Lima, Simon Henin<sup>2</sup>, Lucas C. Parra<sup>2</sup>

<sup>1</sup>The Graduate Center of the City University of New York, New York, New York

<sup>2</sup>The City College of the City University of New York, New York, New York

\* Co-first authors

**Keywords:** EEG; inter-subject correlation; education; online learning; STEM

### **Abstract**

Online educational materials are largely disseminated through videos, and yet there is little understanding of how these videos engage students and fuel academic success. We hypothesized that components of the electroencephalogram (EEG), previously shown to reflect video engagement, would be predictive of academic performance in the context of educational videos. Two groups of subjects watched educational videos in either an intentional learning paradigm, in which they were aware of an upcoming test, or in an incidental learning paradigm, in which they were unaware that they would be tested. "Neural engagement" was quantified by the inter-subject correlation (ISC) of the EEG that was evoked by the videos. In both groups, students with higher neural engagement retained more information. Neural engagement also discriminated between attentive and inattentive video viewing. These results suggest that this EEG metric is a marker of the stimulus-related attentional mechanisms necessary to retain information. In the future, EEG may be used as a tool to design and assess online educational content.

### **Introduction**

Student engagement is critical to academic success, and yet surprisingly little is known about the neural underpinnings of this process that lead to true psychological investment (Newmann, Wehlage, & Lamborn, 1992). Engagement is typically assessed with surveys after learning has commenced (Robinson & Hullinger, 2008), but these kinds of questionnaires do not provide a direct assessment of engagement during the learning process, and it is not clear that they are a reliable metric of psychological investment (Trowler & Trowler, 2010). In contrast to the classroom environment, where a teacher might readily assess physical manifestations of disengagement, the problem is much more acute in the increasingly common online learning environment, where expository lectures are often presented with videos (Means, Toyama, Murphy, Bakia, & Jones, 2009).

Online engagement can be measured by the number views or clicks (Koller, Ng, Do, & Chen, 2013), participation in online discussion forums (Brinton et al., 2014; Kizilcec, Piech, & Schneider, 2013), or by the length of viewing time (Guo, Kim, & Rubin, 2014; Kim et al., 2014). However, these outcome measures do not necessarily correlate with academic success (Koller et al., 2013). Online courses have an alarmingly high attrition rate of around 90% (Breslow et al., 2013; Jordan, 2014), indicating that

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