1. Title of the project:

Measuring Mind Wandering during Online Learning

2. Coordinators

Dr. Myrthe Faber (Department of Communication and Cognition)

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3. Project Summary

In the light of the current COVID-19 pandemic, students are more reliant on online learning than ever. However, they report to be more easily distracted in online settings (Monk, Guidry, Pusecker, & Ilvento, 2020). Distractions can have an *external* cause, such as noisy neighbors, or repeated phone notifications, but they can also be *internally*-generated, such as thoughts about family and friends, or worries about the future. The category of internally-generated thoughts, which comprises spontaneous task-unrelated thoughts, is also known as mind wandering (Smallwood & Schooler, 2015). Previous work provides evidence that mind wandering has an overall negative effect on (online) learning and performance across contexts, such as watching online lectures (e.g., Faber, Krasich, Bixler, Brockmole, & D'Mello, 2020) and interacting with computer interfaces (e.g., Dias da Silva & Postma, 2019).

However, recent work has suggested that not all mind wandering is equal: In general, deliberate mind wandering seems to have less of a negative impact than its involuntary counterpart (Soemer & Schiefele, 2019). An additional relevant dimension that has received little attention is the difference between a mind wandering episode that hones in on a specific thought, compared to when thoughts move relatively freely (Mills, Raffaelli, Iriving, Stan, & Christoff, 2018). In the context of reading literary texts, for instance, supplying material from one's own freely flowing thoughts may be necessary for the literary experience (Fabry & Kukkonen, 2019). Also, mind wandering thoughts that make a personal connection with the learning materials are less detrimental to comprehension than those that do not (Smith, Faber, & Mills, in revision).

These findings suggest that there might be dissociable types of mind wandering, with differential effects on learning and memory. Mind wandering should therefore be regarded as a multidimensional phenomenon that can vary along multiple axes of content, intentionality, and progression. An open question is whether particular types of mind wandering have a positive (or less negative) effect on the processing of written information. In the proposed project, we aim to establish the effect of the dynamics of thoughts on reading in online contexts.

An important scientific challenge is how to dissociate different types of mind wandering, particularly those that have a positive impact on processing written material from those that have a negative effect. In the proposed project, we will leverage the fact that different types of mind wandering might have different behavioral and neural signatures. In particular, we assume that the pursuit of an internally-generated, task-unrelated thought might be related to mechanisms of exploitation—a state in which a goal is pursued—whereas freely drifting thoughts might be related to exploration—a state in which a new goal is determined (Mittner, Hawkins, Boekel, & Forstmann, 2016). These states are thought to be accompanied by differential patterns in behavioral variability (e.g., irregular eye movements or mouse movements), pupil size and response, and up- and downregulation of brain networks.

The overall aim of the current project is to develop and evaluate a novel measure of explorative and exploitative mind wandering based on their behavioral and/or neural signatures, and to use this measure to establish their effects on processing of online written materials.

Possible research questions:

1. Do explorative and exploitative mind wandering have different behavioral and neural correlates?
2. Can we use the behavioral and neural correlates of explorative and exploitative mind wandering to train a machine learning model to distinguish these mental states?
3. Do explorative and exploitative mind wandering have a differential effect on reading in online contexts?

Methods

We will collect multimodal data of participants performing an online reading task. These data can include eye tracking (eye movements, pupil size), mouse tracking, self-reported mind wandering data, and EEG data. With these data, we aim to advance basic scientific knowledge (RQ1) as well as to develop a computational tool (RQ2) in an applied context (RQ3).

Work package: Behavioral and neural signatures of explorative and exploitative mind wandering

The work package will include a review of the existing literature to identify which behavioral and neural measures have previously been associated with exploration, exploitation, and mind wandering in general. This will form the basis for a systematic analysis of the multimodal data that will be collected as part of this project. The literature review, alongside the findings of the multivariate analysis, will be presented in a manuscript (to be published in a cognitive science journal) and as a conference presentation.

Deliverables: openly available multimodal data set, manuscript, conference presentation.

Collaboration

This collaboration integrates ideas and methodologies from both departments involved: we will bring together skills and knowledge acquired in the CIS program (eye tracking, data analysis, and design of learning materials) with those central to the CSAI program (technical implementation of machine learning algorithms and integration across sensing modalities) to answer questions about human cognition. This collaboration will be led by Dr. Faber, Dr. Postma, and Drs. Dias da Silva, who all have extensive expertise in mind wandering research across sensing modalities, and in the development of quantitative techniques to measure mind wandering. This research project and its deliverables will form the basis for a longer-term collaboration between the DCC and DCA departments.

Project results

The project will result in one manuscript, a conference presentation, and a multimodal data set that will be of interest to the scientific community.

4. Project Timeline

Month	Trainee 1	Trainee 2	Milestone
Sept 2020	Literature Study		Literature review manuscript
Oct-Nov 2020	Setting up the experiment		Experimental environment
Dec 2020	Piloting the study, Iterative refinement		Preliminary data

Jan-Feb 2021	Data Collection	Multimodal data set
Mar-Apr 2021	Data Processing and Analysis	Results
May 2021	Conference abstract / Proceedings paper preparation	Conference abstract / Proceedings paper ready for submission
June 2021	Manuscript preparation	Full article ready for submission

5. Research Trainee Profile

We are looking for an enthusiastic student who is interested in cognitive phenomena related to attention, and wants to become acquainted with lab techniques necessary to collect behavioral and neurocognitive data. The candidate would preferably have a sound knowledge of statistical analyses in R or Python. Both Master level and advanced Bachelor level candidates can apply.

Depending on the expertise of the trainee, they will be involved in a literature study, the design of the experiment, and data processing. The trainee can attain hands-on experience with setting up data acquisition across different sensing technologies, including eye tracking, mouse tracking and/or EEG, and cognitive modeling.

Applications, including a motivation letter and a CV, should be sent to all three participating researchers: Dr. Myrthe Faber m.faber@tilburguniversity.edu, Dr. Marie Postma marie.postma@tilburguniversity.edu, and Drs. Mariana Dias da Silva m.r.diasdasilva@tilburguniversity.edu.

References

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