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## Examining the Influence of Lecture Format on Degree of Mind Wandering

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We examined mind wandering and memory for information in both live undergraduate lectures and a laboratory-based video lecture. In Study 1, which spanned a full-term live course, we found that degree of mind wandering did not increase over time in an average lecture, and was associated with poorer memory for lecture material. In Study 2, we examined changes in degree of mind wandering across three groups that differed in whether they viewed the lecture in video-recorded or live format, and whether or not they were enrolled in the course. We found that despite viewing the exact same lecture, participants who viewed it in video format showed a significant increase in mind wandering over the duration of the lecture, while those who viewed it live did not. This finding suggests that video, relative to live lectures are especially likely to elicit increases in mind wandering over the duration of a lecture.

**General Audience Summary**

Research has shown that the longer people are asked to complete basic sustained attention tasks, the more likely they are to experience lapses in attention, often in the form of mind wandering. This increase in mind wandering over time also tends to occur during video lectures. However, studies testing whether this occurs during actual live undergraduate lectures are scarce. In Study 1, we found that students in an actual live undergraduate course did not show an increase in the degree to which they were mind wandering over the duration of an average lecture. However, when students' mind wandering did fluctuate in degree, their learning of the presented lecture material correspondingly fluctuated, such that as degree of mind wandering increased, learning decreased. In Study 2 we showed that in contrast to those who viewed a lecture live, students who viewed the exact same lecture in video format demonstrated a consistent increase in degree of mind wandering over time. Taken together, these findings indicate that when applied to the real world, increases in mind-wandering over time in lectures are not as apparent as they have been in previous research, and that lecture format is an important determinant of attention maintenance. Many universities and educational institutions are moving toward providing online video lecture content rather than live lectures. Administrators should be aware that there may be consequences to this choice in terms of student attention span.

**Keywords:** Mind wandering, Education, Attention, Video lecture, Memory

Given that attention lapses tend to be associated with performance declines in educational settings (e.g. [Lindquist & McLean, 2011](#); [Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012](#); [Szpunar, Moulton, & Schacter, 2013](#)), it is important to understand how students' levels of attentional engagement during live and video lectures fluctuate over time,

as well as how these fluctuations might impact longer term test scores and academic performance. In a recent large-scale study, we documented the natural fluctuations in mind wandering over time in a veridical live university lecture ([Wammes, Boucher, Seli, Cheyne, & Smilek, 2016](#); [Wammes, Seli, Cheyne, Boucher, & Smilek, 2016](#)). Across an entire term, students periodically

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reported whether they were mind wandering (intentionally or unintentionally) during the lectures of a course in which they were enrolled. The main findings were that mind-wandering rates: (1) fluctuated over days of a typical week and over the term; (2) were modestly related to in-class quiz and later exam performance; and (3) remained relatively steady across an average lecture. The stability of mind-wandering rates over time within an average lecture is most central to this work: unintentional mind-wandering rates were remarkably low (14% of probes), and mind wandering *did not* increase over the four quarters of a lecture (Wammes, Boucher, et al., 2016; Wammes, Seli, et al., 2016). Presently, we extend these findings in two studies that examine mind wandering and performance in live lectures and in laboratory video lectures.

The finding that mind wandering did not increase over time is surprising, as mind wandering tends to increase, while attention and performance tend to decline when individuals are asked to focus on a single task over extended periods of time (e.g. Helton & Russell, 2011; Mackworth, 1948, 1950; Thomson, Seli, Besner, & Smilek, 2014; Warm, 1984). Declines in attention are also alarmingly common over time spent in university or college lectures (Cameron & Giuntoli, 1972; Farley, Risko, & Kingstone, 2013; Lindquist & McLean, 2011; Risko et al., 2012; Risko, Buchanan, Medimorec, & Kingstone, 2013; Schacter & Szpunar, 2015; Schoen, 1970; Seli, Wammes, Risko, & Smilek, 2015; Stuart & Rutherford, 1978; Young, Robinson, & Alberts, 2009). In particular, studies assessing mind wandering in video lectures in a laboratory setting have consistently shown that mind wandering increases as a lecture progresses (Farley et al., 2013; Risko et al., 2012, 2013; Seli, Wammes, et al., 2015).

One possible reason for the discrepancy between our findings and previous findings with regard to changes in mind wandering as a lecture elapses, is that previous documentations of increases in mind wandering over time in a lecture were a byproduct of the often used video presentation format of the lecture content. Indeed, recent work has demonstrated that video lectures can be associated with reduced interest, memory and motivation relative to live lectures (Varao-Sousa & Kingstone, 2015; but see Abdous & Yoshimura, 2010). An alternative possibility concerns the nature of the thought probe we used to assess mind wandering, a probe that involved asking people whether they were on task, mind wandering intentionally or mind wandering unintentionally. It is possible that this three-option probe might not have been sufficiently sensitive to detect subtle changes in mind wandering that might occur in degree of mind wandering, rather than frequency.

Building on previous work and the foregoing considerations, the first aim of the present work was to measure mind wandering in a live classroom over a complete term, employing a more precise thought probe (Study 1). Our second aim was to directly compare changes in mind-wandering rates over time between the live classroom and laboratory-based video lectures (Study 2). Accordingly, during Study 1 we video recorded a lecture in which three probes were presented. In Study 2, we then presented this video, including probes, to two independent groups in the laboratory. Fortuitously, the exact course that provided the basis for Study 1 was offered by the same instructor in the

term immediately following the term in which Study 1 was conducted. Thus, for our first group in Study 2, we were able to sample from naïve students who were enrolled in this, the same course as in Study 1. The second group included students who *were not* enrolled in or associated with the course whatsoever. Comparing these groups allowed us to determine the extent to which being a student currently completing the course, and/or lecture presentation format, influenced mind-wandering degree, and changes in mind-wandering degree over time.

### Study 1: In-Class Study

In Study 1 we tested participants over a full term of a second-year undergraduate course, with the primary goal of exploring how degree of mind wandering changes over an average class. We incorporated pseudo-randomly presented thought probes into many of the lectures that comprised the course. The thought probe required participants to report the degree to which they were either mind wandering or on task during the lecture. Recently, other researchers have moved toward using similar continuous scales, reflecting a phenomenological issue: People seem to experience *degrees* of mind wandering, which are not easily captured with a dichotomous response (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Mrazek, Smallwood, & Schooler, 2012; Seli, Cheyne, & Smilek, 2013b; Seli et al., 2014). We reasoned that despite our previous findings to the contrary, mind wandering *may* increase over time in a live lecture, but that we did not have the sensitivity to detect the increase with a measure that simply asks whether one was mind wandering (intentionally or unintentionally) or not.

In addition to our primary goal of determining how mind-wandering degree changes over time in a lecture, the design of this study also allowed us to investigate mind wandering over longer time frames (an average week, and the entire term). Given the dearth of explorations of mind wandering over these timescales, we sought to investigate this issue further.

Also of secondary interest was the relation between degree of mind wandering and memory for lecture information. Previous studies have shown that participants' memory for material presented in a video lecture decreased over time, as mind-wandering rates correspondingly increased (Risko et al., 2012, 2013), and that mind wandering was negatively associated with test performance (Seli, Wammes, et al., 2015). Moreover, increased reports of task-unrelated thought have been associated with lower academic ability (Lindquist & McLean, 2011; Unsworth, McMillan, Brewer, & Spillers, 2013). The resource-control theory of mind wandering (Thomson et al., 2014) holds that one's available attentional resources remain stable over time, and that a portion of these resources can be allocated to mind wandering (assuming a low-demand task) without incurring performance costs. However, as more attention is shifted to mind wandering, possibly due to faltering executive control (McVay & Kane, 2010), the attentional requirements of the current task are not met, and performance suffers (Mrazek et al., 2012; Thomson et al., 2014). In line with this theory, we tested whether memory for lecture content would decline as participants mind-wandered to greater degrees.

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