MIND WANDERING DURING ACADEMIC HALF-DAYS

WHAT ARE RESIDENTS PAYING ATTENTION TO? AN EXPLORATION OF MIND WANDERING DURING CLASSROOM-BASED TEACHING SESSIONS (ACADEMIC HALF-DAYS) IN POSTGRADUATE MEDICAL EDUCATION

By ANITA ACAI, BSC(HONS)

A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree Master of Science

MASTER OF SCIENCE (2016) (Health Science Education)	McMaster University Hamilton, ON, CANADA
TITLE:	What Are Residents Paying Attention To? An Exploration of Mind Wandering During Classroom-Based Teaching Sessions (Academic Half-Days) in Postgraduate Medical Education
AUTHOR:	Anita Acai, BSc(Hons) (McMaster University)
SUPERVISOR:	Kelly Dore, PhD
SUPERVISORY COMMITTEE:	Geoff Norman, PhD Joe Kim, PhD
NUMBER OF PAGES:	xiii, 83

LAY ABSTRACT

Academic half-days (AHDs) are regular teaching events that occur outside of patient care. AHDs often take the form of extended didactic lectures, despite the literature around effective teaching techniques. This may decrease residents' ability to pay attention to the content being presented and instead promote mind wandering (defined in this thesis as self-reported task-unrelated thought). This thesis examines mind wandering during AHDs, with the goal of understanding how results might inform the design of classroom-based teaching sessions in postgraduate medical education through two studies: a qualitative study examining residents' perceptions about their learning experience during AHDs, and a quantitative study examining how three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning) influenced mind wandering during AHDs. Taken together, these two studies make a contribution to the exploration of how classroom-based teaching sessions such as AHDs can be optimized to enhance student learning in postgraduate medical education. ✣

ABSTRACT

Introduction: Academic half-days (AHDs) are regular teaching events that occur outside of patient care. AHDs often take the form of extended didactic lectures, despite the literature around effective teaching techniques. This may decrease residents' ability to pay attention to the content being presented and instead promote mind wandering (defined in this thesis as self-reported task-unrelated thought). This thesis examines mind wandering during academic half-days (AHDs) in postgraduate medical training through two studies, with the overarching goal of understanding how results might inform the design of classroom-based teaching sessions in postgraduate medical education.

Methods: In the first study, a qualitative approach was used to examine residents' perceptions about the nature of their learning experience during AHDs. Two focus groups were held with residents in hematology (n = 5) and obstetrics and gynecology (n = 15) and analyzed using a thematic analysis approach. In the second study, thought probes were administered approximately every 15 minutes during three AHD sessions in each program (hematology: n = 6 residents; obstetrics and gynecology: n = 30 residents) to quantitatively examine how three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning) influenced mind wandering during AHDs.

Results: Findings of the qualitative study revealed differences with respect to residents' overall perceptions of AHDs, perceptions of attention during AHDs, and motivations for learning. However, residents in both programs agreed that presenters could maximize resident engagement and learning by spending more time on case-based learning and group discussions as opposed to didactic lectures. Quantitative findings

supported resident perceptions, demonstrating significantly less mind wandering during case-based learning (7%) than didactic lectures (33%).

Conclusions: The findings of this work suggest that instructional method influences the amount of self-reported mind wandering during AHDs, and specifically, that case-based learning may be more effective than didactic lectures in maintaining engagement during AHDs. ✣

DEDICATION

To my earliest and best teachers…
Mom and Dad.

ACKNOWLEDGEMENTS

I would like to extend my sincere thanks to my supervisor, Dr. Kelly Dore, for her guidance, support, and encouragement throughout the completion of this degree. I would also like to thank Dr. Geoff Norman for statistical and methodological assistance and Dr. Joe Kim for many valuable insights and opportunities that contributed to the completion of this work and to my development as a graduate student. My gratitude extends to Dr. Val Mueller, Dr. Chris Hillis, and Rebecca Misiak for their support of this work; to Brandon Pindar-Donick and Geoff Riddell for early work on this topic that informed our pilot data collection strategy; to David McDonough for assisting with many pilot data collection sessions; and to members of the Applied Cognition in Education Lab and the Sonnadara Lab for their friendship, collaboration, and valuable feedback on this work. Thank you, Mom and Dad, for your unfailing love, support, and guidance throughout this and all of my other endeavors (I love you both!) and Walker, for being my best sidekick over the past ten years. Finally, I wish to acknowledge the financial contributions of the Canadian Institutes of Health Research Canada Graduate Scholarships Program, the Ontario Graduate Scholarships Program, and the MSc of Health Science in Education Graduate Program in making this thesis and my graduate education possible. ✣

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

LIST OF ABBREVIATIONS AND SYMBOLS

AHD:	Academic Half-Day
Ob/Gyn:	Obstetrics and Gynecology
OSCE:	Objective Structured Clinical Examination
RCPSC:	Royal College of Physicians and Surgeons of Canada

DECLARATION OF ACADEMIC ACHIEVEMENT

The work described in this thesis was performed by Anita Acai (hereafter referred to as "the primary researcher") and supervised by Dr. Kelly Dore. The pilot data described in Chapter 1, Section 1.2 were collected with the assistance of David McDonough, a Research Assistant in the Program for Educational Research and Development at McMaster University. Participant recruitment was done with the permission and assistance of Dr. Val Mueller, Dr. Chris Hillis, and Rebecca Misiak. Statistical analyses were completed with the assistance of Dr. Geoff Norman. ✣

CHAPTER 1: INTRODUCTION

1.1 The Changing Landscape of Postgraduate Medical Education

Traditional models of residency education have relied on an apprenticeship-based approach to training where residents are expected to undertake supervised study for predetermined amount of time in order to become successful practitioners (Hodges, 2010). However, gradual changes in the healthcare system since traditional models were first developed, including a reduction in resident duty hours and a continual struggle to balance teaching with service provision in light of the renewed emphasis on system efficiency and patient safety, have led to a number of challenges with respect to postgraduate medical training (Reznick & MacRae, 2006). While many of these recent shifts have meant that residents now have fewer clinical learning opportunities, they have occurred concomitantly with advances in healthcare that have substantially broadened the knowledge base required of physicians (Densen, 2011; Reznick & MacRae, 2006). This has led to the general understanding that traditional models of residency education are no longer adequate for educating twenty-first century physicians (Gruppen, Mangrulkar, & Kolars, 2012; Reznick & MacRae, 2006).

A global shift towards competency-based models of medical education has emerged as one possible response to the challenges described above, shifting the focus from the amount of time a resident spends in training to the performance outcomes that they are expected to achieve during their training (Frank et al., 2010). In Canada, the Royal College of Physicians and Surgeons of Canada (RCPSC) has published the CanMEDS framework, whose most recent iteration includes the following core

competencies of a physician: medical expert, communicator, collaborator, health advocate, scholar, professional, and leader (Frank, Snell, & Sherbino, 2015). This new framework also includes several competency milestones, which indicate the skills that a trainee should be able to demonstrate at specific points in their training (Frank et al., 2015). Regulatory bodies across the world have developed similar competency-based frameworks, including the Accreditation Council for Graduate Medical Education in the United States (Swing, 2007) and the Joint Committee for Higher Medical Training in the United Kingdom (Mayor, 2002). In Canada, the RCPSC has mandated a shift to competency-based education via their "Competence by Design" initiative, which is a hybrid model that does not discount or adjust time spent in training, but instead conceptualizes time as a resource for acquiring competencies (RCPSC, 2016).

In order for a competency-based model of education to be successful, postgraduate medical training programs will not only need to ensure that key outcomes are properly defined, but also residents have adequate exposure to learning opportunities that will facilitate their progression towards them (Frank et al., 2010). Given the reductions in clinical learning opportunities described above, it is important that non-clinical time is used effectively to compensate for this change.

1.2 Academic Half-Days and Resident Learning

AHDs are regularly scheduled teaching events for residents that occur outside of the sphere of patient care and are common in postgraduate medical training programs across both North America and the United Kingdom (Chalk, 2004; McClean, Card, & D'Eon, 2006). Importantly, they represent protected time for learning away from clinical

duties (RCPSC, 2003). The specific structure and content of AHDs vary from program to program, but several elements are usually consistent. AHDs are typically held once per week and are up to four hours in length (Chalk, 2004). Topics include key program-specific learning objectives, including both common and rare events, as well as core concepts such as communication and teaching, healthcare management, and ethical, medicolegal, and lifestyle issues (Chalk, 2004; Taylor & Chudley, 2001). Presenters are often clinical faculty with relevant content knowledge and/or teaching availability who rotate from topic to topic, although may also sometimes be residents (Chalk, 2004). While didactic lecturing is most common, presenters may use a variety of instructional methods including case-based learning, small or large group discussion, or in many cases, a combination of these methods (Chalk, 2004; Taylor & Chudley, 2001).

Although AHDs are widespread across residency programs in Canada and the United States, relatively little published literature exists on their pedagogical effectiveness (Chalk, 2004). Of the existing literature, however, some work has suggested that AHDs are an effective alternative to multiple noon-hour conferences, which may suffer from a variety of deficits including poor retention of material (Eid, Hsieh, Shah, & Wolff, 2015; Ha et al., 2014), poor attendance, a disjointed curriculum, an overreliance on didactic lecturing, and virtually no teaching development for presenters (Batalden, Warm, & Logio, 2013). However, while in these studies the overhaul of the traditional noon-hour conference represented an opportunity to develop new AHD curricula with considerable improvements in content, instructional design, and faculty and resident development, it is important to consider that many existing AHDs take a form that is very

similar to the original traditional, noon-hour conference format. For example, McLean et al. noted that AHDs in their internal medicine program:

> *Contained too much factual detail, had no stated objectives, and only rarely emphasized key points. There was a heavy reliance on major medical texts for content information and little inclusion of current evidence. Presentations frequently lacked practical relevance and often included outdated or inaccurate information…Faculty attendance was near zero and resident attendance was only about 50% of the total resident group of about 24. Many residents left sessions to answer "pages" or at the break and then did not return.* (2006, p. 2)

Although some residency programs may believe that residents are self-directed, "adult learners" who are intrinsically motivated to learn during AHDs (e.g., Hartzell, 2007; see also Norman, 1999 for a commentary on the myth of the "adult learner"), work by Winter et al. (2007) revealed just the opposite: long-term knowledge retention among residents who attended regularly scheduled AHDs at their institution was no better than among non-attendees. This finding was further supported by qualitative results from Chen, McDonald, Pratt, Wisener, and Jarvis-Selinger (2015) who found that residents across several specialties believed that knowledge retention from AHDs was suboptimal. Although some residency programs make AHD attendance mandatory for residents, most AHD sessions do not include any assessment of resident learning, thus potentially disincentivizing learning even in cases where residents are forced to attend (Chalk, 2004). Taken together, this evidence suggests that AHDs at many institutions may not be as effective in promoting student learning as some programs might hope.

These findings, along with anecdotal evidence of poor resident engagement during AHDs locally, prompted the primary researcher to undertake formal study of AHDs in two programs at McMaster University. Over the course of approximately a year, a pilot

study was conducted to explore AHDs in obstetrics and gynecology (ob/gyn) and hematology at McMaster University. The primary researcher and a research assistant attended a variety of AHDs in both programs and recorded observations at five-minute intervals. These observations typically included notes on content, presentation style, and perceived attentiveness of the residents in the room.

Findings during this initial pilot study revealed that residents appeared to be either somewhat or completely inattentive at least a quarter of the time. This level of inattention is lower than reports of mind wandering in other classroom settings (i.e., 33 to 43%; Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012; Szpunar, Khan, & Schacter, 2013; Wammes, Boucher, Seli, Cheyne, & Smilek, 2016) likely because the observations during the present pilot study were based only on qualitative observations. Distractions appeared to predominantly be from either technology (i.e., cell phones or computers, although the exact nature of the distraction could not be confirmed in all cases) or social interactions (e.g., residents chatting with one another about material unrelated to the content of the AHD). Importantly, there appeared to be a relationship between residents' level of engagement and the presenter's chosen instructional method. While residents seemed more prone to disengagement during didactic lectures, presenters who engaged residents directly by asking questions, promoting discussion, or using case-based learning appeared to be more successful at maintaining engagement throughout the course of the AHD. These initial findings prompted the primary researcher's further interest in exploring the possible links between AHDs, attention, and learning.

1.3 Attention and Mind Wandering

William James, an American psychologist from Harvard University, provided a definition for attention that is still widely used today:

> *Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought…It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatterbrained state which…is called distraction.* (1983, pp. 331–332)

In his definition, James clearly points to two "sides" of attention: one in which we attend to specific stimuli in our external environment and another in which we are seemingly disengaged. One possible state of disengagement is known as mind wandering, formally defined as a state of inwardly directed thought while performing a task (Schooler et al., 2011). The ubiquity of mind wandering—up to 50 percent of our waking hours (Killingsworth & Gilbert, 2010)—makes it an experience that most people can easily relate to. As Williams describes:

> *Unlike other animals, humans spend a lot of time thinking about what isn't going on around them: contemplating events that happened in the past, might happen in the future, or may never happen at all. Indeed, mind wandering appears to be the human brain's default mode of operation.* (2015, para. 3)

As a relatively new area of formal study, mind wandering appears, at times, to suffer from conflation with other attention-related constructs. For example, a distinction that emerged only recently is between mind wandering and daydreaming, which are thought to differ because mind wandering requires the individual to be engaged in a specific task rather than simply be at rest (Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013). Moreover, recent work by Seli, Risko, and Smilek (2016) suggests that mind wandering itself is not a unitary construct since it can occur either unintentionally or

intentionally. While unintentional mind wandering is thought to be the outcome of a failure of the executive control system (described in more detail later in Section 1.3.2 of this chapter) and involves disengaging from a task without meaning to do so, intentional episodes represent deliberate shifts of attention toward task-unrelated thought (Seli et al., 2016). However, it remains unclear as to how intentional mind wandering differs from task switching, which Monsell (2003) describes as frequent shifts between a set of simple tasks—for example, sitting at a computer to write a paper but then deliberately choosing to attend to several open browser windows instead. While the distinction may lie in whether or not a subject has shifted only in thought (mind wandering) or both in thought and in action (task switching), these two constructs remain, at least to some extent, conflated in the literature.

1.3.1 *When* the Mind Wanders: Mind Wandering and Cognitive Load

Although mind wandering is highly prevalent and often occurs in a seemingly spontaneous fashion, certain elements of a task may make it more or less conducive to mind wandering. Cognitive load refers to the total amount of mental effort being used in the working memory when performing a task (Sweller, 1988). Researchers have identified an inverse relationship between cognitive load and mind wandering, such that cognitively undemanding tasks (i.e., those that do not place a heavy burden on working memory capacity) tend to result in higher rates of mind wandering (Smallwood, Obonsawin, & Reid, 2003), as do tasks that people find uninteresting (Smallwood, Nind, & O'Connor, 2009). However, it remains unclear as to whether there is an upper limit on this effect—for example, if a task is too cognitively demanding, an individual could

conceivably give up and deliberately choose to think about something else instead, thereby engaging in intentional mind wandering.

1.3.2 *How* and *Why* the Mind Wanders: Mechanisms of Mind Wandering

Like the precise definition of mind wandering, research into the cognitive mechanisms of mind wandering is also in its infancy; thus, researchers do not have a clear understanding of how and why it occurs (Pachai, Acai, LoGiudice, & Kim, 2016; Smallwood, 2013). However, the perceptual decoupling hypothesis suggests that a single system—the executive control system—may be responsible for both on- and off-task thought (Antrobus, Singer, & Greenberg, 1966). Since the mind cannot attend to both internal and external stimuli simultaneously, mind wandering results in the decoupling of attention from the external environment so that the stream of internal thought can be maintained without disruption (Kane & Engle, 2002). In other words, while one attending to internal thoughts, fewer cognitive resources are available to register external cues. This mechanism is thought, at least in part, to be responsible for the performance costs that are associated with mind wandering (Schooler et al., 2011), which will be discussed in greater detail in Section 1.5 of this chapter.

The perceptual decoupling hypothesis provides some indication as to one possible mechanism underlying mind wandering, but does not explain why it occurs (Smallwood, 2013). The executive failure hypothesis suggests that the executive control system is responsible for reducing both external and internal thoughts that might distract from the task at hand (McVay & Kane, 2009, 2010, 2012). According to this hypothesis, mind wandering occurs when the executive control system fails to do its job of inhibiting

distracting internal thoughts. The current concerns hypothesis, on the other hand, operates on the principle that it is the most salient stimuli in our environment—be they internal or external—that capture our attention (Klinger, Gregoire, & Barta, 1973). Mind wandering may occur in response to an individual's goals and desires, which draw attention away from the external environment and direct it towards personally relevant thoughts. These two hypotheses are not mutually exclusive and, in fact, most likely work in conjunction with one another— for example, current concerns may result in a decoupling of the mind from the external environment when the executive control system fails to inhibit distracting internal thoughts (McVay & Kane, 2010).

Finally, it is pertinent to consider the resource control account of mind wandering (Thomson, Besner, & Smilek, 2015). This relatively new theory of mind wandering aims to bring parsimony to previous views on mind wandering and in doing so, suggests that mind wandering is the default state of our cognitive system. In fact, the ubiquity of mind wandering, which is a central tenet of this theoretical account, has prompted some researchers to examine if there are any potential benefits of mind wandering, which will be discussed further in Section 1.5 of this chapter. According to the resource control account, the amount of cognitive resources that can be devoted to both task-related and task-unrelated thought are finite; thus, the executive control system must appropriately allot the limited resources available to both the current task and mind wandering to promote optimal performance. However, as executive control naturally wanes over time, the cognitive resources being devoted to mind wandering increase while the resources

being devoted to the task at hand simultaneously decrease. This, in turn, results in performance decrements. Importantly, Thomson et al. note that:

> *It is not a failure in executive control per se that causes mind wandering (because mind wandering occurs early in the task when one is exerting a high degree of control), but a failure in executive control that leads to performance costs that are due to mind wandering.* (2015, p. 90)

1.4 Measuring Mind Wandering

The most common approach used to measure mind wandering in applied cognitive research is the use of thought probes (Szpunar, Moulton, & Schacter, 2013). During a learning task such as a lecture, students are interrupted, either randomly or at set time intervals, by an auditory and/or visual cue and asked to respond to a probe question that asks them to self-report their mental state just prior to hearing or seeing the probe. A simple dichotomous probe question might be, "Just prior to hearing/seeing this probe, were you mind wandering?" Probe questions can also be made more specific, for example by asking students to identify whether they were on-task (i.e., paying attention to the lecture), unintentionally mind wandering (i.e., having disengaged from the lecture without meaning to do so), or intentionally mind wandering (i.e., deliberately choosing to disengage from the lecture; Wammes, Boucher, et al., 2016).

When using thought probes, the researcher has control over when the probes are presented throughout the task. Some may choose to present probes at random time points, whereas others may present them separated by a set time interval that is dependent on the task (Seli, Carriere, Levene, & Smilek, 2013). This interval may be in the order of several seconds for laboratory tasks (Seli et al., 2013), but is typically longer in classroom studies

in order to avoid excessive disruption to the lecture and to prevent students from being in a "constant state of reflection" regarding their mental state (Risko et al., 2012, p. 236).

One of the challenges of using thought probes to measure mind wandering is that participants are required to self-report their state of attention. In some cases, they may be reluctant to do so (e.g., due to issues of social desirability; King & Bruner, 2000) and in others, they may simply be unable to provide accurate responses if they are unaware of their cognitive state (Schooler et al., 2011). It is also possible that the use of thought probes might alter participants' attention, making them either more or less attentive to the task at hand (Seli et al., 2013). Questions about the credibility of thought probes may also arise given the large body of literature suggesting that people are inherently poor at self-assessment (e.g., Eva & Regehr, 2008), although it is pertinent to consider that evaluating one's performance on a task (i.e., self-assessment) is different—and perhaps more difficult to do accurately—than self-reporting a cognitive state. Moreover, when using thought probes, self-reporting occurs during a task as opposed to retrospectively and may therefore more closely resemble reflective practice than does self-assessment, the former being reflection-*in*-practice as opposed to reflection-*on*-practice and more widely accepted as being beneficial to health professionals' metacognition (Davies, 2012; Eva & Regehr, 2005; Schön, 1983). Lending further credibility to the use of thought probes is the fact that they reliably predict changes in: behavioural markers such as gaze duration, reaction time, and performance errors; physiological measures such as pupil dilation and heart rate; and brain activity as measured by functional magnetic resonance imaging, electroencephalography, and eye tracking (Schooler et al., 2014). Yet, they remain less

resource-intensive to administer and therefore continue to be widely used by mind wandering researchers as other, more objective approaches are still in their infancy.

1.5 Effects of Mind Wandering on Classroom-Based Learning

Although more work is needed in this area, recent literature on mind wandering has identified several potential benefits of mind wandering, including autobiographical planning (Baird, Smallwood, & Schooler, 2011), enhanced creative thinking (Baird et al., 2012), social problem solving (Ruby, Smallwood, Sackur, & Singer, 2013), relief from boredom (Mooneyham & Schooler, 2013; Schooler et al., 2011), and dishabituation (the representation of an "old" stimulus as "new", which can help the brain refresh its attentive capacity; Mooneyham & Schooler, 2013; Schooler et al., 2011). While these benefits are all relevant to postgraduate medical education, it is important to note that whether or not mind wandering is beneficial depends highly on the context in which it occurs. For example, in studies by both Baird et al. (2012) and Ruby et al. (2013), the authors deliberately induced mind wandering by providing participants with a monotonous task that was meant to reduce cognitive load and allow more resources to be devoted to internally generated thought. While this conferred benefits in terms of the author's intended outcomes (creativity and social problem solving, respectively), it is critical to note that the primary task was not a learning task and, thus, any impairments in task performance arising from mind wandering were virtually inconsequential. This is fundamentally different from learning contexts such as AHDs, for example, in which the information presented is important and has bearing on residents' knowledge base for

future practice. In these situations, the potential costs of mind wandering likely outweigh the benefits and should be taken into account.

The body of literature describing the costs of mind wandering is extensive, and spans across both laboratory tasks and tasks that are more educationally-relevant (see Mooneyham & Schooler, 2013; Pachai et al., 2016 for published reviews of the general and educationally-relevant mind wandering literature, respectively). It is generally agreed upon that direct effects of mind wandering on task performance are due to perceptual decoupling, in which cognitive resources are directed towards an internal stream of thought and external cues are ignored (Schooler et al., 2011). With respect to education, the relationship between mind wandering and learning has been explored in a variety of contexts at the undergraduate level, including during lectures (e.g., Bunce, Flens, & Neiles, 2010; Lindquist & McLean, 2011; Risko et al., 2012; Risko, Buchanan, Medimorec, & Kingstone, 2013; Wammes, Boucher, et al., 2016; Wammes, Seli, Cheyne, Boucher, & Smilek, 2016), reading (e.g., Smallwood, McSpadden, & Schooler, 2008; Unsworth & McMillan, 2012; Varao Sousa, Carriere, & Smilek, 2013), and in relation to general aptitude (Mrazek et al., 2012). Across learning contexts, these studies have all concluded that mind wandering is often detrimental to learning and academic performance. However, given that the focus of this thesis is on classroom-based learning in postgraduate medical education, further review of the literature will focus primarily on studies conducted in classroom settings.

1.5.1 Direct Effects on Learning

Studies that have examined mind wandering in classroom settings have done so during live (Bunce et al., 2010; Lindquist & McLean, 2011; Wammes, Boucher, et al., 2016; Wammes, Seli, et al., 2016) or prerecorded video (Risko et al., 2012, 2013; Szpunar, Khan, et al., 2013) lectures. To date, the focus has exclusively been on didactic lectures in all but one study (Bunce et al., 2010); thus, the mind wandering profiles of classrooms where other instructional methods are used are not yet well documented. Nonetheless, existing classroom-based studies allow a number of conclusions about mind wandering in educational settings to be drawn that may generalize to AHDs, which also tend to rely heavily on didactic lecturing (Chalk, 2004).

Consistent with laboratory-based studies showing an increase in mind wandering with time-on-task (see Smallwood & Schooler, 2006 for a review), studies of mind wandering in classrooms have shown that mind wandering typically increases over the course of a lecture (e.g., Farley, Risko, & Kingstone, 2013; Risko et al., 2012, 2013; Szpunar, Khan, et al., 2013; but see Wammes, Boucher, et al., 2016 for recent contradictory results in a more ecologically valid environment). This ties into what other literature describes as a vigilance decrement—in other words, a deterioration in one's ability to sustain their attention for prolonged periods of time, thus resulting in performance declines (Young, Robinson, & Alberts, 2009). This is particularly relevant to AHDs, given that they can be up to four hours in length (Chalk, 2004), potentially making paying attention especially challenging for residents. Nonetheless, some accounts of the vigilance decrement suggest that this effect may be mitigated if individuals are

intrinsically motivated to complete a given task, or perceive it to be of value to them in some way (Hancock, 2013; Kurzban, Duckworth, Kable, & Myers, 2013).

Classroom-based studies of mind wandering have also provided substantial evidence that mind wandering during lecture harms comprehension of the material being taught. For example, in a study by Risko et al. (2012), students watched an hour-long video lecture and responded to mind wandering probes throughout. They then completed a comprehension test following the lecture. Participants reported twice as much mind wandering during the second half of the lecture compared with the first half, and were also less likely to correctly answer questions drawn from content presented in the second half. These findings mirror those from other lecture-based studies (Lindquist & McLean, 2011; Szpunar, Khan, et al., 2013).

Additionally, studies of mind wandering and reading have shown that mind wandering at "critical points" throughout the text (i.e., when key information is being presented) is, not surprisingly, even more detrimental to comprehension than mind wandering randomly throughout (Smallwood et al., 2008). This finding may also apply to AHDs and classroom-based learning, although it may be harder to identify what information is critical in this context unless cued by the presenter in some way. Nonetheless, this finding implies that students who mind wander when foundational information is being presented may miss out on understanding these concepts and thus be unable to understand future content that builds on this information. In fact, given the widely acknowledged fact that assessment drives learning across learning contexts (Epstein, 2007), residents may feel that it is acceptable to only pay attention to

information that they expect to be tested on in the future. Importantly though, information that is not directly testable may still be important for building residents' foundational knowledge of a topic area, and therefore, their understanding of future concepts that may in fact be "on the test."

1.5.2 Indirect Effects on Learning

Besides a direct effect on task performance, mind wandering may also harm performance indirectly, for example by negatively affecting tasks that support learning such as note-taking (Lindquist & McLean, 2011; Szpunar, Khan, et al., 2013). Note-taking is linked to better academic achievement because it can allow deeper processing of the material at the time of the lecture as well as serve as reference material when studying at a later date (Kiewra, 1989). Thus, fewer and poorer quality notes taken during a lecture may serve as an indication of shallower processing of the lecture material and may also impair performance on future examinations that rely on the content being taught. In the case of AHDs, this may mean that residents who mind wander more during AHDs might take fewer (or lower-quality) notes and therefore have fewer materials to refer back to when they are studying for their licensing exam several months (or years) into the future or during future clinical rotations that may rely on the information taught in AHD.

Residents are also increasingly relying on computers to take notes as well as to perform other functions (e.g., to look up information), which may introduce other distractions to the lecture environment (Wallace, Clark, & White, 2012). Therefore, as the prevalence of technology in medical education and elsewhere in our lives continues to increase, it is pertinent to consider its relationship with mind wandering (Guze, 2015). In

a study by Risko et al. (2013), participants were required to watch an hour-long lecture and then answer comprehension questions about the material they had learned. Selected participants were given a computer with internet access and were told to execute a variety of common tasks such as check social media or respond to emails, which although part of a laboratory experiment, was meant to simulate what they might ordinarily do in lecture. As expected, students with Internet access reported higher rates of mind wandering during the lecture and also exhibited poorer comprehension of the lecture material than those who did not have Internet access.

While few comparable studies have been conducted in medical education, the existing literature clearly points to distractions due to technology in both clinical and classroom settings. For example, a survey conducted among 439 perfusionists conducting cardiopulmonary bypass surgery found that 56% used their phones during the procedure (Smith, Darling, & Searles, 2011). Of those respondents who reported doing so, the following activities were acknowledged: sending text messages (49%), accessing email (21%), using the Internet (15%), and checking/posting on social media (3%). Similarly, a mixed-methods study by Wallace et al. (2012) revealed that the use of mobile devices was "widespread and frequent, and…occurred in all settings where learners and teachers were present, from classrooms to hospitals" (p. 3). Sixty-three percent of respondents (including medical students, residents, and faculty) agreed that Smartphones were a distraction in the classroom, and some participants also worried that frequent use of these devices would lead to superficial learning. Therefore, it clear that technology use poses distraction in classroom settings such as AHDs and may lead to poorer learning,

particularly because there are often no real social rules or expectations for appropriate technology use in this setting. However, as described in more detail in Section 1.3, it remains unclear if distraction due to technology more closely represents task switching or intentional mind wandering, and how exactly these two constructs differ cognitively.

1.6 Mind Wandering in Medical Education

Despite its recent popularity in the applied education cognition literature, mind wandering as an area of research is only just beginning to gain traction in medical education. Smallwood, Mrazek, and Schooler (2011) suggest that mind wandering is particularly relevant to medical practice because of the combination of fatigue, low mood, and the often-routine nature of medical work—all of which may increase the prevalence of mind wandering and, therefore, the potential for medical errors to occur (i.e., due to the performance costs associated with mind wandering). In response to this evidence, several studies have examined the role of mindfulness training in attempting to ameliorate the cost of mind wandering to the medical profession.

Mindfulness represents a state of attention in which one's awareness is actively, intentionally, and non-judgmentally (i.e., without regard to whether they are good or bad) focused on emotions, thoughts, and sensations occurring in the present moment (Brown & Ryan, 2003; Kabat-Zinn, 1982). Mindfulness training—which typically places an emphasis on such things as posture, being conscious of thoughts and learning to reframe elaborated or distracting thoughts, focusing on breathing and using the breath as an anchor for attention during meditation, and mental relaxation to prevent forceful suppression of thoughts (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013)—has its

roots in therapeutic activities to reduce stress, depression, and anxiety (Brown & Ryan, 2003). However, regular mindfulness training (in one study, 45 minutes four times per week, plus ten minutes of daily meditation outside of the course) has also been shown to improve scores on both tasks of working memory capacity and standardized tests, while considerably reducing levels of mind wandering (Mrazek, Franklin, et al., 2013). Benefits of mindfulness training have also been identified in the context of medical education, for example in enhancing primary care physicians' well being, capacity to relate to patients, and job satisfaction while reducing psychological distress and burnout (e.g., Beach et al., 2013; Fortney, Luchterhand, Zakletskaia, Zgierska, & Rakel, 2013; Krasner et al., 2009).

Interestingly, despite the prevalence of classroom-based instruction in postgraduate medical education, existing research to address mind wandering in medical education has focused almost exclusively on physicians' well being and their behaviour in the clinical environment (e.g., how they interact with patients). To date, no studies have been conducted to examine the role that mind wandering may play in classroom-learning contexts, such as AHDs. Yet, given their widespread use and continued importance in light of changes to residency education, there remains a gap in the literature with respect to the effectiveness of AHDs in promoting resident learning. The aim of this thesis is to address the growing need to optimize non-clinical teaching time by extending mind wandering research in medical education into classroom-based teaching sessions (AHDs) and exploring the potential implications on effective AHD design and delivery.

1.7 Research Objectives

This thesis seeks to examine mind wandering and its potential implications on AHD design and delivery by exploring the following two research questions:

1. **Research Question 1 (RQ1):** What are residents' perceptions about the nature of their learning experience during AHDs?
2. **Research Question 2 (RQ2):** How do three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning)[1] influence mind wandering during AHDs?

1.8 Thesis Overview

This thesis examines mind wandering during AHDs, with the overarching goal of understanding how results might inform the design of classroom-based teaching sessions in postgraduate medical education. A multimethod approach was selected in order to better support the two programs considered in this study. Chapter 2 describes the first study of this thesis, which used a qualitative approach (focus groups) to examine residents' perceptions about the nature of their learning experience during AHDs (RQ1). Chapter 3 describes the second study, which used a quantitative approach to examine how three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning) influenced mind wandering during AHDs (RQ2). Specifically, thought probes, administered in ob/gyn and hematology AHDs, were used to examine whether or not active learning strategies could lead to a reduction in levels of mind wandering among trainees. Implications of the results of both studies and conclusions are summarized in

[1]Note that these instructional methods were selected based on the approaches that were most commonly observed during the pilot study described in Section 1.2 of this chapter.

Chapter 4, the general discussion. Taken together, the two studies that comprise this thesis make a contribution to the exploration of how classroom-based teaching sessions such as AHDs can be optimized to enhance student learning in postgraduate medical education. ✣

CHAPTER 2: PERCEPTIONS OF LEARNING DURING ACADEMIC HALF-DAYS

2.1 Overview and Rationale

To explore residents' perceptions of their learning during AHDs (RQ1), focus groups were conducted with residents in the hematology and ob/gyn postgraduate medical training programs in McMaster University. A qualitative methodology and in particular, focus groups using a thematic analysis approach as described by Braun and Clarke (2006), was selected in order to gain a deeper perspective into residents' perceptions of AHDs and to take advantage of the benefits of insights that might emerge from group discussions on the topic (Barbour, 2005). Given that there is little published research on AHDs and that there is some context specificity with respect to how AHDs are structured in different programs and institutions, it was felt that results from the focus groups would help to provide some context for subsequent quantitative work on this topic.

2.2 Methods

2.2.1 Participants

Five hematology residents and 15 ob/gyn residents participated in two separate focus groups (one per program). In hematology, the average number of years of postgraduate training was 4.80 (*SD* = .44) and the ratio of male to female participants was 4:1. In ob/gyn, the average number of years of postgraduate training was 3.27 (*SD* = 1.22) and the ratio of male to female participants was 1:14. While in qualitative research it is difficult to decide an optimal number of participants that should be included in a focus group, the ideal group size is generally between four and 12 participants (Tang & Davis, 1995). This ensures that diverse perspectives are adequately represented while still

allowing all participants to contribute in the allotted time frame. Although the primary researcher had originally planned to hold multiple focus groups with ob/gyn residents given their larger program size and potential differences across years of training, but this was not possible due to scheduling difficulties. This resulted in a focus group that was slightly larger than recommended in the literature.

Hematology is a two-year, subspecialty program that residents enter after the completion of three years of prior postgraduate training in internal medicine; thus, all hematology residents in their first and second years of training are in the fourth and fifth years of their postgraduate medical training, respectively. The focus of the program in the first year is on both clinical hematology and laboratory medicine, while in the second year it is on inpatient and outpatient malignant, pediatric, and consultative hematology (Department of Medicine, 2016). In contrast, ob/gyn is a five-year postgraduate training program that trainees enter directly after the completion of an undergraduate medical degree, although only residents in years two to five attend ob/gyn AHDs (first-year residents only participate in AHD sessions that are a part of a surgical foundations training program). Over the course of their five years in the program, trainees engage in the general practice of the specialty, which include both pregnancy care, both high and low risk, and the care of pelvic and endocrine disorders affecting women (Department of Obstetrics and Gynecology, 2016).

Both programs incorporate AHDs as a mandatory aspect of the formal curriculum, but differ in length, degree of specialization, and the amount of prior training that is required for entry. They also differ in terms of size: hematology is currently comprised of

six residents across two years, while ob/gyn is comprised of 31 residents distributed across five years. Given that contextual differences may affect the nature of residents' learning experiences during AHDs, hematology and ob/gyn were selected with the intention of comparing and contrasting findings between a smaller, more specialized training program and a larger, more generalized one.

2.2.2 Recruitment

Ethics approval was sought from the Hamilton Integrated Research Ethics Board (HiREB) by submitting an amendment to an existing blanket ethics application to conduct studies in medical education (#11-409). With the permission of the AHD coordinator in hematology and the postgraduate program director in ob/gyn, an announcement about the study was made to all residents in ob/gyn and hematology who were present during a regularly scheduled AHD in each program. A follow-up email was sent announcing when and where the focus groups in each program would be held so that residents were free to choose whether or not to attend. As indicated earlier, scheduling difficulties did not permit the primary researcher to hold more than one focus group in ob/gyn; thus, only one focus group was held per program.

2.2.3 Data Collection and Analysis

Informed consent was obtained from each participant prior to data collection. Focus groups took place in November 2015 (hematology) and March 2016 (ob/gyn) and were each audio-recorded. It is pertinent to note that the hematology focus group was held in lieu of a regularly scheduled AHD session while the ob/gyn focus group was held immediately following the third data collection day, which was a presentation on a core

AHD topic: gynecological emergencies. Residents were prompted using the following questions with respect to AHDs in general (i.e., not just their most recent experience), although the semi-structured format allowed the primary researcher to ask follow-up and clarification questions as needed:

1. Overall, what are your views on AHDs?
2. With respect to learning, what are effective aspects of AHDs? The least effective?
3. How much of the content, in your opinion, is applicable to you as a trainee?
4. What are your thoughts about the length and timing of AHDs?
5. How easy is it for you to pay attention during AHDs? What are the primary barriers that you face?
6. Are there any particular teaching styles/instructional methods that you feel enhance your learning? Any that you feel don't?

Once complete, each focus group was transcribed verbatim by the primary researcher. All personal identifiers were removed from the transcripts prior to analysis. Thematic analysis involved the creation and application of codes to the data resulting in a theme-code set, developed by the primary researcher, based on review and preliminary interpretation of all interview transcripts (Braun & Clarke, 2006). Subsequent coding of the focus group transcripts involved reading and open-coding discrete units of text to support individual codes found in the theme code set (Braun & Clarke, 2006). Comparison of themes across the two programs and with results emerging from the experimental work described in Chapter 3 of this thesis allowed for triangulation of the qualitative data and helped substantiate the findings (Lincoln & Guba, 1984). While

member checking would have further helped ensure the trustworthiness of the findings (Lincoln & Guba, 1984), this was not done due to time constraints.

2.2.4 Researcher Characteristics

The primary researcher is a graduate student in the Master of Health Science Education Program at McMaster University. While she had no prior personal or professional relationships with any of the residents and is a non-clinician, she had been involved in observing a number of AHD sessions in both hematology and ob/gyn during the pilot work described earlier in Chapter 1, Section 1.2. As such, she was able to establish a certain level of rapport with the residents in both programs, who were familiar with who she was and the nature of her research. Her previous experiences enabled a more nuanced understanding of the AHDs in each program. The primary researcher's role as a graduate student in education as opposed to a program director or a faculty member were likely helpful in ensuring that residents were comfortable freely disclosing their thoughts and perceptions of AHD without fear of any negative repercussions, although as part of the ethical guidelines for this study, residents were also explicitly told that the data collected in the focus groups would be anonymized prior to dissemination and that individual residents could not be discerned from the data by anyone reading the results.

2.3 Results

The following elements were explored in the focus groups: overall perceptions of AHDs, perceptions of instructional methods used during AHDs, perceptions of attention during AHDs, and motivations for learning. Salient themes from the two focus groups are described in further detail below and a summary is provided in Table 1.

2.3.1 Program Culture

Prior to describing the results of the two focus groups, it is pertinent to briefly contextualize the findings by discussing what the primary researcher observed to be distinct cultural differences between the two programs she examined over the course of her work. While both groups seemed truthful in their responses to the focus group questions, hematology residents were quieter and more reserved by nature, often requiring prompting to elaborate on specific concepts. During the focus groups, they generally tended to agree with one another and no considerable differences in opinion were apparent. Ob/gyn residents, on the other hand, were a much more social group and candidly—and at times, unreservedly—gave feedback about various aspects of their program. During the focus groups, a number of areas emerged in which there were differences in opinion between residents, prompting further discussion among some but perhaps failing to capture the perspective of others. These observable differences in program culture likely contributed to the way that residents in the two different programs described their perceptions of learning during AHDs during the focus groups and may help to provide some context for the subsequent focus group findings.

2.3.2 Overall Perceptions of Academic Half-Days

Overall perceptions of AHD varied considerably between the two programs. Hematology residents spoke very positively about AHDs and believed that they were useful for learning about various aspects of the core curriculum.

> *I think for residents, from an education perspective, it is very helpful to our program. It covers most of the topics that are in hematology. [It] gives us perspective about some practical points, updates about illnesses and management,*

> *and also it's a guide for further studies about certain diseases or certain treatment.* (Hematology resident)

Another hematology resident remarked that most of the topics covered during AHDs were relevant to clinical practice and that it only "rarely would happen [that] you have some information that's really irrelevant."

Ob/gyn residents, on the other hand, were more negative in their perceptions. While one resident commented that it was "nice to have a focused curriculum that I know will be planned out over my five years," the majority of other residents felt that the content covered in AHDs was sometimes irrelevant to their clinical practice. Several ob/gyn residents reported being unsure about how AHD topics were typically selected for inclusion in the curriculum.

> *Sometimes the topics for half-day seem like we have this gap in our accreditation of things we were supposed to have taught you at some point in residency so there's the topic, but there's not a lot of induction of labour or the very basics…The academic half-day topics are something that I don't really ever encounter in my day-to-day life.* (Ob/gyn resident)

Both groups indicated a preference for greater structure during AHDs—in other words, a consolidated curriculum rather than disjointed topics. For example, one hematology resident stated: "I feel like sometimes it could be structured a little bit better. I wish we had modules." However, a lack of structure seemed to resonate more strongly with the ob/gyn residents, who discussed the perceived disjunction between some of their AHD topics at length.

> *There is no core. It's just this smattering of lectures of them [the presenters] talking about whatever they want to talk about…as opposed to having it be like, you should*

> *talk about this and you should draw from Williams [the core textbook] and the guidelines.* (Ob/gyn resident)

Similarly, while residents in both programs noted that there was a difference in quality between different AHD presentations, this theme was stronger among the ob/gyn residents than the hematology residents.

> *I find some [talks] are really high yield with how well they're put together and others are just free-for-all discussion where it's like, well I could have probably had a better chance just reading this chapter on my own.* (Ob/gyn resident)

Several of the ob/gyn residents also seemed concerned that the presenters that were selected to deliver AHD sessions were not always experts in the subject matter that they were presenting on or lacked presentation skills.

> *We have a talk every so often where the staff is like, oh I'm not really comfortable giving this talk, or I'm not really the best person to give this talk. And I always think why isn't somebody else giving it, then?* (Ob/gyn resident)

> *Some people are just better speakers [than others]. Some people like it and try to do more talks and enjoy that sort of thing and others are like, I have to come to half-day and give a talk. And you can tell.* (Ob/gyn resident)

Ob/gyn residents also indicated that presenters did not always appropriately reference materials for their presentations. For example, some presenters reportedly had the tendency to draw on esoteric case reports or use guidelines that are not applicable in Canada. They considered this problematic because residents are expected to know and refer to specific key resources on their licensing exam as opposed to simply any material that is available on the topic.

> *Sometimes the topics are excellent and it's just that it's not the right speaker for that talk. I have to tell myself not to listen and not to trust what they're saying because it's not the right resources that they're quoting for what we need to know.*

> *They might draw on very esoteric case reports, or it's interesting, but it's not what we need to know as a core curriculum for academic half-day.* (Ob/gyn resident)

2.3.3 Perceptions of Instructional Methods Used During Academic Half-Days

In discussing their perceptions of instructional methods used during AHDs, hematology residents had a strong preference for active instructional methods over more passive methods such as didactic lecturing. In particular, they had very positive views of case-based learning and felt that they were useful for not only creating a more engaging environment, but also for enhancing learning.

> *I think that one of the best half-days that we usually have is from Dr. [name withheld], for example. She brings cases for each person. So, each person goes through it and then around the topic that the case is around, she'll present a mini didactic lecture…Each person has the opportunity to go through a case and others add to it at the end.* (Hematology resident)

Hematology residents felt that the cases enhanced their learning both by creating opportunities for group discussion and also by serving as practice for the practical component of their licensing examination, which is an objective clinical structured examination (OSCE) and is usually based on a particular case, or scenario, at each station.

> *We get to take the cases home at the end of the half-day, we work through them [and] it also incorporates Royal College-type learning really well as well because that's [what] our oral exam is based [on].* (Hematology resident)

Opportunities for group discussion were also seen as important for learning and were easier to facilitate, according to the residents, since their specialty was small in size.

> *That's the nice thing about a small group. We are not similar to other [larger groups]…like internal medicine and groups like that. Having a small group allow[s]…for discussion.* (Hematology resident)

Like the hematology residents, ob/gyn residents also had a preference for case-based learning over didactic lecturing. However, there was a considerable amount of debate about who should present the cases, and when. Some residents felt that cases should be integrated into AHDs by the presenter, whereas others preferred them to be presented by a resident in between two AHD topics to allow for discussion and learning about a recent, real-life case that had been encountered during a rotation.

> *I like the structure that has a case integrated. I don't know if you guys remember [name withheld]'s lecture on ectopics? It was amazing. She had a couple of different cases of different ectopics and then structured her whole talk around each patient and it keeps you alert, and awake, and more engaged.* (Ob/gyn resident)

> *The case-based learning would be good for when there's been a case at one of the sites and the people that were there or were around for those couple of weeks all are talking about it…Those big cases that happen once a month or something would be nice to bring so that everyone learns from it.* (Ob/gyn resident)

Ob/gyn residents also identified the relevance of a case-based approach to preparing for the practical component of their licensing examination, which is based on a similar format. As one resident identified: "The case-based learning is also a really good point because…for our exams, we need to practice for the OSCEs. So, the case-based learning could be a way to practice…together."

Ob/gyn residents also saw value in having group discussions, although with several caveats. For example, several residents noted that it was sometimes easy for group discussions to get off-track and lose their clinical relevance. A proposed alternative was the use of quizzing with live results followed by an opportunity for discussion, which is a technique that many of the residents felt positively about because they had previously encountered it working well during a licensing examination preparatory course.

> *There was a speaker who once said if you want to keep a group of doctors awake, quiz them! Because we intrinsically want to be good at things.* (Ob/gyn resident)

> *When you just openly say let's discuss this, then that can take 15 minutes and…afterwards you think, we just digressed and chatted and didn't really use that time as efficiently as we could have…But, if you're using [quiz] questions, I find it only takes 30 seconds and then [the presenter has] a sense of how much we know and that can also bring out a discussion point.* (Ob/gyn resident)

2.3.4 Perceptions of Attention During Academic Half-Days

While one resident admitted that sometimes "we're planning for [our next trip] or what we're going to have for dinner or what [our] patients are doing," hematology residents did not generally seem to feel that it was difficult to pay attention during AHDs. While technology and other distractions were sometimes present, hematology residents felt that this was simply "just life…everybody has something [other than what they are doing] to think about." Furthermore, they seemed to feel accountable for paying attention given their smaller program size. As one resident indicated, "most of the time, because we are a small group, I think the attention is okay…if one of us was sleeping, everyone would notice!"

> *We know what we need to get out of it…and so, I think most of us approach it in that way…We're here because we want to know what that person has to say, and at different times in the talk, there's stuff that's more or less relevant.* (Hematology resident)

In contrast to the hematology residents, ob/gyn residents indicated that paying attention during AHDs was quite often a challenge. They cited a variety of factors, including the presenter's presentation skills, the relevance of the content being presented, and how tired they felt during the AHD.

> *So much of it, for me, in terms of how engaged I am on a given down to just, is the staff a good speaker. And some of them are very engaging speakers and some of them not so much. And it's not always topic dependent…[Name withheld] did a recent talk and it was very stats-heavy and lots of slides, but I was with her the whole way because for those sorts of topics, I find her a really good speaker.* (Ob/gyn resident)

> *Often what [the presenter is] talking about is not relevant to what you're doing right now and you're exhausted and your brain has a limited capacity, and you're just not paying attention because this is an [obstetrics] topic and I'm on [gynecologic oncology] and I just don't care right now.* (Ob/gyn resident)

When asked what could be done to help their attention, residents in both programs felt that they were more attentive during AHDs when the presenters were able to engage them using more active instructional methods. As one hematology resident noted, "it's easier to pay attention if it's case-based rather than didactic, one person going on for three hours." Similarly, an ob/gyn resident confirmed, "anything you can do to engage us is helpful. Otherwise…you can only pay attention for so long before you start to zone out."

Interestingly, while hematology residents felt that the length of AHDs was appropriate because it was "needed[ed] to cover…topic[s] properly," ob/gyn residents felt that shortening AHDs by having multiple, shorter sessions each week would help them be more attentive. While there did not seem to be group consensus around how these shorter sessions should be structured, one ob/gyn resident's comment seemed to effectively capture the group's overall perceptions: "I don't know what the right answer is, but I know I start to fade at the hour mark even if it's a really good talk."

2.3.5 Motivations for Learning During Academic Half-Days

During the focus groups, residents in both programs focused predominately on the role of AHDs in preparing them for their licensing examination. For example, one hematology resident remarked: "There's a little bit of learning for life, but most of the learning is for the Royal College that I need to get out of this two years!" Not surprisingly, residents reported being more motivated to pay attention to material that they expected would be on their exam. One ob/gyn resident indicated: "Now we are going to write our exam in May, so many of the topics that we are getting lately…I pay more attention." Many of the suggestions they made for improving AHDs also seemed to be motivated by the perception that the primary purpose of AHDs was exam preparation.

> *And the only resource you would have to [use] for the actual lecture…would be Williams…It's not like a lit review, like go look at review articles and blablabla. You don't actually need to know that for the exam.* (Ob/gyn resident)

Interestingly, hematology residents did acknowledge that AHDs might have a role beyond just exam preparation: "I think they do a good job of making sure that we're learning for life and also Royal College-based learning." They also indicated that some of the content covered during AHDs was relevant to them not just because it was on the exam, but also because it was helpful for clinical practice.

> *The half-day that we had today, it was just so relevant for us because it was someone who was not that far away from being in our shoes, so understanding exactly what are the types of questions that we would have clinically that would be challenging, so, sometimes that's helpful too.* (Hematology resident)

2.4 Discussion

The first study of this thesis examined residents' perceptions of learning during AHDs across two programs (hematology and ob/gyn) using focus groups. Findings revealed that while residents in the two programs had different perceptions of the overall effectiveness of AHDs, residents agreed that mind wandering certainly occurred during AHDs and could, at times, be a barrier to their learning. Moreover, the comment made by one of the hematology residents that mind wandering is "just life…everybody has something [other than what they are doing] to think about," illustrates the ubiquity of mind wandering in our daily lives and in educational environments (Killingsworth & Gilbert, 2010). This and other comments made during the focus groups (e.g., "Yeah, we're planning for [our next trip] or what we're going to have for dinner or what your patients are doing") are well-supported by theories pertaining to the autobiographical planning function of mind wandering (Baird et al., 2011), as well as the current concerns hypothesis, which suggests that pertinent internal thoughts may take precedence over less engaging, external ones (Klinger et al., 1973).

Therefore, changing the external environment to make it more engaging can help address the vigilance decrement that may occur during monotonous lectures and "re-orient" residents' attention back to the task at hand (Young et al., 2009). Indeed, the focus group results of this thesis indicated that residents not only felt that active instructional methods such as case-based learning and group discussions kept them engaged, but also that they were more conducive to learning. This finding is supported by the experimental results in this thesis, which are presented and discussed in Chapter 3 of this thesis.

Residents in both programs also agreed on some ways in which AHDs could be improved, including a need to ensure that topics are part of a well-defined core curriculum that addresses key program objectives and where possible, builds on itself as opposed to simply being a "smattering of [unrelated] lectures." While this points to a need for programs to periodically review their AHD curricula and ensure that key objectives are being met, it also underscores the importance of understanding what motivates residents to learn during AHDs. It became clear from the focus groups that residents in both programs felt that AHDs had a major role to play in preparing them for their licensing examination and therefore wanted them to be structured in a way that would streamline their studying. As a result, residents' motivation to learn during AHDs seemed relatively extrinsic in both specialties—in other words, residents' perceptions of what they would be tested on during licensing guided what content they chose to pay attention to during AHDs.

This was confirmed by the primary researcher's qualitative observations that residents' attention was immediately reset when they were told that the content would be "on the exam" and that few residents were interested in tangential group discussions during AHDs unless the topic was especially interesting or controversial. While this is not surprising given the literature around how assessment drives learning in medical education (Epstein, 2007), it provides a clearer understanding of residents' motivation during AHDs and what drives their learning in this context. However, it is also possible that the wording of the focus group questions had an effect on how residents described their learning during AHDs. Specifically, residents in both programs were asked how

much of the AHD content they felt was applicable to them *as trainees*, which may have shifted their focus away from clinical practice and towards their more immediate training goals, which likely depended on where residents were in their training. For residents in their more senior years of training, this might have included passing their licensing exam.

Unfortunately, the finding that residents are rather extrinsically motivated to learn during AHDs and direct their attention accordingly may be concerning from a residency education perspective, whose ultimate goal it is to develop residents into successful clinical practitioners who are "lifelong learners" as opposed to simply residents who can pass a licensing examination. In fact, one of the hematology residents indirectly pointed to this problem in the focus group when they indicated that, "There's a little bit of learning for life, but most of the learning is for the Royal College that I need to get out of this two years!" While they recognized that an equally important purpose of AHDs was to teach content that was not only relevant for the exam but also for clinical practice, they also pointed to the inherent difficulty in challenging residents' extrinsically focused motivations to learn.

Nonetheless, some of the findings of this work offer some useful insights into how programs may be able to accomplish both "Royal College learning" and "learning for life." For example, residents seemed much more attentive to content when presenters showed genuine excitement about the material and were able to convey that it was important despite it not being on the exam. In one AHD, the presenter was not only an engaging speaker, but was also clear in indicating that while the content they were presenting on would not be testable, "you wouldn't want to be caught not knowing this in

practice." As a result, engagement during this particular AHD session was still relatively high despite the material not being testable. Therefore, explicitly making residents aware about material that is important for clinical practice in the same way that they are made aware about material that is important for the exam is a strategy that presenters can use to help promote resident engagement during AHDs. And, in fact, there does seem to be an appetite for clinically relevant content among residents—it may just require presenters to more directly draw links between AHD content and clinical practice. To reiterate a comment made by one of the hematology residents:

> *The half-day that we had today, it was just so relevant for us because it was someone who was not that far away from being in our shoes, so understanding exactly what are the types of questions that we would have clinically that would be challenging, so, sometimes that's helpful too.*

2.4.1 Explaining Differences in Perceptions Between Programs

Focus groups held with residents in hematology and ob/gyn also revealed a number of differences between the two programs with respect to overall perceptions of AHDs, the extent to which mind wandering was considered a problem during AHDs, and to a degree, residents' motivations for learning. While hematology residents appeared to be relatively satisfied with their AHDs, ob/gyn residents described similar concerns as previously published work on AHDs, including the lack of a core curriculum; content that, at times, did not seem relevant to their clinical practice; and concerns related to a lack of teaching development for faculty (Chen et al., 2015; McClean et al., 2006; Winter et al., 2007). Ob/gyn residents also found it harder to pay attention during AHDs. While both groups seemed relatively extrinsically motivated to learn, this was especially evident among ob/gyn residents.

Some of these differences can likely be accounted for by programmatic factors, such as program size and approach to AHD design; however, the timing of the focus groups may have also played a role, since the ob/gyn focus group was conducted only a few months before their licensing examination was set to take place. Notwithstanding this limitation, hematology residents suggested that their smaller program size makes it much easier for presenters to engage residents and for group discussions about various topics to take place. Moreover, hematology residents indicated that they felt more accountable for paying attention since "everyone would notice" if they were not. Therefore, having a smaller program size may be beneficial for hematology residents' overall engagement during AHDs and provide more opportunity for them to tailor these sessions to their learning needs.

In larger programs such as ob/gyn, it may be more difficult for presenters to directly engage with each resident who is present, and it may also be more challenging to design AHD curricula that is relevant to all learners given the potential for greater variety in residents' interests and levels of study. It is also worth noting that through informal discussions with the hematology AHD coordinator, it emerged that the hematology program under study had over the years developed a more refined list of AHD presenters by taking prior residents' feedback into account. As such, it may be the case that this presenter "screening" process resulted in a higher number of quality AHD presentations being delivered in hematology than in ob/gyn. Moreover, it seemed that presenters in hematology were more often content experts in the material they were presenting than in

ob/gyn, where scheduling was often a significant factor in determining AHD presenters and sometimes resulted in presenters who were not content experts.

As alluded to above, differences in the focus group findings can also be explained, at least in part, by differences among learners. Hematology is considered a subspecialty program that residents enter after completing three years of prior training in internal medicine whereas ob/gyn is a more general specialty with a mix of learners ranging across five years of postgraduate medical training (although, as indicated earlier, only residents in years two through to five attend ob/gyn AHDs). Therefore, there may be some validity in presuming that hematology residents are somewhat more intrinsically motivated to learn AHD content, having selected hematology as their subspecialty of choice. Ob/gyn residents, on the other hand, may have to learn about a range of topics that they do not always find relevant or interesting, potentially contributing to a more extrinsic motivation to learn.

2.4.2 Limitations

While the focus group held with hematology residents was an optimal size (n = 5), the focus group held with ob/gyn residents (n = 15) was larger than recommended due to difficulties scheduling more than one focus group. Despite the fact that there are no strict guidelines for determining focus group size, having more than 12 participants is generally not recommended (Tang & Davis, 1995). While all residents who were present during the focus group participated in the discussion, this may have created somewhat of a "groupthink" mentality where some residents whose opinions differed from those of the majority may have chosen to agree with their peers instead of voicing their disagreement.

There may have also been an effect of focus group timing and question wording on the finding that ob/gyn residents seemed to be somewhat more extrinsically motivated to learn than hematology residents. As described earlier in Section 2.4.1, the ob/gyn focus group was conducted much more closely in time to the licensing examination than the hematology focus group, and residents in both programs were specifically asked to consider the relevance of the AHD as trainees as opposed to as clinical practitioners. ✣

CHAPTER 3: EFFECT OF INSTRUCTIONAL METHOD ON MIND WANDERING

3.1 Overview and Rationale

The second study of this thesis used a quantitative approach to examine how three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning) influenced mind wandering during AHDs (RQ2). As indicated above, these methods were selected based on the approaches that were most commonly used by presenters during the pilot study described in Chapter 1, Section 1.2. Given that there is a paucity of literature exploring mind wandering during classroom-based teaching sessions in medical education, the purpose of this study was to generate quantitative evidence regarding the role of active learning in promoting engagement during AHDs.

3.2 Methods

3.2.1 Participants

Six hematology residents and 30 ob/gyn residents participated in the quantitative study. In hematology, the average number of years of postgraduate training was 4.67 (*SD* = .52) and the ratio of male to female participants was 5:1. In ob/gyn, the average number of years of postgraduate training was 3.39 (*SD* = 1.09) and the ratio of male to female participants was 1:17. The rationale for selecting hematology and ob/gyn as the postgraduate training programs of interest and the characteristics of these programs were previously described in Chapter 2, Section 2.2.1.

3.2.2 Recruitment

Ethics approval was sought from the HiREB by submitting an amendment to an existing blanket ethics application to conduct studies in medical education (#11-409).

With the permission of the AHD coordinator in hematology and the postgraduate program director in ob/gyn, an announcement about the study was made to all residents in ob/gyn and hematology who were present during a regularly scheduled AHD in each program. Follow-up reminders were then sent via email before each AHD to be included in the study. In addition, prior to the selection of AHDs for inclusion in the study, presenters were asked via email for permission to conduct the study during their AHD session and to audio-record it for research purposes.

3.2.3 Selection of Academic Half-Days

AHD sessions in each program were quasi-randomly (i.e., based on the availability of the primary researcher and the consent of the presenter) selected for inclusion in the study between January and March 2016 (Table 2). These sessions took place during normally scheduled AHDs and each typically involved the use of more than one of the three instructional methods considered (didactic lecture, group discussion, or case-based learning). No other instructional methods were used by any of the presenters. Didactic lecture was defined as a format in which the presenter orated content with little to no input from the class. All presenters who used this format also made use of PowerPoint slides, which were displayed on a large screen at the front of the class. In contrast, group discussion was defined as a discussion between the presenter and two or more residents. This was often initiated when a resident asked a question that triggered further conversation among their colleagues. Finally, case-based learning was defined as the presentation of real or imaginary patient data followed by group discussion around specific rather than spontaneous prompts. It is important to note that while the primary

researcher tried her best to define each of these instructional methods, the classifications were ultimately subjective in nature. For example, in some cases, group discussions may have led to informal discussions around cases that residents or staff had seen during clinical rotations, which bears some resemblance to case-based learning and may have resulted in some overlap with respect to the classifications.

As is typical for most AHDs, the presenter changed from topic to topic, but was always a clinical faculty member. In hematology, there was typically only one topic presented per AHD (between one and three hours in length, depending on the presenter), while in ob/gyn there were usually two topics and presenters back-to-back with a short break in between (for a total of three hours in length). However, due to scheduling difficulties and challenges around presenter consent, thought probes could only be administered during one topic on two of the data collection days in ob/gyn, and the remaining data collection day only had one topic and presenter.

3.2.4 Demographic Questionnaire and Thought Probes

At the beginning of each session, all residents who agreed to participate in the study were given a short demographic questionnaire with questions about their number of years of postgraduate training, typical number of hours of sleep on an average night, number of hours of sleep the night before the AHD, perceived level of alertness at the start of the AHD, interest in the topic, and prior familiarity with the topic. (Appendix 1). They also received a clicker device to be used for responding to thought probes throughout the session with a unique identifier that allowed their responses to be anonymously linked with their demographic questionnaire responses. The clicker device

was a small remote with buttons corresponding to multiple-choice response options (i.e., A, B, C, D, etc.) and allowed the primary researcher to collect participant responses via a receiver connected to her computer.

The primary researcher administered thought probes approximately once every 15 minutes during each AHD session using an audio file on her computer. Slight variations in probe timing by up to three minutes allowed the presenter to finish his or her main idea prior to the onset of the probe. This interval used in the present study is consistent with estimates of when attention is thought to begin to wane in the classroom (e.g., Bunce et al., 2010; Young et al., 2009), and was also selected to minimize disruption to the lecture and allow residents' attention to reset prior to administering a subsequent probe.

Each probe was identical and required residents to respond to a question that read as follows: "In the moments just prior to hearing this probe, which best describes what you were doing?" Residents had this question on a piece of paper in front of them throughout the entire session and were asked to submit a response using their clicker device whenever they heard an auditory cue, a 474 Hz triangular tone with 3 ms linear ramps lasting approximately 300 ms in duration. Possible response options were: A) actively listening to the lecture, B) not actively listening to the lecture, but thinking about something *related*, C) not actively listening to the lecture, but thinking about something *unrelated*, or D) unsure or unaware. While this thought probe question did not distinguish between intentional versus unintentional types of mind wandering like other recently published studies (e.g., Wammes, Boucher, et al., 2016; Wammes, Seli, et al., 2016), it

too was developed with the aim of gaining some insight into the nature of the mind wandering that residents were engaging in throughout the AHD session.

Qualitative observations of the room were made concurrently with the thought probes and involved recording the presenter's chosen instructional method (didactic lecture, group discussion, or case-based learning), the nature of the content being covered, and any notes about residents' behaviours and perceived attentiveness.

3.3 Results

3.3.1 Demographic Questionnaire

Averaged across the three data collection days, 94% of hematology residents reported between six to eight hours of sleep the night before the AHD. Using a five-point Likert scale, the majority of residents reported being "somewhat alert" prior to each AHD (M = 1.65, SD = .61), "somewhat interested" in the topic (M = 1.88, SD = .78), and "neutral" in terms of their prior familiarity with the topic (M = 2.59, SD = .87). In ob/gyn, 87% of residents reported between six to eight hours of sleep the night before the AHD, averaged across the three data collection days. Using a five-point Likert scale, the majority of residents reported being "neutral" in terms of their alertness prior to each AHD (M = 2.66, SD = 1.04), "somewhat interested" in the topic (M = 1.78, SD = .85), and "neutral" in terms of their prior familiarity with the topic (M = 2.54, SD = .93). Specific results pertaining to each AHD topic are presented in Table 3.

3.3.2 Effect of Instructional Method on Mind Wandering

This study yielded 303 out of a possible 331 unique observations of mind wandering over the course of three AHD sessions in two programs. Of these observations,

188 took place during didactic lecture, 89 during group discussion, and 26 during case-based learning, reflecting the relative amount of time presenters spent using each instructional method. The remaining 28 observations were missing because not all residents responded to every thought probe and were excluded from any further analyses.

A preliminary ANCOVA conducted on the existing individual observations revealed no significant main effects of program (hematology or ob/gyn), $F(1, 302) = 2.80$, $p = .10$; session number (i.e., whether the AHD occurred on the first, second, or third day of data collection), $F(2, 302) = .42$, $p = .66$; or instructional method (didactic lecture, group discussion, or case-based learning), $F(2, 302) = .95$, $p = .39$ on thought probe responses. Probe time was initially treated as a covariate in the model since mind wandering was expected to increase with time-on-task (e.g., Farley et al., 2013; Risko et al., 2012, 2013; Szpunar, Khan, et al., 2013), but was subsequently dropped because it was not significant in the analysis, $F(1, 302) = 1.42$, $p = .24$.

Given the non-significant main effects in the preliminary analysis, responses were collapsed across program, session number, and probe time to examine the effect of instructional method with greater statistical power. Thought probes were grouped by instructional method (i.e., whether they occurred during a didactic lecture, group discussion, or case-based learning session) and a mean mind wandering score (i.e., the proportion of probe responses where off-task thought was reported) was calculated for each. Mean mind wandering scores for didactic lecture, group discussion, and case-based learning were 0.33 ± 0.01, 0.23 ± 0.01, and 0.07 ± 0.05, respectively (Figure 1). At this stage, 15 participants in ob/gyn were dropped from the analysis because they did not

attend a sufficient number of data collection sessions for a mean mind wandering score to be calculated for each of the three instructional methods in the study.

Using the remaining participants (n = 21), a repeated measures ANOVA with the sphericity assumption met (Mauchly's test; $\chi^2(2, 40) = .47$, $p = .73$) and using participant means revealed a significant main effect of instructional method on mind wandering, $F(2, 40) = 6.53$, $p < .01$. Pairwise comparisons using the Bonferroni correction to correct for inflated Type I error as a result of multiple comparisons (Shaffer, 1995) revealed significantly lower mind wandering during case-based learning than during didactic lectures ($p = .03$). Other pairwise comparisons were not significant.

Qualitative observations made concurrently with the thought probes confirmed the quantitative findings in that residents seemed more attentive during case-based learning than during didactic lectures. While group discussions also seemed to result in more resident engagement than didactic lectures, the primary researcher observed that when a resident asked a question that prompted a lengthier (and sometimes tangential) discussion between them, a few other residents, and the presenter, other residents in the room would seemingly disengage by pulling out their phones, for example. This was particularly prevalent among residents in ob/gyn, the larger of the two programs under study.

Another interesting observation was that the physical layout of the room often seemed to influence engagement during AHDs. While in hematology AHDs the layout of the room was such that the presenter often sat among the residents and was able to make frequent eye contact with the residents, the layout in ob/gyn was considerably more like that of a traditional lecture where the presenter was standing at the front of the room, not

always making direct eye contact with each resident. In one AHD session that had a relatively high level of disengagement compared with the others, the presenter had elected to turn off all of the lights, was standing in one corner of the room as opposed to the middle, and relied exclusively on didactic lecturing. Furthermore, residents in both programs immediately became more attentive when the presenter indicated that something they had just said would be on their exam; however, in one case, a similar effect occurred when a presenter explained that his content would not be on their licensing exam but that it was something that "you wouldn't want to be caught not knowing…in practice."

Finally, it was interesting to note that some presenters prefaced their AHD session by telling the residents that they were not sure why they had been selected to present at the AHD, as they were not experts on the topic. While it was qualitatively difficult to tell whether or not this resulted in lower engagement during the AHD overall, it paralleled some of the comments heard during the ob/gyn focus group—for example:

> *We have a talk every so often where the staff is like, oh I'm not really comfortable giving this talk, or I'm not really the best person to give this talk. And I always think why isn't somebody else giving it, then?*

3.3.3 Type of Mind Wandering Reported

In addition to capturing if residents were paying attention to the material being presented by the lecturer in the moments just before the thought probe, the thought probes used in this study also attempted to capture the type of mind wandering that residents were engaging in when they reported being off-task (i.e., if their mind wandering was in some way related to the content being covered or if it was completely unrelated). Of all

reports of mind wandering that were recorded throughout the study, exactly half were classified as being related to the AHD content and half were classified as unrelated. There were no significant differences in the proportion of related versus unrelated bouts of mind wandering between the two programs (p = .23, Fisher's exact test). There were also no significant differences in the proportion of related versus unrelated bouts of mind wandering between the three instructional methods in neither hematology (p = .64, Fisher's exact test) nor ob/gyn (p = .41, Fisher's exact test). Specific proportions for each program and instructional method are provided in Table 4.

3.3.4 Effect of Training Level, Perceived Alertness, Interest in Topic, and Prior Familiarity with Topic on Mind Wandering

A subsequent set of ANOVAs was conducted to determine if there were any differences in mind wandering across the three data collection days in ob/gyn as a function of residents' level of training. This analysis was not performed using hematology data given that all of the residents in this program were at a relatively senior level of training. These analyses revealed no significant differences across years of training during the first, $F(3, 16) = .49$, p = .69, and third data collection days in ob/gyn, $F(2, 13) = 1.04$, p = .39. However, there was a significant difference across years of training during the second data collection day, $F(3, 18) = 7.25$, p = .03. Post-hoc tests (Tukey's HSD) revealed that fifth-year residents reported significantly less mind wandering than third- (p = .01) and fourth-year ($p < .01$) residents, but not second-year residents (.46).

The final analysis with respect to the present study examined whether or not there were any correlations between the measures on the demographic questionnaire and residents' self-reports of mind wandering. While correlations were determined for

perceived alertness, interest in topic, and prior familiarity with topic, a correlation could not be determined for hours of sleep prior to AHD due to a poorly designed survey question in which participants were asked to circle the range they fell into as opposed to give an absolute value. This considerably reduced the variability in participants' responses to this question since nearly all residents fell into the range of between six and eight hours, which prevented further analysis of these data.

Across all three AHD sessions included in the study, using Bonferroni-corrected *p*-values to account for multiple comparisons, there were no significant correlations between hematology residents' mind wandering scores and their perceived alertness, interest in the topic, or prior familiarity with the topic (Table 5). Similar results were obtained across the three AHD sessions in ob/gyn with no significant correlations between ob/gyn residents' mind wandering scores and their perceived alertness, interest in the topic, or prior familiarity with the topic, with the exception of a significant correlation between interest in the topic and mind wandering scores during the second data collection session, $r(16) = .70$, $p < .01$ (Table 5).

3.4 Discussion

The second study of this thesis used a quantitative approach to examine how three commonly-used instructional methods (didactic lecture, group discussion, and case-based learning) influenced mind wandering during AHDs. Combining results from both specialties since there was no main effect of program on mind wandering, residents mind wandered approximately 33%, 23%, and 7% of the time during didactic lectures, group discussions, and case-based learning, respectively. The rate of mind wandering observed

throughout didactic lecturing in the present study (approximately 33% of the time using thought probes) is coincidentally identical to that the rate of mind wandering observed in a large classroom study conducted by Wammes, Boucher, et al. (2016), although somewhat lower than previously reported in other studies conducted in educational settings (e.g., 41-43% in Risko et al., 2012; Szpunar, Khan, et al., 2013).

Both the present study and the study by Wammes, Boucher, et al. (2016) were conducted in authentic classroom environments, whereas other work examining the rates of mind wandering of the course of a lecture did so using prerecorded video lectures whose content did not matter outside of the given laboratory task, which could potentially have resulted in inflated levels of mind wandering. Moreover, while other studies have not yet examined the effect of student-centered instructional methods on mind wandering using the same methodology as the present study, comparable results were reported by Bunce et al. (2010) who found that students reported fewer bouts of off-task thought in chemistry lectures when active (demonstrations and quiz questions) rather than passive (didactic lecturing) instructional methods were used (see also Young et al., 2009). Therefore, while rates of mind wandering during case-based learning and group discussions could not be compared with other studies in absolute terms, the overall rates of mind wandering obtained in the present study appear to be relatively consistent with the existing literature on mind wandering in the classroom.

3.4.1 Rates of Mind Wandering Over Time

Interestingly, like Wammes, Boucher, et al. (2016), the present study did not find that mind wandering increased over the course of an AHD. This is striking considering

the previously outlined prevalence of literature demonstrating an increase in mind wandering over time across both laboratory and non-laboratory (i.e., educationally-relevant) tasks and the length of an average AHD (up to four hours; Chalk, 2004), although the AHDs selected for consideration in the present study may have been shorter than what is typical in most programs. Thus, as suggested by Wammes, Boucher, et al. (2016), it is "*not* that increments in mind wandering over time do not occur in many contexts…[but rather] that mind wandering increments over time-on-task are *not necessary* outcomes of attention-demanding tasks, within the parameters that characterize traditional lectures" (p. 11). For example, live presentations are generally more engaging than most "talking-head" video lectures, and students may also be more motivated to learn in authentic classroom environments than during laboratory tasks that have no real-life importance (Hancock, 2013; Kurzban et al., 2013; Wammes, Boucher, et al., 2016).

Moreover, during live lectures, presenters have the ability to continuously monitor students' overall level of engagement and modify their method of instruction accordingly (Wammes, Boucher, et al., 2016). This illustrates some of the differences that may exist between studies of mind wandering conducted in the laboratory versus those conducted in authentic classroom environments and brings to light potential challenges around ecological validity in laboratory-based studies of mind wandering. It may also have interesting implications for resident engagement during prerecorded video lectures, which are becoming more prevalent in medical education and therefore merit further study (Ruiz, Mintzer, & Leipzig, 2006).

3.4.2. Active vs. Passive Instructional Methods

The findings of the present study clearly pointed towards a reduction in mind wandering during more active instructional methods such as case-based learning and group discussion, as compared with passive methods such as didactic lecturing. As indicated above, this is well-supported by findings from other studies, such as by Bunce et al. (2010) and Young et al. (2009). Given that mind wandering tends to occur most often during cognitively undemanding tasks (Smallwood et al., 2003) and tasks that people find uninteresting (Smallwood et al., 2009), it is logical that instructional methods that requires students to participate more actively would result in less mind wandering than those in which students are simply passive recipients of information. Moreover, given that the mind tends to attend to wherever the most salient cues exist—be they internal or external—there is likely benefit to using more than one instructional method during AHD, as doing so may help to "reset" students' attention (Smallwood & Schooler, 2006). However, presenters should also be mindful that they monitor students' attention even during more active instructional methods, considering that the qualitative observations in the present study revealed some of the nuances of these approaches. For example, during group discussions, residents were initially attentive but tended to disengage when the presenter was asked a question and engaged in a lengthy discussion with only a few residents as opposed to the whole class.

3.4.3 Type of Mind Wandering Reported

Although there were no differences in the type of mind wandering reported across program or instructional method, it is interesting to note that approximately half of the

occurrences of mind wandering reported in the study as a whole were reported as being related in some way to the AHD content. This could have represented times when residents were thinking back to earlier segments of the AHD session or relating the content to their own clinical experiences. Although the present study did not examine the effect of mind wandering on resident learning of the content taught during AHDs, it is possible that related versus unrelated bouts of mind wandering may each affect learning differently. In fact, recent work by Jing, Szpunar, and Schacter (2016) suggests that this is likely to be the case—the authors demonstrated that lecture-related thoughts during a video-recorded lecture were positively related to performance on a final test while lecture-unrelated thoughts were negatively related. Therefore, while this is beyond the scope of the study presented in this thesis, the role of content-related versus content-unrelated bouts of mind wandering in educational environments merits further study.

3.4.4 Effect of Training Level, Perceived Alertness, Interest in Topic, and Prior Familiarity with Topic on Mind Wandering

The present study did not determine a relationship between ob/gyn residents' level of training and mind wandering scores, with the exception of the second data collection day, during which fifth-year residents reported significantly less mind wandering than third- and fourth-year residents, but not second-year residents. While it was hypothesized that residents who were more senior in their training would be more likely to pay attention to material presented during AHDs since they would be writing their licensing examination within a few months, this did not appear to be the case during the majority of the AHD sessions. A potential explanation may be that second-year residents were attentive because the material was relatively new for them, while third- and fourth-year

residents were more familiar with the material and were potentially more focused on their clinical rotations, which may not have been completely aligned with the AHD content.

There were also no significant correlations between residents' mind wandering scores and their perceived alertness, interest in the topic, and prior familiarity with the topic in either program, with the exception of one data collection session in ob/gyn in which there were significant correlations between interest in the topic and mind wandering scores. However, this may simply be an artifact of the analysis and not educationally relevant, particularly given the small sample sizes used in the correlational analysis and the potential lack of statistical power.

Besides statistical underpowering, the lack of significant correlations between the demographic questionnaire results and mind wandering scores may have been because residents' mind wandering levels depended more on the events that took place during AHD—for example, how engaging the speaker was—than the baseline measures captures by the demographic questionnaire. Moreover, for the most part, residents' responses did not tend towards either extreme on the questionnaire, indicating that they were either relatively neutral with respect to each measure on the questionnaire or that there was some degree of response bias (i.e., residents filling out the survey as quickly as possible as opposed to giving accurate responses). However, the latter is unlikely to be the case as the demographic questionnaire was short and successfully captured hematology residents' lack of familiarity with porphyria and ob/gyn residents' strong interest in second trimester abortion, both of which were things residents talked about informally with one another as the primary researcher was observing the AHD session.

3.4.5 Limitations

A considerable limitation of the present study was the lack of experimental control over the AHDs selected for inclusion. While the primary researcher sought permission from each presenter to conduct the study during their AHD session, she had no influence over the instructional methods used by the presenters, nor the content that they were presenting. Although this likely enhanced the ecological validity of this work, it also made controlling for a variety of external factors nearly impossible. For example, there were an uneven number of thought probes per instructional method (188 during didactic lecture, 89 during group discussion, and 26 during case-based learning) because presenters used didactic lectures more commonly than group discussions and case-based learning. Moreover, given that each AHD session had a different presenter and a different topic, there were differences in terms of presenters' teaching skill as well as differences in the nature of the content presented across the different AHD sessions that could not be controlled for. However, it is pertinent to note that the significant difference found between case-based learning and didactic lecturing with respect to mind wandering scores held despite having mind wandering scores collapsed across the different AHD sessions.

Second, with respect to the selection of AHDs for inclusion in the study was that due to scheduling difficulties and challenges around presenter consent, thought probes could only be administered during one topic on two of the data collection days in ob/gyn, and the remaining data collection day only had one topic and presenter. This is not fully representative of typical AHDs in ob/gyn, which typically have two topics and presenters back-to-back with a short break in between and can be up to three hours in length.

Furthermore, it was noted in hematology that while presenters were allotted up to three hours to present their AHD topic, the majority took less than the maximum time allotment provided (in the sample of hematology AHDs selected for inclusion in this study, the shortest session was 1 h 15 min and the longest was 2 h 30 min). Therefore, this length of AHD may have been shorter than is typical for some programs, which may have AHDs that are up to four hours in length (Chalk, 2004).

Third, as described in Chapter 1, Section 1.4, while thought probes are currently the most feasible way of measuring mind wandering in studies of cognition, there are limitations inherent to using this approach—primarily, that thought probes require participants to self-report their current cognitive state. This may be subject to response bias (e.g., due to issues of social desirability) or may be inaccurate if participants are unaware of their cognitive state (Schooler et al., 2011). Moreover, it is currently unclear as to what effect the use of thought probes may have on participants' attention (Seli et al., 2013), and in fact, could influence in both ways (by one line of reasoning, participants may be more attentive if they know that they are being monitored; by another, they may find the thought probes distracting and have more difficulty paying attention). For example, in this particular study, thought probes were administered systematically every 15 plus/minus three minutes in order to allow the presenter to finish his or her main idea prior to the onset of the probe. Residents may have been more attentive at these points in time not only because of the systematic presentation of the thought probes, but also because the probes were more likely to occur at the end of an idea unit as opposed to the beginning or middle. These factors might potentially have resulted in an underestimate of

mind wandering during AHDs. Therefore, these limitations pertaining to the use of thought probes call for a need to continue the development of more objective measures of mind wandering (e.g., behavioural markers such as gaze duration, reaction time, and performance errors; physiological measures such as pupil dilation and heart rate; and brain activity), which ideally could be used to corroborate findings and gain a better understanding of mind wandering in educational settings as well as in other contexts.

Finally, with respect to the present study pertained to the correlational analyses and demographic questionnaire reported on in Section 3.3.4, there is a strong possibility that the correlational analyses were underpowered given the small sample sizes used. Moreover, a correlation between hours of sleep prior to the AHD and mind wandering scores could not be calculated due to a poorly designed survey question that asked question to circle the range they fell into as opposed to give an absolute value. This considerably reduced the variability in participants' responses to this question since nearly all residents fell into the range of between six and eight hours, which prevented further analysis of these data. The ranges provided were also not ideal, given literature suggesting that the optimal number of hours per sleep per night is seven, with fewer hours resulting in poorer performance and memory in the short-run and increased mortality risks in the long-run (Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002). ✣

CHAPTER 4: GENERAL DISCUSSION

This thesis sought to examine mind wandering during AHDs, with the overarching goal of understanding how results might inform the design of classroom-based teaching sessions in postgraduate medical education. The first study of this thesis examined residents' perceptions about the nature of their learning experience during AHDs via two focus groups. Findings revealed that while hematology residents were more positive in their perceptions of AHDs and felt that they provided a useful opportunity for learning, ob/gyn residents tended to focus on the shortcomings of their AHDs and had more difficulty paying attention. Nonetheless, both groups agreed on several ways in which AHDs could be improved and more specifically, felt that presenters could increase resident engagement during AHDs by spending more time on case-based learning and group discussions as compared with didactic lectures. These findings were supported by the results of the second study of this thesis, which was able to demonstrate significantly lower self-reported mind wandering during case-based learning than during didactic lectures. Mind wandering also appeared to be lower during group discussions than didactic lectures, although this difference was not significant.

Taken together, the two studies in this thesis provide some insight into how AHDs may be better designed and delivered to optimize resident engagement and learning. Findings from the focus groups illustrated that residents—especially those in a larger, more general training program—perceive a number of challenges with AHDs that have previously been identified in the literature including the lack of a core curriculum; content that, at times, seems irrelevant; concerns related to a lack of teaching development for

faculty; and difficulties paying attention for a variety of reasons, which was often "just life" for many the residents. Although overall perceptions of AHDs were certainly contextual and depended on residents' programs, resident concerns about the effectiveness of AHDs were evident in the findings from both focus groups.

Given the many different things may be competing for residents' attention during AHDs, trying to completely eliminate mind wandering in this or any other classroom environment is almost certainly futile (Pachai et al., 2016). However, factors under a presenter's control—such as their chosen instructional method—may play an important role in maintaining resident engagement during AHDs. **Indeed, both the qualitative and quantitative results in this thesis point to the fact that incorporating more active learning into AHDs will likely help drive improvements in resident engagement.** It is important to note that this is not suggesting that presenters eliminate didactic lecturing entirely, but rather that they aim to use a variety of instructional methods throughout the AHD to keep residents engaged.

While the results of this thesis suggested that case-based learning was most effective in reducing mind wandering, other instructional methods exist and may merit further study in the context of AHDs. For example, ob/gyn residents suggested interspersing low-stakes quiz questions throughout the lecture, which has been shown to be effective in reducing mind wandering in other classroom contexts (Szpunar, Khan, et al., 2013). In addition, Pachai et al. (2016) suggest that giving students periodic breaks during longer lectures may in fact be the most potent intervention for reducing mind wandering in the classroom.

The results also point to a broader need for programs to periodically review their AHD curricula and ensure that stated objectives are being met. Classroom-based learning sessions such as AHDs represent a substantial time commitment on part of residents and faculty; thus, it is important that this protected teaching time be used as effectively as possible, particularly in light of changes to changes to the healthcare system that have resulted in fewer clinical learning opportunities for residents. **Programs may find it beneficial to involve residents in designing AHD curricula that addresses not only residents' need to prepare for their licensing examination, but also the broader outcome of teaching residents knowledge and skills that will benefit them in their future clinical practice.** Both goals can reasonably be accomplished with well-designed AHD curricula, but require that programs and residents work together to understand each other's needs and develop mutually beneficial solutions. Some examples are to more frequently involve residents as presenters during AHDs, a suggestion made during the ob/gyn focus group, or to have them assist in the creation or curating of resources pertaining to AHDs (e.g., maintaining a central web repository of past AHD notes or developing quiz questions that can be used during AHD sessions).

A final implication of this work is the need for greater faculty development around teaching skills given that at present, clinical faculty who are selected to present at AHDs do not typically receive any prior training and may at times even be asked to speak not because of their area of expertise, but because of their teaching availability. During the focus groups, residents clearly identified that while some presenters were very good speakers, others were not and "you can tell." In fact, it is entirely possible that factors

such as the capability and interestingness of the presenter are as important, if not more important, than the type of instructional method that a presenter chooses to use. Simply put, using active instructional methods is unlikely to be a viable replacement for poor teaching quality. **Therefore, presenters may benefit from more explicit faculty development with respect to teaching.** Besides using more active instructional methods, other suggestions for presenters include: paying attention to their physical presence in the room, including where they are sitting or standing with respect to residents (removing themselves from the direct line of sight of residents or not making eye contact may promote disengagement); ensuring that residents understand the importance of all content being presented by making the relevance to clinical practice explicit; and avoiding prefacing lectures by downplaying their expertise in the topic and suggesting that they may not be the best person to present (while this may be true, it does not set a good precedent for the AHD session and may serve to normalize disengagement). Moreover, it may be prudent for programs to keep track of past AHD presenters and resident feedback in order to decide whom to invite back in subsequent years. This approach was one that was taken by one of the programs in this study (hematology) and seemed to result in higher quality presentations overall.

As substantial changes in residency education take shape, in particular the shift to a competency-based training system, classroom-based teaching sessions such as AHD will have a continued, if not more important, role in conferring key training objectives. Given reductions in resident duty hours and fewer opportunities for clinical learning in general, it will be important to ensure that non-clinical learning opportunities such as

AHDs are as effective as possible. As such, there will be a continued need to examine this and other aspects of residency education to ensure that residents are being properly equipped with the knowledge and skills needed to be effective in the rapidly changing healthcare environment of the twenty-first century. ✣

TABLES AND FIGURES

Table 1. Summary of focus group results exploring hematology and ob/gyn residents' perceptions of learning during AHDs.

	Hematology	Ob/Gyn
Overall perceptions of AHDs	Hematology residents were positive in their perceptions of AHDs and felt that they provided a useful opportunity for learning.	Ob/gyn residents indicated several shortcomings of AHDs, including the lack of a core curriculum; content, that at times, did not seem relevant to their clinical practice; and concerns related to a lack of teaching development for faculty.
Perceptions of instructional methods used during AHDs	Both groups agreed that presenters could increase resident learning and engagement during AHDs by spending more time on case-based learning and group discussions as opposed to didactic lectures.	
Perceptions of attention during AHDs	Hematology residents did not feel that it was particularly difficult to pay attention during AHDs and felt more accountable for doing so as a result of their small program size.	Ob/gyn residents identified mind wandering as a barrier to their learning during AHDs. Contributing factors included the presenter's presentation skills, the relevance of the content being presented, and how tired they felt during the AHD.
Motivations for learning	Residents in both programs were highly motivated to learn AHD content that they expected to be tested on and seemed to feel that the primary purpose of AHDs was to prepare them for their licensing examinations. However, residents in the hematology focus group also described a second, broader role of AHDs with respect to preparing them for clinical practice.	

Table 2. Topics covered in AHDs selected for inclusion in the study.

Hematology	Ob/Gyn
1. Ethics Frameworks (2 h 30 min)	1. Second Trimester Abortion (1 h 15 min)
2. Pre-Transplant Screening (1 h 35 min)	2. Gametogenesis and Embryogenesis (1 h 15 min)
3. Porphyria (1 h 15 min)	3. Gynecological Emergencies (1 h)

Table 3. Results of the demographic questionnaire administered at the beginning of each AHD in the quantitative study. Responses to each question (besides hours of sleep) were given on a five-point Likert scale (1 = very alert/interested/familiar, 5 = not at all alert/interested/familiar).

Measure	Hematology	Ob/Gyn
	Topic 1: **Ethics Frameworks**	**Topic 1:** **Second Trimester Abortion**
Hours of sleep the night before	100% of residents: between 6-8 h	94% of residents: between 6-8 h 6% of residents: between 3-5 h
Perceived alertness	"Somewhat alert" *M* = 1.83, *SD* = .75	"Neutral" *M* = 2.72, *SD* = 1.27
Interest in the topic	"Somewhat interested" *M* = 1.83, *SD* = .75	"Very interested" *M* = 1.45, *SD* = .69
Prior familiarity with the topic	"Somewhat familiar" *M* = 2.00, *SD* = 0	"Neutral" *M* = 2.72, *SD* = .90
	Topic 2: **Pre-Transplant Screening**	**Topic 2:** **Gametogenesis and Embryogenesis**
Hours of sleep the night before	83% of residents: between 6-8 h 17% of residents: between 3-5 h	81% of residents: between 6-8 h 19% of residents: between 3-5 h
Perceived alertness	"Somewhat alert" *M* = 1.50, *SD* = .55	"Neutral" *M* = 2.69, *SD* = 1.01
Interest in the topic	"Somewhat interested" *M* = 1.67, *SD* = .81	"Somewhat interested" *M* = 2.25, *SD* = 1.00
Prior familiarity with the topic	"Neutral" *M* = 2.50, *SD* = .84	"Neutral" *M* = 2.88, *SD* = .89
	Topic 3: **Porphyria**	**Topic 3:** **Gynecological Emergencies**
Hours of sleep the night before	100% of residents: between 6-8 h	86% of residents: between 6-8 h 14% of residents: between 3-5 h
Perceived alertness	"Somewhat alert" *M* = 1.60, *SD* = .55	"Neutral" *M* = 2.57, *SD* = .94
Interest in the topic	"Somewhat interested" *M* = 2.20, *SD* = .84	"Somewhat interested" *M* = 1.50, *SD* = .52
Prior familiarity with the topic	"Not very familiar" *M* = 3.40, *SD* = .89	"Somewhat familiar" *M* = 2.00, *SD* = .78

Table 4. Type of mind wandering (MW; related vs. unrelated to the AHD material) reported by program and instructional method. The number of observations of each is presented in brackets beside each proportion.

Program	Type of MW	Lecture	Group Discussion	Case-Based Learning	Overall
Hematology	Related	.69 (9)	.50 (5)	1.00 (1)	.63 (15)
	Unrelated	.31 (4)	.50 (5)	--	.38 (9)
Ob/gyn	Related	.42 (22)	.55 (6)	1.00 (1)	.45 (29)
	Unrelated	.58 (30)	.45 (5)	--	.55 (35)

Table 5. Correlation of demographic questionnaire results with mind wandering scores (proportion of thought probes where mind wandering was reported) by topic and specialty. *$p < 0.05$, Bonferroni corrected p-values.

Measure	Hematology	Ob/Gyn
	Topic 1: **Ethics Frameworks**	**Topic 1:** **Second Trimester Abortion**
Perceived alertness	$r(6) = -.65, p = .48$	$r(11) = -.28, p = 1.00$
Interest in the topic	$r(6) = -.86, p = .09$	$r(11) = -.16, p = 1.00$
Prior familiarity with the topic	$r(6) = .00, p = 1.00$	$r(11) = -.17, p = 1.00$
	Topic 2: **Pre-Transplant Screening**	**Topic 2:** **Gametogenesis and Embryogenesis**
Perceived alertness	$r(6) = .41, p = 1.00$	$r(16) = .12, p = 1.00$
Interest in the topic	$r(6) = .00, p = 1.00$	$r(16) = .70, p < .03$*
Prior familiarity with the topic	$r(6) = -.27, p = 1.00$	$r(16) = .23, p = 1.00$
	Topic 3: **Porphyria**	**Topic 3:** **Gynecological Emergencies**
Perceived alertness	$r(5) = .00, p = 1.00$	$r(14) = .041, p = 1.00$
Interest in the topic	$r(5) = .78, p = .36$	$r(14) = -.52, p = .18$
Prior familiarity with the topic	$r(5) = .51, p = 1.00$	$r(14) = .11, p = 1.00$

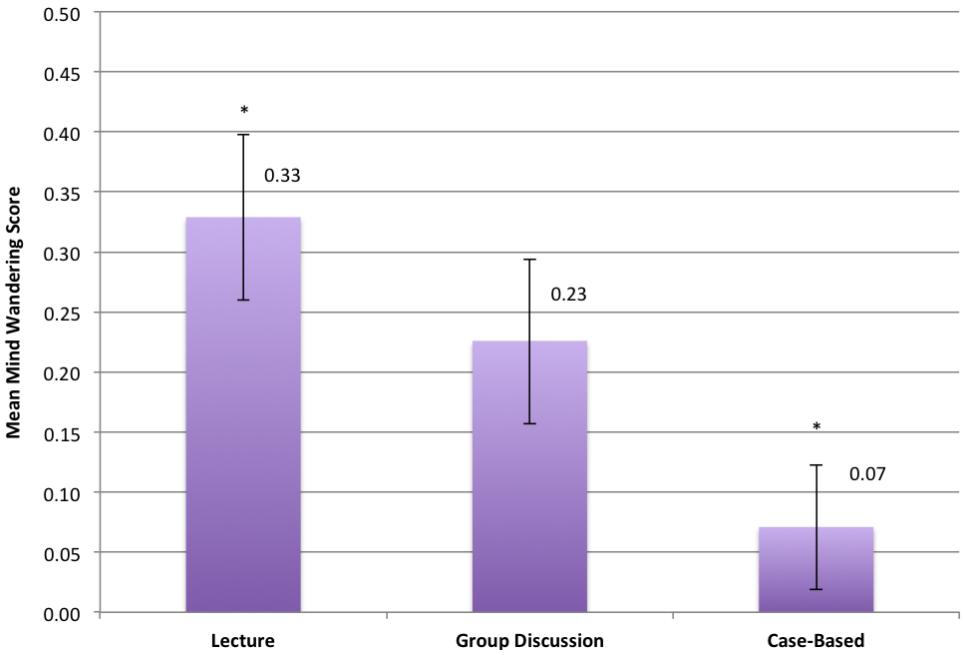

Figure 1. Mean mind wandering score (proportion of thought probes where mind wandering was reported) by instructional method. Error bars represent the standard error of the mean. *$p < 0.05$.

REFERENCES

(RCPSC), Royal College of Physicians and Surgeons of Canada. (2003). *Accreditation committee position paper on service and education in residency education*. Ottawa, ON. Retrieved from http://www.royalcollege.ca/portal/page/portal/rc/common/documents/accreditation/service_education_e.pdf

(RCPSC), Royal College of Physicians and Surgeons of Canada. (2016). An interative and adaptive approach to CBD implementation. Retrieved from http://www.royalcollege.ca/rcsite/cbd/implementation-cbd-e

Antrobus, J. S., Singer, J. L., & Greenberg, S. (1966). Studies in the stream of consciousness: Experimental enhancement and suppression of spontaneous cognitive processes. *Perceptual and Motor Skills*, *23*(2), 399–417. http://doi.org/10.2466/pms.1966.23.2.399

Baird, B., Smallwood, J., Mrazek, M. D., Kam, J. W. Y., Franklin, M. S., & Schooler, J. W. (2012). Inspired by distraction: Mind wandering facilitates creative incubation. *Psychological Science*, *23*(10), 1117–1122. http://doi.org/10.1177/0956797612446024

Baird, B., Smallwood, J., & Schooler, J. W. (2011). Back to the future: Autobiographical planning and the functionality of mind-wandering. *Consciousness and Cognition*, *20*(4), 1604–1611. http://doi.org/10.1016/j.concog.2011.08.007

Barbour, R. S. (2005). Making sense of focus groups. *Medical Education*, *39*(7), 742–750. http://doi.org/10.1111/j.1365-2929.2005.02200.x

Batalden, M. K., Warm, E. J., & Logio, L. S. (2013). Beyond a curricular design of convenience: Replacing the noon conference with an academic half day in three internal medicine residency programs. *Academic Medicine*, *88*(5), 644–651. http://doi.org/10.1097/ACM.0b013e31828b09f4

Beach, M. C., Roter, D., Korthuis, P. T., Epstein, R. M., Sharp, V., Ratanawongsa, N., … Saha, S. (2013). A multicenter study of physician mindfulness and health care quality. *Annals of Family Medicine*, *11*(5), 421–428. http://doi.org/10.1370/afm.1507

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. http://doi.org/10.1191/1478088706qp063oa

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. http://doi.org/10.1037/0022-3514.84.4.822

Bunce, D. M., Flens, E. A., & Neiles, K. Y. (2010). How long can students pay attention in class? A study of student attention decline using clickers. *Journal of Chemical Education*, *87*(12), 1438–1443. http://doi.org/10.1021/ed100409p

Chalk, C. (2004). The academic half-day in Canadian neurology residency programs. *The Canadian Journal of Neurological Sciences/Le Journal Canadien Des Sciences Neurologiques*, *31*(4), 511–513.

Chen, L. Y. C., McDonald, J. A., Pratt, D. D., Wisener, K. M., & Jarvis-Selinger, S. (2015). Residents' views of the role of classroom-based learning in graduate medical education through the lens of academic half days. *Academic Medicine*, *90*(4), 532–

538. http://doi.org/10.1097/ACM.0000000000000605

Davies, S. (2012). Embracing reflective practice. *Education for Primary Care*, *23*(1), 9–12. http://doi.org/10.1080/14739879.2012.11494064

Densen, P. (2011). Challenges and opportunities facing medical education. *Transactions of the American Clinical and Climatological Association*, *122*, 48–58.

Department of Medicine, McMaster University. (2016). Overview & rotation description: Hematology and thromboembolism residency program. Retrieved from http://fhs.mcmaster.ca/medicine/hematology/residency/rotation_overview.htm

Department of Obstetrics and Gynecology, McMaster University. (2016). Education overview: Obstetrics and gynecology residency program. Retrieved from http://obgyn.mcmaster.ca/education/

Eid, A., Hsieh, P., Shah, P., & Wolff, R. (2015). Cross-sectional longitudinal study of the academic half-day format in a hematology-oncology fellowship training program. *BMC Medical Education*, *15*(139). http://doi.org/10.1186/s12909-015-0418-y

Epstein, R. M. (2007). Assessment in medical education. *The New England Journal of Medicine*, *356*(4), 387–396. http://doi.org/10.1056/NEJMra054784

Eva, K. W., & Regehr, G. (2005). Self-assessment in the health professions: A reformulation and research agenda. *Academic Medicine*, *80*(10 Suppl), S46–S54.

Eva, K. W., & Regehr, G. (2008). "I'll never play professional football" and other fallacies of self-assessment. *The Journal of Continuing Education in the Health Professions*, *28*(1), 14–19. http://doi.org/10.1002/chp.150

Farley, J., Risko, E. F., & Kingstone, A. (2013). Everyday attention and lecture retention:

The effects of time, fidgeting, and mind wandering. *Frontiers in Psychology*, *4*(September). http://doi.org/10.3389/fpsyg.2013.00619

Fortney, L., Luchterhand, C., Zakletskaia, L., Zgierska, A., & Rakel, D. (2013). Abbreviated mindfulness intervention for job satisfaction, quality of life, and compassion in primary care clinicians: A pilot study. *Annals of Family Medicine*, *11*(5), 412–420. http://doi.org/10.1370/afm.1511

Frank, J. R., Snell, L. S., Cate, O. Ten, Holmboe, E. S., Carraccio, C., Swing, S. R., … Harris, K. A. (2010). Competency-based medical education: Theory to practice. *Medical Teacher*, *32*(8), 638–45. http://doi.org/10.3109/0142159X.2010.501190

Frank, J. R., Snell, L. S., & Sherbino, J. (2015). *CanMEDS 2015 physician competency framework*. Ottawa, ON. Retrieved from http://canmeds.royalcollege.ca/uploads/en/framework/CanMEDS 2015 Framework_EN_Reduced.pdf

Gruppen, L. D., Mangrulkar, R. S., & Kolars, J. C. (2012). The promise of competency-based education in the health professions for improving global health. *Human Resources for Health*, *10*(1). http://doi.org/10.1186/1478-4491-10-43

Guze, P. A. (2015). Using technology to meet the challenges of medical education. *Transactions of the American Clinical and Climatological Association*, *126*, 260–270.

Ha, D., Faulx, M., Isada, C., Kattan, M., Yu, C., Olender, J., … Brateanu, A. (2014). Transitioning from a noon conference to an academic half-day curriculum model: Effect on medical knowledge acquisition and learning satisfaction. *Journal of*

Graduate Medical Education, *6*(1), 93–99. http://doi.org/10.4300/JGME-D-13-00185.1

Hancock, P. A. (2013). In search of vigilance: The problem of iatrogenically created psychological phenomena. *The American Psychologist*, *68*(2), 97–109. http://doi.org/10.1037/a0030214

Hartzell, J. D. (2007). Adult learning theory in medical education. *The American Journal of Medicine*, *120*(11), e11; author reply e13.

Hodges, B. D. (2010). A tea-steeping or i-Doc model for medical education? *Academic Medicine*, *85*(9 Suppl), S34–S44. http://doi.org/10.1097/ACM.0b013e3181f12f32

James, W. (1983). *The principles of psychology*. Cambridge, MA: Harvard University Press.

Jing, H. G., Szpunar, K. K., & Schacter, D. L. (2016). Interpolated testing influences focused attention and improves integration of information during a video-recorded lecture. *Journal of Experimental Psychology: Applied*. http://doi.org/10.1037/xap0000087

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry*, *4*(1), 33–47. http://doi.org/10.1016/0163-8343(82)90026-3

Kane, M. J., & Engle, R. W. (2002). The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual-differences perspective. *Psychonomic Bulletin & Review*, *9*(4), 637–671.

http://doi.org/10.3758/BF03196323

Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review*, *1*(2), 147–172. http://doi.org/10.1007/BF01326640

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, *330*(6006), 932. http://doi.org/10.1126/science.1192439

King, M. F., & Bruner, G. C. (2000). Social desirability bias: A neglected aspect of validity testing. *Psychology and Marketing*, *17*(2), 79–103. http://doi.org/10.1002/(SICI)1520-6793(200002)17:2<79::AID-MAR2>3.0.CO;2-0

Klinger, E., Gregoire, K. C., & Barta, S. G. (1973). Physiological correlates of mental activity: Eye movements, alpha, and heart rate during imagining, suppression, concentration, search, and choice. *Psychophysiology*, *10*(5), 471–477. http://doi.org/10.1111/j.1469-8986.1973.tb00534.x

Krasner, M. S., Epstein, R. M., Beckman, H., Suchman, A. L., Chapman, B., Mooney, C. J., & Quill, T. E. (2009). Association of an educational program in mindful communication with burnout, empathy, and attitudes among primary care physicians. *JAMA*, *302*(12), 1284–1293. http://doi.org/10.1001/jama.2009.1384

Kripke, D. F., Garfinkel, L., Wingard, D. L., Klauber, M. R., & Marler, M. R. (2002). Mortality associated with sleep duration and insomnia. *Archives of General Psychiatry*, *59*(2), 131–136. http://doi.org/10.1001/archpsyc.59.2.131

Kurzban, R., Duckworth, A., Kable, J. W., & Myers, J. (2013). An opportunity cost model of subjective effort and task performance. *The Behavioral and Brain*

Sciences, *36*(6), 661–679. http://doi.org/10.1017/S0140525X12003196

Lincoln, Y. S., & Guba, E. G. (1984). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications.

Lindquist, S. I., & McLean, J. P. (2011). Daydreaming and its correlates in an educational environment. *Learning and Individual Differences*, *21*(2), 158–167. http://doi.org/10.1016/j.lindif.2010.12.006

Mayor, S. (2002). UK royal colleges publish competency based curriculums. *BMJ*, *325*(7377), 1378.

McClean, K. L., Card, S. E., & D'Eon, M. (2006). Re-vitalizing the academic half day: Improving academic teaching and learning in residency education. *Canadian Association for Medical Education Newsletter*, *16*(1), 3–7. Retrieved from http://www.came-acem.ca/docs/newsletters/16_1/newsletter_16_1_en.pdf

McVay, J. C., & Kane, M. J. (2009). Conducting the train of thought: Working memory capacity, goal neglect, and mind wandering in an executive-control task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *35*(1), 196–204. http://doi.org/10.1037/a0014104

McVay, J. C., & Kane, M. J. (2010). Does mind wandering reflect executive function or executive failure? Comment on Smallwood and Schooler (2006) and Watkins (2008). *Psychological Bulletin*, *136*(2), 188–197; discussion 198–207. http://doi.org/10.1037/a0018298

McVay, J. C., & Kane, M. J. (2012). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and

executive attention. *Journal of Experimental Psychology: General*, *141*(2), 302–320. http://doi.org/10.1037/a0025250

Monsell, S. (2003). Task switching. *Trends in Cognitive Sciences*, *7*(3), 134–140. http://doi.org/10.1016/S1364-6613(03)00028-7

Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie Expérimentale*, *67*(1), 11–18. http://doi.org/10.1037/a0031569

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science*, *24*(5), 776–781. http://doi.org/10.1177/0956797612459659

Mrazek, M. D., Phillips, D. T., Franklin, M. S., Broadway, J. M., & Schooler, J. W. (2013). Young and restless: Validation of the Mind-Wandering Questionnaire (MWQ) reveals disruptive impact of mind-wandering for youth. *Frontiers in Psychology*, *4*(August), 1–7. http://doi.org/10.3389/fpsyg.2013.00560

Mrazek, M. D., Smallwood, J., Franklin, M. S., Chin, J. M., Baird, B., & Schooler, J. W. (2012). The role of mind-wandering in measurements of general aptitude. *Journal of Experimental Psychology: General*, *141*(4), 788–798. http://doi.org/10.1037/a0027968

Norman, G. R. (1999). The adult learner: A mythical species. *Academic Medicine*, *74*(8), 886–889.

Pachai, A. A., Acai, A., LoGiudice, A. B., & Kim, J. A. (2016). The mind that wanders: Challenges and benefits of mind wandering in education. *Scholarship of Teaching and Learning in Psychology*, *2*(2), 134–146. http://doi.org/10.1037/stl0000060

Reznick, R. K., & MacRae, H. (2006). Teaching surgical skills—changes in the wind. *The New England Journal of Medicine*, *355*(25), 2664–2669. http://doi.org/10.1056/NEJMra054785

Risko, E. F., Anderson, N., Sarwal, A., Engelhardt, M., & Kingstone, A. (2012). Everyday attention: Variation in mind wandering and memory in a lecture. *Applied Cognitive Psychology*, *26*(2), 234–242. http://doi.org/10.1002/acp.1814

Risko, E. F., Buchanan, D., Medimorec, S., & Kingstone, A. (2013). Everyday attention: Mind wandering and computer use during lectures. *Computers and Education*, *68*(October), 275–283. http://doi.org/10.1016/j.compedu.2013.05.001

Ruby, F. J. M., Smallwood, J., Sackur, J., & Singer, T. (2013). Is self-generated thought a means of social problem solving? *Frontiers in Psychology*, *4*(December). http://doi.org/10.3389/fpsyg.2013.00962

Ruiz, J. G., Mintzer, M. J., & Leipzig, R. M. (2006). The impact of E-learning in medical education. *Academic Medicine*, *81*(3), 207–212.

Schön, D. (1983). *The reflective practitioner: How professionals think in action*. London, UK: London, Temple Smith.

Schooler, J. W., Mrazek, M. D., Franklin, M. S., Baird, B., Mooneyham, B. W., Zedelius, C., & Broadway, J. M. (2014). The middle way: Finding the balance between mindfulness and mind-wandering. In B. H. Ross (Ed.), *The Psychology of Learning*

and Motivation, Vol. 60 (pp. 1–33). Burlington, MA: Academic Press. Retrieved from https://labs.psych.ucsb.edu/schooler/jonathan/sites/labs.psych.ucsb.edu.schooler.jonathan/files/pubs/middle_way.pdf

Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Sciences*, *15*(7), 319–326. http://doi.org/10.1016/j.tics.2011.05.006

Seli, P., Carriere, J. S. A., Levene, M., & Smilek, D. (2013). How few and far between? Examining the effects of probe rate on self-reported mind wandering. *Frontiers in Psychology*, *4*(July). http://doi.org/10.3389/fpsyg.2013.00430

Seli, P., Risko, E. F., & Smilek, D. (2016). On the necessity of distinguishing between unintentional and intentional mind wandering. *Psychological Science*, *27*(5), 685–691. http://doi.org/10.1177/0956797616634068

Shaffer, J. P. (1995). Multiple hypothesis testing. *Annual Review of Psychology*, *46*, 561–584. http://doi.org/10.1146/annurev.ps.46.020195.003021

Smallwood, J. (2013). Distinguishing how from why the mind wanders: A process-occurrence framework for self-generated mental activity. *Psychological Bulletin*, *139*(3), 519–535. http://doi.org/10.1037/a0030010

Smallwood, J., McSpadden, M., & Schooler, J. W. (2008). When attention matters: The curious incident of the wandering mind. *Memory and Cognition*, *36*(6), 1144–1150. http://doi.org/10.3758/MC.36.6.1144

Smallwood, J., Mrazek, M. D., & Schooler, J. W. (2011). Medicine for the wandering

mind: Mind wandering in medical practice. *Medical Education*, *45*(11), 1072–1080. http://doi.org/10.1111/j.1365-2923.2011.04074.x

Smallwood, J., Nind, L., & O'Connor, R. C. (2009). When is your head at? An exploration of the factors associated with the temporal focus of the wandering mind. *Consciousness and Cognition*, *18*(1), 118–125. http://doi.org/10.1016/j.concog.2008.11.004

Smallwood, J., Obonsawin, M., & Reid, H. (2003). The effects of block duration and task demands on the experience of task unrelated thought. *Imagination, Cognition and Personality*, *22*(1), 13–31. http://doi.org/10.2190/TBML-N8JN-W5YB-4L9R

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin*, *132*(6), 946–958. http://doi.org/10.1037/0033-2909.132.6.946

Smith, T., Darling, E., & Searles, B. (2011). 2010 Survey on cell phone use while performing cardiopulmonary bypass. *Perfusion*, *26*(5), 375–380. http://doi.org/10.1177/0267659111409969

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. http://doi.org/10.1016/0364-0213(88)90023-7

Swing, S. R. (2007). The ACGME outcome project: Retrospective and prospective. *Medical Teacher*, *29*(7), 648–654. http://doi.org/10.1080/01421590701392903

Szpunar, K. K., Khan, N. Y., & Schacter, D. L. (2013). Interpolated memory tests reduce mind wandering and improve learning of online lectures. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(16), 6313–6317. http://doi.org/10.1073/pnas.1221764110

Szpunar, K. K., Moulton, S. T., & Schacter, D. L. (2013). Mind wandering and education: From the classroom to online learning. *Frontiers in Psychology*, *4*(August). http://doi.org/10.3389/fpsyg.2013.00495

Tang, K. C., & Davis, A. (1995). Critical factors in the determination of focus group size. *Family Practice*, *12*(4), 474–475. http://doi.org/10.1093/fampra/12.4.474

Taylor, K. L., & Chudley, A. E. (2001). Meeting the needs of future physicians: A core curriculum initiative for postgraduate medical education at a Canadian university. *Medical Education*, *35*(10), 973–982. http://doi.org/10.1111/j.1365-2923.2001.01021.x

Thomson, D. R., Besner, D., & Smilek, D. (2015). A resource-control account of sustained attention: Evidence from mind wandering and vigilance paradigms. *Perspectives on Psychological Science*, *10*(1), 82–96. http://doi.org/10.1177/1745691614556681

Unsworth, N., & McMillan, B. D. (2012). Mind wandering and reading comprehension: Examining the roles of working memory capacity, interest, motivation, and topic experience. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*(3), 832–842. http://doi.org/10.1037/a0029669

Varao Sousa, T. L., Carriere, J. S. A., & Smilek, D. (2013). The way we encounter reading material influences how frequently we mind wander. *Frontiers in Psychology*, *4*(November). http://doi.org/10.3389/fpsyg.2013.00892

Wallace, S., Clark, M., & White, J. (2012). “It’s on my iPhone”: Attitudes to the use of mobile computing devices in medical education, a mixed-methods study. *BMJ Open*,

2(4). http://doi.org/10.1136/bmjopen-2012-001099

Wammes, J. D., Boucher, P. O., Seli, P., Cheyne, J. A., & Smilek, D. (2016). Mind wandering during lectures I: Changes in rates across an entire semester. *Scholarship of Teaching and Learning in Psychology*, *2*(1), 13–32. http://doi.org/10.1037/stl0000053

Wammes, J. D., Seli, P., Cheyne, J. A., Boucher, P. O., & Smilek, D. (2016). Mind wandering during lectures II: Relation to academic performance. *Scholarship of Teaching and Learning in Psychology*, *2*(1), 33–48. http://doi.org/10.1037/stl0000055

Williams, R. (2015). Is mind wandering a good or bad thing? *Psychology Today*. Retrieved from https://www.psychologytoday.com/blog/wired-success/201504/is-mind-wandering-good-or-bad-thing

Winter, R. O., Picciano, A., Birnberg, B., Chae, M., Chae, S., Jacks, M., … Milne, C. (2007). Resident knowledge acquisition during a block conference series. *Family Medicine*, *39*(7), 498–503.

Young, M. S., Robinson, S., & Alberts, P. (2009). Students pay attention!: Combating the vigilance decrement to improve learning during lectures. *Active Learning in Higher Education*, *10*(1), 41–55. http://doi.org/10.1177/1469787408100194

APPENDIX 1: DEMOGRAPHIC QUESTIONNAIRE

Clicker ID: _____

Q1. Your gender?

A. Female
B. Male

Q2. Approximately how many hours of sleep did you get last night? Please round to the nearest hour.

A. Less than 3 hours
B. Between 3 and 5 hours
C. Between 6 and 8 hours
D. More than 8 hours
E. I do not know

Q3. Approximately how many hours of sleep do you normally get on an average night? Please round to the nearest hour.

A. Less than 3 hours
B. Between 3 and 5 hours
C. Between 6 and 8 hours
D. More than 8 hours
E. I do not know

Q4. How alert do you currently feel?

A. Very alert
B. Somewhat alert
C. Neutral
D. Not very alert
E. Not at all alert

Q5. How interested are you in the topic of this upcoming presentation?

A. Very interested
B. Somewhat interested
C. Neutral
D. Not very interested
E. Not at all interested

Q6. How would you rate your prior familiarity with this topic?

A. Very familiar
B. Somewhat familiar
C. Neutral
D. Not very familiar
E. Not at all familiar

Thank you for your participation.