Pilot Study Investigating the Impacts of Behavioural Inattention and Meta-Attention on Post-Secondary Students’ Online Information Seeking for Academic Purposes

by

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Abstract

Success at the graduate level of postsecondary education requires proficiency with academic online information seeking. Navigating the internet to find information is a complicated task that is vulnerable to lapses in attention. This study examined the relationships between graduate students’ self-reported behavioural inattention symptoms, meta-attention and online academic information seeking abilities. One-hundred and thirteen (99 female) graduate students (83 Masters-Level, 27 Doctoral Level) completed an online self-report questionnaire examining behavioural inattention symptoms, meta-attention, time-management and online information seeking ability. Results indicated that self-reported inattention, meta-attention, experience, and diagnostic status each significantly predicted unique variance in online information seeking ability. Implications for future research and intervention are discussed.
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1 Introduction

Increasingly, students are required to navigate information on the internet as part of their research and learning in tertiary education (e.g. Du & Evans, 2011; Fichten et al., 2012). In 2012 the Ontario Ministry of Training, Colleges and Universities published a discussion paper which highlighted ‘technology-enabled learning’ as a priority in their innovation plans for post-secondary education (Government of Ontario, 2012). Online learning at the undergraduate and graduate levels has proliferated in light of its ability to increase accessibility for students and decrease costs for institutions (Wu, 2015). Allen and Seaman (2010) reported that most recent estimates in the United States find that 4.6 million students are taking an online course. This translates to approximately 25% of students enrolled in tertiary education. Online learning can occur in several ways. For example, a student may take a structured online course where they access course material (e.g. lectures, videos, tests) and collaborate with peers and instructors via the internet, or they may use online tools (e.g. search engines) for independent activities such as gathering information to complete academic tasks (e.g. writing a paper or thesis; Wu, 2015).

The non-linear and open-ended nature of the internet makes using this medium as a learning tool both empowering and complex (Wu, 2015). Understanding individual differences in online learning can provide insight into this increasingly relevant academic skill and has the potential to inform how institution of tertiary education can support students’ academic achievement.

Information literacy describes an individual’s aptitude for interacting with information to meet their needs. This is important in everyday life, and critical for academic achievement at the tertiary level. Graduate theses, dissertations, and research projects require sophisticated information behaviours to be completed at the highest level and quality (Barry, 1997). Long and Shrikhande (2005) found statistically significant differences in the quality of written work that was produced by a group of students who received information literacy training compared to a control group. The necessity of sophisticated information literacy for success in graduate school has been recognized and is reflected in the increasing implementation of information literacy courses and programming documented in the literature. These courses have been shown to support graduate students’ academic success even when they deliver information literacy
teachings at the most basic and general level (e.g. Hoffman, Antwi-Nsiah, Feng, & Stanley, 2008; Madden, 2014). In addition, if a graduate student is pursuing a career as a faculty member in higher education, the necessary path of writing and publishing research requires refined information literacy (Harrington, 2009).

Information seeking, a component of information literacy that involves the effective and efficient locating of information, is a specific and important component of information literacy for graduate students to master. One hundred percent of students in a study by Harrington (2009) used online databases for coursework and research as part of their information seeking strategy. The more research requirements a student has in their program, the more information seeking skills they require in order to be successful (Warburton & Macauley, 2014). For example, Mullins and Kiley (2002) reported that doctoral student’s research quality was related to their ability to effectively complete literature reviews, a component of the project which demands strong information literacy and specifically searching skills. Despite the importance of these skills, graduate students continually overestimate their capacity to find information (e.g. Perrett, 2004). However, they do respond to, and benefit from, additional information seeking instruction (e.g. Perrett, 2004). Increased information literacy and refined information seeking skills differentiate graduate students from undergraduates, help them progress from generalists to specialists, and move from them from students to scholars (Fleming-May & Yuro, 2009).

When considering ways individuals may differ in their capacity for information seeking, attention (e.g., level of focus, distractibility) provides an interesting lens for analysis. In order to take in information for the purposes of learning, one must be able to attend to the information. Straying from maintaining focused attention on a task negatively impacts implicit learning (Franklin, Smallwood, Zedelius, Broadway, & Schooler, 2015). During a lecture, decoupling attention from external stimulus to internal thoughts negatively impacts memory for material from the lecture (Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2011), and reduces deep comprehension of the material (Schooler, Reichle, & Halpern, 2004). Multitasking, or switching of attention between more than one task, is detrimental to achievement. For example, using instant messaging tools while reading impacts the efficiency of students’ task completion as it takes students longer to reach similar levels of achievement in comprehension and memory tasks.
(Bowman, Levine, Waite, & Gendron, 2010; Fox, Rosen, & Crawford, 2009). Foerde, Knowlton, and Poldrack (2006) suggest that the learning that occurs when distracted, or engaging in dual-tasks, is encoded through a different mechanism resulting in superficial or ‘habit’ learning compared to the more flexible and explicit knowledge that results from focused single-task learning. The disruptive use of social networking applications while performing academic tasks has been shown to negatively impact the academic performance of students in the United States (Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013). The diversion of attention away from academic tasks towards electronic media for procrastination has also been implicated in poorer academic and wellbeing outcomes (e.g. Meier, Reinecke, & Meltzer, 2016). Lapses in attention can therefore impact learning through a variety of mechanisms including lessening comprehension and memory of material, impacting efficiency and compromising deep learning.

Exploring the relationship between students’ attentional processes and online information seeking ability is warranted based on the high opportunity for distraction while using the internet for learning (Wu, 2015) and the negative impacts inattention has been shown to have on academic behaviours and achievement (e.g. Frazier, Youngstrom, Glutting, & Watkins, 2007). Below, the general construct of information seeking will be discussed in greater depth followed by the specific nature of online information seeking. Next, the relevance of online information seeking for graduate students in the academic context will be discussed followed by a review of relevant predictors of academic online information seeking ability including attention, meta-attention, executive functioning and experience.

1.1 Information Seeking

We live in an information society where the ability to access, assess, and utilize information is integral to our functioning and successful participation in day-to-day life (Van Deursen & Van Dijk, 2010). Information is defined in the Oxford English Dictionary (2009) as, “Knowledge communicated concerning some particular fact, subject, or event” and Abram and Luther (2004) argue that for individuals born after the early 80s, “information is information”, meaning there no digital-divide and information is format-independent (O’Brien & Symons, 2005).
Information literacy is the term used to describe one’s competency with a set of skills that includes the ability to recognize an information need and subsequently effectively and efficiently access, critically and comprehensively evaluate, and accurately and creatively use information to meet the identified need (ALA, 1998). Information literacy is an essential competency in our pursuit of knowledge (Harrington, 2009).

A critical component of information literacy is information seeking ability, the set of behaviours one engages in after identifying a need for information (Cheng, Liang, & Tsai, 2013). Information seeking behaviours include those initial steps undertaken to identify sources of information that may help one meet their information need (Spezi, 2016). Specifically, one must initiate the search for information when an information need is identified rather than choosing to abstain from the pursuit of answers. Next, searching strategies must be constructed. Individuals may ask themselves where the information they need is housed? Should they search online or search in a library book? Should they seek out an expert to talk to? What database and search terms will they use if they choose to go online for information? The final step in the information seeking process involves implementing searching strategies and evaluating information sources’ potential to meet an information need. This process is iterative and will continue to evolve based on the sources found and the resulting evaluation of sources (Spezi, 2016).

A variety of models for both on- and offline information behaviours (which are used to measure information literacy), including information seeking behaviours, exist in the literature. These models conceptualize the process through a variety of lenses using diverse definitions (for review see Wilson, 1997). In these models, and in the literature more broadly, the term information seeking is often used interchangeably with information searching. Wilson (1997) suggests that information searching research emphasizes the relationship between the searcher and the technology used for the search, emphasizing operational skills, and existing within the information seeking behavioural domain. In this work, we will use the broader and more popular term information seeking, which encompasses both the interaction between the searcher and the computer-based information system as well as the information itself as discussed below.
1.1.1 Online Information Seeking

An extensive amount of information is housed online, accessible and producible almost immediately and in large volumes through our computers (National Center for Education Statistics, 2006). The extent of information housed online means that individuals in modern society are increasingly inclined to turn to the internet to solve their information problems. The process by which we use the internet to solve information or learning problems is dynamic and complex, made so by the non-linear, open ended and participatory nature of this medium (Kim & Glassman, 2013). Given these characteristics of the internet, individual searchers are likely to come up with different supporting evidence and conclusions from an information search on the same topic (Kim & Glassman, 2013). An individual using the internet as part of their information seeking plan will encounter hyperlinks and advertisements to choose from or ignore while combing through information in the form of text or video. During a search, an individual may be diverted from their course after receiving an alert from a communication app they have open. They may also be tempted to engage in a game or view a video open in another tab or window. The amount of information housed online, and the demands of navigating hypermedia, increases cognitive load and strains the mechanisms that help us learn from information (Mayer & Moreno, 2003). This is in stark contrast to more traditional sources of information (e.g., print material) which is presented in a linear and directed fashion.

Although information literacy is considered a capacity independent of the format in which the information is being interacted with, seeking digital information comes with additional barriers and opportunities. For example, persons who have a health-related information need are increasingly accessing the internet to find answers (Percheski & Hargittai, 2011). Access to health information is greatly improved in this case, specifically for people who may not have access to knowledgeable health professionals – a significant source of health information (Percheski & Hargittai, 2011). Despite the increase in access through a simple Google search, an information seeker must still employ fundamental information seeking behaviours such as the planning of strategies to find the information they’re looking for and the comprehension and evaluation of information found in their search. In fact, online health information has been shown to vary widely in its accuracy and readability (e.g. Storino et al., 2016). The proliferation
of online health information increases individuals’ access but also provides a new and vast medium to navigate with almost endless information to interact with. A person with access to medical professionals and online health information is also challenged to use information literacy skills to reconcile information they are able to find in both mediums (Percheski & Hargittai, 2011).

Online, the opportunity to deviate from linear reading is unceasing. In an online, dynamic environment planning, monitoring, and re-assessing of the information presented to you while searching to ensure that you are meeting your learning needs is necessary and diversion from linear paths is the norm (Nicholas, Williams, Rowlands, & Jamali, 2010). On the internet, there are a significantly increased number of decision points, which could lead to a large variability between individuals in the information they encounter based on how they make efficient and effective choices almost constantly (Kim & Glassman, 2013). Cho (2004) has found that self-regulated learning skills such as goal setting, self-evaluation, and volition impact individuals’ abilities to learn in an online environment which requires continuous decision making. The accessibility of large bodies of information on almost infinite topics from different perspectives is unprecedented. Agency is given to the information-seeker through decision points at every hyperlink and on every webpage or search list to find information that they believe is relevant to their problem, without the bias of a singular linear set of information. The dominance of online information and the nonlinear format in which it exists makes understanding how people interact with it critical to successful participation in modern society.

1.1.2 Academic Online Information Seeking

The use of the internet by post-secondary students is ubiquitous (Allen & Seaman, 2010) and the ability to successfully navigate the internet is an increasingly necessary skill for post-secondary academic success (Fichten et al., 2012). Specifically, searching for information to support knowledge acquisition is critical (Wu, 2015). Further, online information literacy is increasingly an expectation at the post-secondary level. For example, the Association of College and Research Libraries (ACRL, 2000) framework ‘Information Literacy Competency Standards for Higher Education’ outlines the need for students at this level to be able to, “access the information needed effectively and efficiently” with a component of this competency being
“applying search strategies”. Successful internet learning is argued to result from locating relevant information efficiently, evaluating that information, and using it effectively for a goal (Timmers & Glas, 2010). The ability to engage in successful online information seeking is therefore a foundational skill at the post-secondary academic level and worth specific inquiry. This is especially true when considering that the quality of learning resulting from accessing information on the internet may be related to one’s ability to navigate this medium.

Online information seeking abilities are an essential skill for the graduate student population to master due to their increased focus on research-related tasks (Du & Evans, 2011; Rempel, 2010). There is strong indication in the literature that researchers have a distinct preference for starting their information searches on the internet (Niu et al., 2010; Spezi, 2016). Graduate students have unique and sophisticated information needs compared to undergraduate students as they hone their knowledge in a given discipline and are expected to produce higher quality, novel and refined research (Catalano, 2013). Competencies such as selecting a searching platform and search terms, as well as synthesizing information for a certain purpose are critical to research-related academic expectations at this level (George et al., 2006).

As the prevalence of online information storage increases and becomes more complex, there has been an increasing interest in how graduate students engage in online information seeking activities to support their academic goals and coursework. Both large scale cross-discipline (e.g. Du & Evans, 2011) and discipline-specific (e.g. Ying-Hsueh & Chin-Chung, 2017) inquiries have been conducted. These studies describe the complicated online information seeking behaviours that graduate students engage in generally, and the skills that may be necessary for discipline specific information seeking in diverse programs around the world.

It has been established that students from the elementary to post-secondary level encounter unique online information seeking-specific challenges (e.g., specifying search terms) when compared to information seeking through other means such as reading books in the library (Waalaven, Brand-Gruwel, & Boshuizen, 2008). Employing strategies to regulate the search process such as picking out hyperlinks to ignore or follow, is an example of an information seeking skill that is often harder to develop and can impact a student’s opportunity to learn
online (Walraven et al., 2008). The proper and effective use of search terms (e.g. exact terminology, Boolean operators or truncation) in online databases is also a challenging skill to develop, even at the doctoral level (Chu & Law, 2007).

Students in higher education report that the use of communication technology – such as instant messaging – was related to distractibility while performing academic tasks (Levine, Bradley, Waite, & Bowman, 2007). Specifically, these students reported that they often switched between academic tasks and their communication technology. Furthermore, Levine et al. (2007) reported that these students demonstrated a preference for short and divided attention over focused attention. Graduate students using the internet for information seeking often choose convenience when employing information seeking behaviours above other strategy implementation plans which may be more effective or exhaustive (Connaway, Hood, Lanclos, White, & Cornu, 2013). The use of the internet for information seeking is both extremely important and reportedly challenging for students, even at the graduate level.

The relevance of academic online information seeking at the graduate level as well as the demonstrated challenges with online information seeking specifically warrant investigation into this process.

1.2 Predictors of Online Information Seeking Variability

1.2.1 Attention

Attention has been considered the gateway to conscious awareness (Broadbent, 1958, 1971; Deutsch & Deutsch, 1963) and cognitive activities (Peterson & Posner, 2012). Our attentional system is used to filter information for further processing from information that is irrelevant (Pashler & Sutherland, 1998). Activating attentional systems is considered prerequisite to learning (Wu, 2015) and failures in attentional systems are implicated in poor academic achievement (e.g. Lubke, Hudziak, Derks, van Bijsterveldt & Boomsma, 2009).
The internet houses a breadth of information resources (Wu, 2015) however it is also the home to social networking and communication platforms (Junco, 2012) as well as games and other entertainment (e.g. video content; Yee, 2006). This diversity of applications that coexist in many colours and fonts alongside advertisements and other links on any given internet page can test a student’s control of their attention and behaviour while using the platform for learning. A student may have their attention focused on an academic information seeking task using a platform such as Google Scholar when they receive an alert that someone has posted on one of their social networking sites. As a result, their attention is then diverted to making a decision about how to react to that alert (Wu, 2015). Whether or not they respond to this alert by opening up their social networking platform, they may still be in a state of divided attention while completing their online academic task by the possibility that they will receive another alert (Wu, 2015). Similarly, a student may be attending to an academic task online while having lingering attentional focus on another activity that they have recently, or will in the future engage in on this same device – such as watching a movie (Wu, 2015). The online environment is rich with opportunities to divert attention. In fact, the internet houses so much information that humans are unable to process all of it and instead employ multitasking strategies to cope (Chun, Golomb & Turk-Browne, 2011). Unfortunately, research has provided clear evidence that attending to multiple sources of information at once while performing a task is not something that humans have the information processing capacity to do effectively or accurately (Chun et al., 2011).

The literature suggests that maintaining attention during academic tasks is a problem for post-secondary students. For example, post-secondary students endorse using communication or social networking applications while doing schoolwork and note that this is academically impairing (Junco & Cotten, 2012). Karpinski, et al. (2013) found that over 85% of post-secondary students in the United States report diverting attention away from a primary computer learning task to attend to another task on the computer. Performing academic-unrelated activities while using the computer or internet compromises efficiency (Bowman et al., 2010). These diversions of attention while using the computer or internet for learning are not only associated with negative academic achievement (Junco & Cotten, 2012) but also with feelings of stress and frustrations (Mark, Gudith, & Klocke, 2008). Ravizza, Hambrick and Fenn (2014) showed that independent of intellectual ability, the use of the internet for non-learning activities during
lectures was related to lower test scores. Rosen, Carrier, and Cheever (2013) showed that university students who accessed Facebook while studying had lower GPAs than those who reported avoiding Facebook. Although this research is correlational in nature, the relationship between academic performance and off-task internet use by postsecondary students is noteworthy. This is especially true when considering the amount of time postsecondary students spend off-task or task-switching while completing academic work on the internet.

Behavioural inattention has been consistently implicated in academic challenges in adolescents and post-secondary students (Frazier et al., 2007). Students with higher levels of inattention (self-reported and other-reported) not only face challenges while completing academic tasks on the internet, they also face obstacles with other academic-adjacent skills. For example, students with high levels of inattention often display challenges with maintaining effective study-habits and skills (DuPaul, Weyandt, O’Dell, & Varejao, 2009; Norwalk, Norvilitis, & MacLean, 2008), test-taking, summarizing information, making outlines and taking notes (Prevatt, Reaser, Proctor, & Petscher, 2007; Zwart & Kallmekoven, 2001), and often display less proficient self-regulated learning than their peers (e.g. Arnold, Hodgkins, Kahle, Madhoo, & Kewley, 2015; Guderjahn, Gold, Stadler, & Gawrilow, 2013).

A student does not have to be diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD) to experience challenges in academic outcomes. Although students with a clinical diagnosis of ADHD have the highest levels of inattentive and hyperactive symptomatology, ADHD-symptoms are normally distributed throughout the population on a severity continuum ranging from very attentive to very inattentive with most of the population residing somewhere in the middle (Crosbie et al., 2013; Lubke, et al., 2009). In fact, individuals who display ‘sub-clinical’ levels of symptomatology are still at risk for negative outcomes such as reduced quality of life or academic achievement compared to their more normally attending counterparts (Lubke et al., 2009). The number of students with ADHD in post-secondary education is increasing with best estimates suggesting that between 2-8% of post-secondary students’ self-report clinically significant levels of ADHD-symptoms (DuPaul et al., 2009). Importantly, from a developmental perspective, it is also known that hyperactive-impulsive symptoms seem to subside in adulthood while inattention is more likely to persist (Mick, Faraone, Biederman, & Spencer, 2004). The
challenges with attention that students with ADHD and those with sub-clinical inattention symptoms face more broadly suggest that they may struggle more than their peers to successfully navigate the internet, particularly for learning outcomes (Brown, 2009). Understanding this process has implications for instruction and intervention.

1.2.2 Meta-Attention

Meta-attention is a component of meta-cognition (our ability to reflect on our own mental processes; Flavell, 1979), and can most easily be thought of as the meta-cognition of our attention (Reisberg & McLean, 1985). Meta-attention consists of awareness of inattention (knowing when one is distracted) and regulation of inattention (having knowledge of focusing strategies and maintaining a system of monitoring involving the implementation of strategies when distraction is recognized; Reisberg & McLean, 1985).

Previous research has indicated that awareness of changes in attentional states mediates the relationship between inattention and behavioural outcomes (Franklin, et al., 2014). As a result, it is argued that the extent to which individuals are aware of distraction should be considered as important as the frequency of distraction when looking at academic outcomes (Franklin et al., 2014). Awareness of an attentional state can impact an individual’s attempt to regain attention or prevent negative outcomes (Schooler, et al., 2011). However, findings suggest that within the general population of people without clinically significant attentional or learning challenges adults have challenges with monitoring and regulating their attention (e.g. Reisberg and McLean, 1985).

Meta-attentional abilities have been correlated with academic achievement in children (Loper & Hallahan, 1982) and post-secondary students (Wu, 2015). Developmental changes in meta-attention also have been noted. As children age and mature, attributions for attention shift from external forces towards the understanding that it is possible for individuals to control and regulate their attention to impact their performance (e.g. Loper & Hallahan, 1982; Loper, Hallahan & Ianna, 1982).
Although younger students with ADHD may be less aware of their inattentiveness (Loper & Hallahan, 1982), qualitative research suggests that youth and adults with ADHD are acutely aware of their behaviour as well as cognizant of the relationship between their behaviour and their academic achievement (Wiener & Daniels, 2016). The challenge, however, is they tend to report little agency or ability to influence this relationship (Wiener & Daniels, 2016). Therefore, they may be aware but not able to change their behaviour. Moreover, Wiener and Daniels (2016) and others (e.g. Hoza, Pelham, Milich, Pillow, & McBride, 1993) report that adolescents with high ADHD-symptomatology tend to attribute their biggest behavioural concerns to internal causes that are uncontrollable, pervasive and stigmatizing. These findings exemplify the difference between an individual’s awareness of inattention, and his or her regulation of inattention as discrete aspects of meta-attention.

Students also may be unaware of the impact of their off-task internet use on their learning outcomes (Ravizza et al., 2014). These authors found that off-task internet use during lectures lead to poorer test scores. However, they also found that students reported that their learning outcomes were unrelated to this diversion of attention. This is an important area of investigation for the purposes of intervention. If a student is able to recognize their attention state, and successfully employ strategies to redirect diverted attention while information seeking, learning goals may still be reached, despite initial attending abilities.

1.2.3 Executive Functioning

Executive functioning is defined by Barkley (2012) as self-regulation to reach a future goal. Deficits in executive functioning can manifest themselves as forgetfulness, disorganization, difficulty initiating tasks, and poor time management, among others (Barkley, 2012). Individual differences in executive functioning have been linked to academic achievement more generally (e.g. Rabin, Fogel & Nutter-Upham, 2011), and internet use (e.g. Chevalier, Dommes & Martins, 2013) specifically.

Among executive functioning capacities, time management – an ability to use one’s resources to complete tasks or expectations in a specified time period – has consistently been related to academic achievement such that the better able a student is to manage their time, the higher they
are able to perform academically (see Cemaloglu & Filiz, 2010). Effectively managing time requires planning and monitoring of tasks to ensure that one is on task and completing tasks in a manner that matches their time constraints (Cemaloglu & Filiz, 2010). Planning and monitoring time on task is also relevant to effective and efficient online information seeking (Wu, 2015) and therefore variability in time management skills may impact an individual’s ability to perform this function.

It is important to understand the unique contributions of time-management to online information seeking ability. Previous research has shown a relationship between high inattention and executive functioning deficits in areas such as response inhibition, delay of gratification, planning, self-control, dividing and focusing attention, and set-shifting (Martel, Nikolas, & Nigg, 2007; Toplack, Bucciarelli, Jain, & Tannock, 2009; Wasserstein, 2005). Evidence suggests that inattentive symptoms more than hyperactive-impulsive symptoms are related to executive function deficits (e.g., Stavro, Ettenhofer, & Nigg, 2007). However, inattention is not always related to executive functioning deficits (Thorell, 2007). Some studies implicate executive functioning as a partial mediator between inattention and academic achievement (Thorell, 2007). Taken together, it is possible that time-management will not explain unique variance in online information seeking ability given the noted relationships between inattention and executive functioning deficits. However, including both constructs in this analysis will shed light on the unique contributions of both capacities and will inform avenues for intervention.

1.2.4 Experience

Experience using a system (such as the internet) for an outcome (such as learning), effects individuals’ abilities to effectively and efficiently perform their desired function (such as online information seeking; e.g. Wilson, 1997). It is practical to presume that the more time someone spends in an online environment, the more opportunity they will have to learn skills in that environment, be they effective or not. The mental models formed while using the internet are dependent on the time and ways one interacts with the internet (Kim & Hirtle, 1995). These interactions inform future behaviours on this medium (Kim & Hirtle, 1995). In addition, expertise and experience in higher level functions such as domain-specific knowledge have also been noted to be influential in the successful navigation of the internet for information.
A variety of studies have explored the relationship between breadth and depth of experience and online information seeking outcomes and implicated experience in variability in outcomes in the graduate student population (e.g. Thatcher, 2008). For example, Tsai (2009) found that the relationship between experience, defined as hours spent online searching per week, was related to students’ abilities to find information online and their use of sophisticated strategies and applications in this process. In contrast, student’s metacognitive strategies while performing online searching, specifically the evaluation of information they were coming across, was not associated with individual differences in level of experience searching (Tsai, 2009). In their review of the graduate information seeking literature, Catalano (2013) found that there were distinct differences between the information seeking behaviours of Masters- and Doctoral-level students. This difference likely results from the progressive levels of search- and domain-specific knowledge these students have based on the number of years they have spent in graduate education (Catalano, 2013).

1.2.5 Diagnostic Status

As discussed above, having a diagnosis of ADHD is related to academic challenges in the post-secondary student population (Frazier et al., 2007). Similarly, students with a diagnosis of a learning disability, or a mental health disorder such as Anxiety or Depression are also more likely to struggle with academic achievement at the post-secondary level (Cowles & Keim, 1995; Holmes & Silvestri, 2016).

Students with attention, learning or mental health disorders tend to report exacerbated challenges with navigating the complicated post-secondary environment compared to their peers (Getzel, 2008). Although students with disabilities are often afforded supports in their learning, students often opt out of disclosing their disability status for a variety of reasons and therefore may not actually receive the support that is designed to reduce learning barriers (Getzel & McManus, 2005).

Based on the academic challenges that have been documented for students with attention, learning and mental disorders, along with the necessarily impairing level of their symptoms to
meet diagnostic criteria, it is likely that this population will struggle with online information seeking.

On the other hand, graduate students with such challenges likely have worked toward developing effective coping and success strategies and thus may also have effective strategies to search academically oriented information using online tools. Dong and Lucas (2013) found that post-secondary students with disabilities who requested accommodations were more likely to have academic success than students with disabilities who did not seek out support from their institution. Fichten et al. (2014) found that they could predict the graduation rate of students with disabilities by measuring components of the Theory of Planned Behaviour (specifically subjective norms, attitudes, and perceived behavioural control). This suggests that students’ intention to achieve academically has also been associated with academic achievement amongst students with disabilities. In a qualitative study of graduate students with disabilities enrolled in online studies, Verdinelli and Kutner (2016) found that themes of resiliency, self-determination, motivation, goal commitment, and institutional assistance influenced persistence in graduate studies by these students.

Research exploring the academic experience and outcomes of graduate students with disabilities is scarce. Despite emerging literature suggesting graduate students with disabilities may have different outcomes or profiles than their undergraduate counterparts, the complex demands of online information seeking likely mean this will remain a challenging skill for this population.

1.3 Objectives and Hypotheses

The current study has three objectives. The first objective was to determine whether online information seeking abilities are related to behavioural inattention in a sample of graduate students. I hypothesized that individuals who reported higher levels of behavioural inattention would also report poorer online information seeking capacities because of the relationship between inattention and academic skill deficits (Frazier et al., 2007), and the academic consequences of distraction online (Wu, 2015). The second objective was to examine the degree to which behavioural inattention, components of meta-attention, time-management, experience
and diagnostic status explained variability in the online information seeking abilities of graduate students. It was hypothesized that all of these factors would be influential in explaining variance in online information seeking. Specifically, I predicted that increases in inattention, awareness of inattention and diagnostic status would be associated with poorer online information seeking ability whereas attention regulation strategy use, experience and good self-reported time management would be related to better reported online information seeking outcomes. Finally, in order to explain the relationship between attention, components of meta-attention and online information seeking ability more fully, a moderated mediation pathway was hypothesized. Specifically, the relationship between inattention and online information seeking ability is hypothesized to be mediated by awareness of inattention (Franklin et al., 2014). This mediation is thought to be moderated by the use of behavioural strategies to regulate inattention (Schooler et al., 2011).

2. Methods

2.1 Participants

This study was submitted to ethical review through the University of Toronto Research Ethics Board and approved. I recruited participants via an online survey that was comprised of existing and adapted measures relevant to the constructs included in the study. All participants provided their informed consent to take part in the study on the first page of the online survey. Participants were informed they could stop at any time by closing their browser.

Participants included 113 graduate students aged 22 to 65 with a Mean age of 28.47 (SD = 7.22). The sample was made up of primarily females (n=99, 87.6%) with 12 males (10.6%) and one individual reporting ‘other’ for their gender. Of these students 83 (73.5%) reported pursuing a Master’s degree, and 27 (23.9%) reported pursuing a Doctorate degree with 3 participants not reporting their degree status. All participants were part of a graduate faculty of psychology and education. The sample included 25 (22.1%) individuals that self-reported a diagnostic status of ADHD, a Learning Disability, or a Mental Health Disorder (e.g. Anxiety, Depression). The mean
The number of hours that participants reported using the internet for academic-related searching per week was 12.9 hours ($SD = 13.54$).

Six participants reported having a formal diagnosis of ADHD. Scores on the SWAN inattention measure for these students ($M = -.426, SD = .882$) were not statistically greater than those for participants who did not endorse a diagnosis of ADHD ($M = -.874, SD = .839; U = 197, p = .206$). This could result from the fact that these students are using medication to manage their inattention symptoms and/or that they have developed other strategies to manage their symptoms, which is not unlikely in a graduate population who have demonstrated academic resilience (e.g. Wilmshurst, Peele, & Wilmshurst, 2011). Analyses were run with and without the group of students who endorsed an ADHD diagnosis and results were similar, therefore this group was included in all analyses.

2.2 Measures

2.2.1 Demographic Information

A brief questionnaire was given to participants to obtain demographic and background information. The information collected included gender, age, degree program (i.e. Masters or Doctoral level), diagnostic status of ADHD, a Learning Disability or a Mental Health disorder (e.g. anxiety/depression), and amount of time spent on the internet for school related purposes.

2.2.2 Attention

*The Strengths and Weaknesses of ADHD Symptoms and Normal Behavior Rating Scale* (SWAN; Swanson et al., 2005) was used as a dimensional measure of behavioural inattention based on the DSM-IV criteria for ADHD diagnosis. The SWAN is an 18-item questionnaire designed to assess the strengths and weaknesses of ADHD symptoms. Inattention symptoms are measured by nine of the items and the other nine items measure hyperactivity/impulsivity symptoms. In this study, only the nine inattention items were used. Internal consistency of the full scale ($\alpha = .88$; Arnett et al., 2013) and inattention subscale ($\alpha = .94$; Young, Levy, Martin & Hay, 2009) are acceptable. The full-scale test-retest reliability range from .72-.90 (Arnett et al., 2013). Scores
were reversed so that higher SWAN scores represented higher ADHD traits for ease of interpretation and discussion. Internal reliability for this sample is good (α = .85).

Increasing value is being placed on broadening the restricted range of information obtained from categorical ADHD scales that exist (e.g. Polderman, et al., 2007). A move towards a dimensional approach to the study of inattention, from positive attentional skills to attentional problems, has been increasingly used (Brites, Salgado-Azoni, Ferreira, Lima & Ciasca, 2015). The SWAN offers a medium for collecting this type of information using items on a seven-point scale with the extremes represented at ‘far below average’ (-3), associated with ADHD traits, and ‘far above average’ (3), associated with a strength in a trait, or low ADHD trait, and the middle being ‘average behaviour’ (0). Studies using the SWAN scale have found behavioural attention to be normally distributed across the population (e.g. Crosbie et al., 2013).

2.2.3 Awareness and Regulation of Attention (Meta-Attention)

A student’s awareness of their attentional state and their knowledge and employment of attention regulation strategies to redirect their attention were measured by the Perceived Attention Discontinuity and Behavioral Strategies subscales of the Online Learning Motivated Attention and Regulatory Strategies Scale respectively (OL-MARS; Wu, 2015). Small changes to the wording of the items were made to ensure clarity for use of the survey with a Canadian sample. Original and modified scales can be found in Appendix A. The Perceived Attention Discontinuity scale includes 10-items that capture the extent to which a student is able to identify when he/she is off-task/distracted while engaging in online searching. An example of an item on this scale is ‘I often click the links of interesting ads, pictures, or articles unconsciously when using computers to search information for my projects’. The Behavioral Strategies subscale consists of 5-items that capture students’ self-reported regulation of attention while online information seeking for an academic task. For example, ‘I use strategies to help myself focus on my work (e.g. unplugging or closing unrelated windows)’. A 5-point Likert scale was used for both subtests ranging from strongly disagree to strongly agree. Internal consistency for the Perceived Attention Discontinuity subscale (.87) and the Behavioral Strategies subscale (.73) are both considered acceptable (Wu, 2015). Internal consistency was also acceptable when
calculated for the sample in this study on both the modified Perceived Attention Discontinuity (α = .909) and Behavioral Strategies (α = .799) subscales.

### 2.2.4 Online Information Seeking Ability

The ability to effectively and efficiently seek out information online was measured using the *Online Information Searching Strategy Inventory – Quick version* (OISSI; Tsai, 2009). The quick version of this scale contains 13 items measuring behavioural, procedural and metacognitive domains on a 6-point Likert scale ranging from *not at all like me* to *very much like me*. Items from this scale were similarly edited for grammar and clarity by the authors and knowledgeable graduate students. In addition, as one item in the scale was perceived to overlap considerably with another item in the scale, it was removed resulting in a 12-item scale. Original and modified scales can be found in Appendix B. The quick version of the original 13 items scale was found to be highly correlated with the complete version of the scale and considered a valid representation of the constructs and theoretical model measured in the full scale (Tsai, 2009).

The *behavioural* domain captures information about control and disorientation such as ‘I always feel lost while searching’. The *procedural* domain uses items such as ‘I try other databases when I cannot get any information in one database’ to capture problem solving while online information seeking. Finally, student’s *metacognitive abilities* while online information seeking are measured by items such as, ‘I keep on evaluating the relationships among the information searched from the web’ which capture evaluation of ideas while information seeking. Higher scores on this scale represent more developed/mature online searching abilities with the exception of two items which were reverse scored before obtaining a total. This scale exhibits good predictive validity in previous studies (Tsai, Hsu, & Tsai, 2012). The reliability alpha for the quick scale was α = 0.85 indicating good internal consistency (Tsai, 2009). Internal consistency for the modified OISSI used in this sample was strong (α = .859).
2.2.5 Mind Wandering

To validate our use of the SWAN scale as a measure of diversion of focus in this population, participants were also asked to complete the 5-item Mind Wandering Questionnaire (MWQ; Mrazek, Phillips, Franklin, & Broadway, 2013). This self-report measure assesses the level of mind-wandering an individual does at the trait level through questions such as “I have difficulty maintaining focus on simple or repetitive tasks” on a 6-point likert scale ranging from 1 (almost never) to 6 (almost always). The total score was the sum of the item scores with a higher sum meaning higher levels of a mind wandering trait. The scale demonstrates good reliability ($\alpha = 0.85$; Mrazek et al., 2013). The reliability for this sample is good ($\alpha = .822$).

2.2.6 Time Management

Executive functioning is an umbrella construct that encompasses many cognitive capacities including organization of time, materials and information, problem solving, motivation and emotional regulation. For the purposes of this exploratory study I focused on a specific executive function that is likely highly relevant to online information seeking: time management. This study included the 4-item Self-Management to Time subscale (reliability $\alpha = 0.92$) from the Barkley Deficits in Executive Functioning- Short Form (Barkley, 2012) as a measure of procrastination, forgetfulness, planning and time management capabilities. Each item was measured on a 4-point Likert scale ranging from 1 (never or rarely) to 4 (very often). The reliability for this sample is acceptable ($\alpha = .777$).

2.3 Procedure

Students enrolled in a graduate program within a department of education and psychology at a Canadian university were approached through a classroom visit or an email listserv with information about the study and provided with a link to the online survey. Students who clicked on the link to the survey were redirected to a screen which included a letter of information and consent to participate in the study. Participants were advised that the survey would take
approximately 20 minutes, that they could refrain from answering any questions and that they could opt-out of the survey at any time by exiting their browser page. Students who provided consent by way of clicking a check box were redirected to complete a battery of self-report measures. As an incentive for their participation in the study, participants were given the opportunity to opt-in to a draw for one of two $100.00 amazon.ca gift cards upon submitting their survey. A draw for one of the cards was made mid-way during data collection, and the second gift card draw occurred at the completion of data collection.

2.4 Statistical Plan

Prior to the regression analysis, a Pearson correlation analysis was conducted to determine the magnitude of the relationships between predictor and outcome variables (i.e. behavioural inattention, time-management, experience, diagnostic status, mind wandering, awareness of inattention, regulation of inattention, and online information seeking ability).

Although I aimed to explore a moderated-mediation pathway, preliminary analysis using the PROCESS macro (Hayes, 2015) in IBM SPSS Statistics Version 24.0 indicated that there was no evidence of statistically significant mediation of behavioural inattention on online information seeking through awareness of inattention. There was also no evidence of a statistically significant moderation by regulation of inattention on the relationship between behavioural inattention, awareness of inattention and online information seeking. Therefore, a hierarchical linear regression was utilized to examine the predictors of online information seeking proficiency. In the hierarchical linear regression broad behavioural traits (i.e. behavioural inattention, time-management, experience, and diagnostic status) were entered in the first step. Components of meta-attention were entered into the second and third steps. Specifically, self-reported awareness of inattention while using the internet for learning was entered into the second step and regulation of inattention while using the internet for learning was entered in the final step. This order of entry was designed to identify the unique contributions of awareness of inattention and regulation of inattention while online searching to student reports of online information seeking capacity.
3 Results

3. 1 Preliminary Analyses

3.1.1 Measuring Inattention

To validate the use of the SWAN as a self-reported dimensional measure of inattention in this population, scores were compared to another validated measure of inattention/focus, the Mind Wandering Questionnaire (MWQ; Mrazek et al., 2013). Previous research has demonstrated the positive relationship between inattention symptomatology and mind-wandering in naturalistic and lab-based activities for young adult populations (e.g. Franklin, et al., 2014). Correlations between SWAN and MWQ scores for participants in this study indicate that the SWAN is a good measure of variability in attention in this graduate student population ($r = .448, p < .001$).

3.2 Primary Analyses

3.2.1 Correlations

Prior to conducting the regression analyses, Pearson correlations among the predictor and outcome variables were examined. As seen in Table 1, degree status, diagnostic status and the use of attention regulation strategies were significantly positively correlated with online information seeking ability. More years in higher education, a reported diagnosis of ADHD, a Learning Disability or a Mental Health Disorder, and use of strategies to regulate inattention were all associated with better online information seeking ability. Compared to this, general behavioural inattention, time-management, and awareness of inattention while using the internet for learning were all significantly negatively correlated with online information seeking ability such that self-reported high behavioural inattention, poor time-management, and high awareness of inattention while using the internet for learning were all associated with poorer online information seeking. Additionally, the two components of meta-attention (awareness and
regulation of inattention) were not significantly correlated suggesting that there was no change in the use of attentional regulation strategies based on awareness of inattention while searching for information online.

### 3.2.2 Hierarchical Linear Regression Results

The first block of the hierarchical linear regression was statistically significant \(R^2 = .254, F(4,75) = 6.375, p < .001\) and accounted for 25.4% of the variance in online information seeking ability. An inspection of the predictor variables indicated that inattention \((\beta = -.351, p = .002)\), degree status \((\beta = .303, p = .004)\), and diagnostic status \((\beta = .242, p = .018)\) each accounted for a significant proportion of the variance in online information seeking ability while time-management did not \((\beta = -.105, p = .337)\). These results indicate that individuals who report greater attention problems also reported poorer online information seeking ability. In contrast, those in the more advanced degree program and those who reported having a learning, attention, or mental health disorder reported better online information seeking proficiency.

When awareness of inattention (measured by the Perceived Attention Discontinuity subscale of the OL-MARS) was entered in the model in the second block, 8.2% of additional variance was predicted \(\Delta R^2 = .082, F(5,74) = 7.469, p < .001\). Awareness of inattention was a significant and negative unique predictor of online information seeking ability \((\beta = -.334, p = .004)\) indicating that individuals who reported being aware that they were inattentive online reported poorer online information seeking abilities. Behavioural inattention \((\beta = -.286, p = .009)\), degree status \((\beta = .258, p = .010)\) and diagnostic status \((\beta = .252, p = .010)\) remained significant predictors in the model. Time management was not a statistically-significant predictor \((\beta = .032, p = .778)\).

In the final block of the regression, regulation of inattention (measured by the Behavioural Strategies subscale of the OL-MARS) was added to the model and accounted for a significant proportion of additional variance \(\Delta R^2 = .077, F(6,73) = 8.555, p < .001\). In the final model regulation of inattention \((\beta = .286, p = .003)\), awareness of inattention \((\beta = -.325, p = .003)\), degree status \((\beta = .283, p = .003)\), diagnostic status \((\beta = .197, p = .035)\) and behavioural inattention \((\beta = -.254, p = .014)\) were significant predictors of online information seeking ability. Time-management was not a significant predictor in the model \((\beta = .023, p = .830)\). Overall, the
final model accounted for 41.3% of the variance in online information seeking ability.

4 Discussion

The goal of this study was to better understand the relationship between graduate students’ self-reported inattention, meta-attention and online information seeking abilities. To address this objective, graduate students were asked to respond to questionnaires that measured their self-reported behavioural inattention, meta-attentional capacities, online information seeking skills, experience, time-management, and diagnostic-status. First, the results of the correlation analyses will be discussed briefly, then predictors of online information seeking ability will be discussed based on the results of the regression analyses. Finally, key limitations of this research and relevant implications for future research and practice will be highlighted.

4.1 Relationships Amongst Predictors and Outcome

The correlation analyses provided insight into the extent to which the various potential predictors of online information seeking were interrelated. The findings indicated that self-reported behavioural inattention was significantly negatively correlated with online information seeking ability. Specifically, the more a student reported having inattentive traits, the lower they reported their online information seeking capacity. This is in line with previous research that has implicated inattention as impairing for academic (Frazier et al., 2007) and academic-adjacent (DuPaul et al., 2009) capacities and outcomes. Understanding that there is a relationship between inattention and online information seeking uncovers an area of vulnerability for postsecondary students with moderate to high levels of inattention. This is especially relevant given the importance of information seeking proficiency for success at the graduate level (George et al., 2006).

Somewhat surprisingly, there was little evidence of an association between self-reports of awareness of inattention during searches and students’ reports of their use of behavioural regulation strategies to regain attention during their online searching. Although Franklin et al.
(2014) suggest that awareness of inattention may set the stage for the implementation of behavioural attention regulation strategies to mitigate negative outcomes resulting from inattention, the present results did not support this argument. Rather, as found previously (Wu, 2015), students’ reports of their awareness of inattention while using the internet for academic searching were not significantly correlated with the use of strategies to regulate inattention. Thus, knowing one was off-task did not necessarily lead to the self-reported implementation of attention regulation strategies (e.g. Wu, 2015; Wu, 2017). Wu (2015) explained these results by identifying distinct categories of students based on their differing meta-attentional abilities. Specifically, Wu (2015) identified five subgroups: students with low awareness of inattention and high regulation of inattention, students with low awareness of inattention and low regulation of inattention, students with high awareness of inattention and high regulation of inattention, students with high awareness of inattention and low regulation of inattention and finally students with mild awareness of inattention and moderate regulation of inattention. Self-reported online information seeking ability and academic outcomes varied depending on the meta-attentional subgroup a student fell into (Wu, 2015). Wu’s (2015) findings highlight the importance of examining both awareness and regulation of inattention for academic and online information seeking outcomes. Further, these findings indicate a need for targeted intervention that acknowledge the profile of meta-attentional capacities that a student displays in both their awareness and regulation of inattention.

As predicted in the literature, experience positively significantly correlated with online information seeking ability. PhD students self-reported more sophisticated online information seeking abilities than Master’s level students. Diagnostic status was also positively significantly correlated with online information seeking abilities. These results highlight the importance of including such variables in the hierarchical regression analysis as these variables appear to provide additional explanation for variation in online information searching behaviour.
4.2 Predictors of Academic Online Information Seeking

The main objective of this study was to identify the *unique* predictors of academic online information seeking proficiency in graduate students drawing on Wu’s (2015) model of attention and meta-attention. The results of the hierarchical regression model revealed that the predictors as a whole explained 41.3% of the variance. In addition, each additional block added to the model accounted for a significant proportion of the variance (7.7 to 8.2 percent). Below I discuss the results in more detail.

First, as predicted, self-reported behavioural inattention was a significant unique predictor of graduate students’ self-reported online information seeking abilities when all variables were entered into the model. This is in line with research that has implicated behavioural inattention in poorer performance on academic tasks (Lubke et al., 2009) and online navigation (Junco & Cotten, 2012). For example, Junco and Cotten (2012) found a negative relationship between student-reported distraction while using the computer for learning and academic achievement. Mark et al. (2008) also found that the more students reported being distracted while using the computer for learning, the more they reported feeling stressed and frustrated. Moreover, Bowman et al. (2010) reported that performing academic-unrelated activities while using the computer or internet compromises students’ efficiency. These studies provide some insight into the observed association between inattention and online information seeking deficits. If a student is distracted while completing academic work on the computer, he or she is likely to be less efficient and effective at finding information online. In turn, this may lead to frustrations and stress over completing work in a given timeframe (Spezi, 2016), and may lead a student to underachieve academically. It would be interesting in future studies to explore whether postsecondary students who report marked attention problems also tend to perform academic-unrelated activities or struggle to inhibit examining interesting, but irrelevant information online. It might therefore be that inattention is a key risk factor for such behaviours.

Another interesting finding was that self-reported inattention remained a significant predictor of online information seeking proficiency when components of self-reported meta-attention were added to the model. Inattention explained 10% of unique variance in online information seeking
ability in the model that did not include meta-attention. When awareness and regulation of inattention were added to the model, inattention explained 6% and 5% of variance in online information seeking ability respectively. This finding indicates that behavioural inattention is a unique and important characteristic to consider when understanding graduate students reported online information seeking ability. It also highlights the important relationship between inattention and meta-attention. Specifically, our variations in attention and meta-attention are intimately tied to one another (Reisberg & McLean, 1985). The fluctuations in an individual's attentional state provide the opportunity to notice changes in attention which in turn beget the implementations of strategies to regulate attention. The use of strategies may then change the original attention state – for example after an individual realises he/she is distracted he/she may implement strategies to re-focus on his/her original task. In this way, meta-attention would not exist without attention, and attention’s variability is tied to one’s meta-attentional capacities.

Both awareness and regulation of inattention uniquely predicted significant variance in online information seeking ability above and beyond behavioural inattention and other control variables such as degree status. These results are in line with Wu’s (2015) findings that meta-attention is an important component of online information seeking proficiency. It also fits with the idea that meta-attention is influential in the relationship between attention and behavioural outcomes (Franklin, et al., 2014).

As predicted, experience positively and significantly correlated with online information seeking ability independent of the remaining variables in the model. PhD students self-reported more sophisticated online information seeking abilities than Master’s level students. Experience, as measured by being in a Master’s or Doctoral level of study (Catalano, 2013), has also been implicated in previous research examining variability in graduate students’ searching styles and capacity (Thatcher, 2008). The construct of experience encapsulates both exposure to opportunities for online information seeking in general, and captures the domain-specific knowledge of information and searching styles that a student in graduate school has in their field of research. Corredor (2006) found that graduate students varied in their search skills and strategies based on both general experience with online information seeking and their domain-specific knowledge. In this study, it was not possible to separate the predictive value of web-
searching experience and experience working with domain-specific information using our measure of experience. It is likely that both experience searching the internet for academic purposes in general, and experience working with field-relevant information more generally predict a student’s report of their online information seeking ability.

The results pertaining to diagnostic status did not support the hypothesis as graduate students who reported having a diagnosis of ADHD, a Learning Disability and/or a Mental Health Disorder reported better online information seeking capacities than their peers. However, when considering the unique attributes of a graduate student population this result seems plausible. Students in graduate programs are necessarily achieving at a high level and sophisticated academic competencies are necessary for acceptance into graduate programs (e.g. Kuncel, Wee, Serafin, & Hezlett, 2010). If students have been accepted into a program at the graduate level, they likely have a number of skills and strategies that support them in their academic pursuits, regardless of their diagnostic status. A population of students with a clinical diagnosis may have received increased exposure to the use of strategies to support their learning as well as experience executing these academic-adjacent skills in order to meet their potentially increased academic needs. In addition, these students may demonstrate added resilience based on overcoming their increased risks for underachievement academically (Wilmshurst et al., 2011). It has been documented that students with disabilities who have high grade point averages and who access supports have improved academic outcomes (Mamiseishvili & Koch, 2012). Finally, this population may receive support from programming offered by their current or previous academic institution that exists for students with a disability status (Mamiseishvili & Koch, 2012).

Finally, the results showed that, time-management ability – a measure of executive functioning – did not explain a significant amount of unique variance in online information seeking ability when behavioural inattention, degree and diagnostic status were included in the model. Time-management was significantly positively correlated with self-reported behavioural inattention, and awareness of inattention, and significantly negatively correlated with online information seeking ability. This suggests that students’ time-management skills and awareness shared variance with inattention and awareness of inattention. Perhaps a student who reports poor time-management does so because they are inattentive while performing tasks and unable to mobilize
strategies to regain their attention and work efficiently. The correlation between inattention and time management is consistent with previous literature (e.g. Coetzer, 2016).

4.3 Limitations

There are some drawbacks to this study and findings should be considered in light of several limitations. As this research is correlational in nature, causal conclusions cannot be made regarding the association between inattention, meta-attention and online information seeking ability. In addition, given the self-report nature of this research, relationships between variables should be interpreted with caution. This is especially true for the concept of meta-attention or awareness and regulation of attention while online information seeking. Previous research has noted the challenges that people with high inattention symptomatology face in recognizing their changes in focus, specifically during mind wandering events (Franklin et al., 2014). Losing focus while participating in tasks is likely an unconscious event, as attention can be considered a precognitive state (Deutsch & Deutsch, 1963). This means that a student may not necessarily notice how much of their time spent using the internet to search for academic information is spent on unrelated articles or task-unrelated thinking (e.g. wondering what is happening on their social media accounts). A student may over- or under-estimate their awareness of attentional waning on the internet based on factors such as previous feedback on their inattention in an academic context, or their belief in their ability to effectively multi-task (Ravizza et al., 2014). This leads to challenges when interpreting self-report responses to questions regarding meta-attention. An individual with higher levels of inattention may not notice their state of distraction and report accordingly or they may not notice their inability to notice their inattention state. There is no way to distinguish these scenarios using the current methodology. Future studies should seek convergent validity with Wu’s (2015) measure of awareness of inattention through the use of an objective measure of distraction online such as eye-tracking (Desjarlais, 2013) or screen capturing measures (Spink & Jansen, 2004).

Future studies also should be conducted with gender-balanced and educationally-diverse populations (e.g. people with different majors) as this study was restricted to primarily female
educational and psychology graduate students. The relatively low number of males in this sample made it impossible to compare the relationship between inattention and online information seeking between genders. This is important for future studies to investigate as gender differences in strategy use have been observed in past studies (e.g. Tsai, 2009; Large, Beheshti, & Rahman, 2002).

One of the strengths of this study was that a valid and reliable measure of mind wandering was included in this study to validate the chosen measure of graduate student attention. The construct of mind wandering has been shown to correlate with inattention and ADHD-symptomology (Franklin et al., 2014). In addition, the construct of mind wandering has been related to online learning such that the more a student reports mind wandering when probed during an online task, the more likely they are to perform poorly on the online task (Hollis & Was, 2016). The significant positive relationship between self-reported mind wandering and behavioural inattention in this study support the use of our measure of inattention as it describes graduate student’s variations in focus. Another strength of the study was the use of measures previously validated in other jurisdictions (e.g., the OL-MARS, OISSI). The validation of measures of meta-attention in the context of online learning and online information seeking ability with a North American sample of graduate students broadens our ability to understand and research these constructs.

4.4 Implications for Research and Practice

This research study sheds light on the relationship between attention, meta-attention and the online information seeking abilities of graduate students and uncovered avenues for future research. Inattention, meta-attention and experience only accounted for approximately 40% of the variance in online information seeking abilities in the graduate population that was sampled. Future research is needed to identify additional factors that contribute to variability in online information seeking. For example, working memory (i.e. the system that helps one hold and manipulate information in short term memory; Baddeley, 1992) has a relationship with attention such that the stronger your working memory, the better able you are able to hold attention (Engle, 2002). Reading ability has also been shown to relate to online information seeking.
ability, navigational skills and metacognition and may inform a student’s ability to learn on the internet effectively (e.g. Wu & Peng, 2016). Most recently, Wu (2017) has implicated media multitasking self-efficacy in online information seeking abilities. Further research uncovering additional predictors of graduate student online information seeking abilities is warranted given the importance of proficiency with this skill for success at the graduate level (George et al., 2006).

Studies of online information seeking for academic purposes at the graduate level should seek convergent validity on measures of online information seeking ability. Graduate students have been shown to inflate their self-reported information seeking scores – they think that they are able to do it more effectively than they are actually able to do it (Perrett, 2004). Graduate students tend to over-estimate their abilities to construct effective search strategies/plans and therefore overestimating their ability to conduct efficient and effective information searches on the internet (Spezi, 2016). A study that combined the cognitive searching information gathered using the OISSI, and analysis based on the recording of information while a student is engaging in a search (e.g. search terms entered, time on sites, navigational patterns) as outlined in Spink and Jansen (2004) would provide more objective data on the search process of graduate students.

Students at all ages and levels are increasingly asked to navigate the internet for learning. Although this task is specifically important for the graduate student population’s academic success, understanding the academic online information seeking process for students of all ages will likely support their academic outcomes. Other populations of students are increasingly asked to perform online information seeking and challenges that these populations face have been documented. For example, Bos (2000) showed that high school students struggled with a variety of online information seeking behaviours. Walraven, et al. (2008) also reported information seeking behavioural challenges across the lifespan amongst children, teens, and adults. Understanding how aspects of attention and meta-attention impact online information seeking developmentally throughout school is warranted.

Besides guiding avenues for future research, this study has implications for practice. The lack of a robust positive relationship between components of meta-attention, as found in this study, or a
negative relationship as found by Wu (2015), has important implications for intervention. Specifically, the unique capacities of students at both levels of meta-attention, awareness and regulation of inattention, should be considered when choosing how to intervene. If the relationship between awareness and regulation of inattention is generally weak, then strategies such as an external alerting compensation system (i.e., a system that alerts a student to check whether they are focused) may not necessarily support students’ ability to effectively and efficiently seek information online. In the current study, we were unable to determine whether the students who did not report using strategies to regain attention did not do so because they did not know that they existed, or if they were aware of possible strategies but did not implement them because other factors such as perceived convenience or timeliness were considered to be important (Connaway et al., 2013). Further research could test different levels of intervention by having a group introduced to attention regulation strategies, a group who is taught and practices attention regulation strategies (e.g. in a Self-Regulated Strategy Development approach; Graham, & Harris, 2003), and a control group. Differences in online information seeking outcomes of these groups could shed light on the relationship between meta-attention, attention and online information seeking and also guide future practice.

Further implications for practice can be drawn from the fact that meta-attentional capacities were more useful in predicting variations in online information seeking abilities than self-reports of behavioural inattention. In the final model awareness of inattention and regulation of inattention both predicted 8% of the variance in online information seeking ability. This means that interventions do not necessarily have to target behavioural inattention. Teaching skills, strategies and tools that can support students in recognizing when they are inattentive online and when and how to help regulate their inattention will likely be beneficial for improving their online information seeking abilities. This is especially relevant for library professionals or other people involved in supporting students in their academic online information seeking. Support in the area of online searching often involves teaching searching skills (e.g. how to use Boolean Operators; Chu & Law, 2007). Findings from this study suggest that students could also benefit from instruction in meta-attentional strategies for recognizing their inattention while using the internet for academic searching and training on how to regain attention. Supporting students’ meta-cognitive skills while using the internet for learning has been suggested previously. For example,
Quintana, Zhang and Krajcik (2005) outline metacognitive scaffolding software and training that can support students in their online learning by making implicit metacognitive strategies explicit.

Results from this study indicate that intervention involving increasing the experience students have using the internet for online information seeking and/or with domain-specific information will likely improve outcomes. Future studies should seek to test the influence that intervening in these areas, along with attention and meta-attention capacities has on online information seeking outcomes.

4.5 Conclusion

High levels of inattention are related to challenges with academic achievement (Frazier et al., 2007). This study shows that inattention is related to online information seeking abilities, a relevant academic skill at the graduate level. Further, this study adds to Wu’s (2015) theoretical framework by confirming the relationship between meta-attentional capacities and online information seeking while controlling for behavioural inattention. Intervention that increase meta-attentional capacities will likely improve online information seeking outcomes.
References


## Tables

Table 1 *Pearson Correlations among Degree Status; Diagnostic Status; Inattentive behavior; Mind Wandering; Time-Management; Awareness of Inattention; Regulation of Inattention; Online Information Seeking Ability*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
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<td>1. Degree Status</td>
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<td>2. Diagnostic Status</td>
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<td>3. Behavioural Inattention</td>
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<td>4. Mind Wandering</td>
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<td>.154</td>
<td>.448**</td>
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<td>5. Time-Management</td>
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<td>.147</td>
<td>.352**</td>
<td>.516**</td>
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<td>6. Awareness of Inattention</td>
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<td>.051</td>
<td>.277**</td>
<td>.506**</td>
<td>.514**</td>
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<tr>
<td>7. Regulation of Inattention</td>
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<td>.138</td>
<td>-.172</td>
<td>-.133</td>
<td>-.064</td>
<td>-.011</td>
<td>1.0</td>
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<tr>
<td>8. Online Information Seeking Ability</td>
<td>.248*</td>
<td>.212*</td>
<td>-.333**</td>
<td>-.348**</td>
<td>-.249*</td>
<td>-.411**</td>
<td>.349**</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*p < .05

**p < .01
## Appendix A

**Original and Modified Online Learning Motivated Attention and Regulatory Strategies Scale**

<table>
<thead>
<tr>
<th>Original Item</th>
<th>Modified Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I often turn on the computer for studying (e.g. writing paper, learning, or</td>
<td>I often turn on the computer for schoolwork (e.g. studying, writing a paper,</td>
</tr>
<tr>
<td>searching information), but find myself always doing irrelevant things (e.g.</td>
<td>learning, or searching information), but always find myself doing irrelevant</td>
</tr>
<tr>
<td>watching Youtube, using Facebook, reading online news, or playing games).</td>
<td>things (e.g. watching YouTube videos, using Facebook, reading online news, or</td>
</tr>
<tr>
<td></td>
<td>playing games).</td>
</tr>
<tr>
<td>I know I have attention problems when using the computers for studying.</td>
<td>I know I have attention problems when using the computer for schoolwork</td>
</tr>
<tr>
<td>I visit websites or use computer applications that are irrelevant to my</td>
<td>I visit websites or use computer applications that are irrelevant to my</td>
</tr>
<tr>
<td>learning when using the Internet for studying.</td>
<td>learning when using the internet for schoolwork</td>
</tr>
<tr>
<td>I turn on the computer for studying, but cannot help visiting other websites</td>
<td>I turn on the computer for schoolwork, but cannot help visiting other websites</td>
</tr>
<tr>
<td>or using other computer programs (e.g. games, Youtube, news).</td>
<td>or using other computer programs (e.g. games, Youtube, news).</td>
</tr>
<tr>
<td>Someone has told me that I spent too much time on the Internet.</td>
<td>I have been told that that I spent too much time on the internet.</td>
</tr>
<tr>
<td>I often turn on the computer for studying (e.g., writing paper, learning, or</td>
<td>I often turn on the computer for schoolwork (e.g. studying, writing a paper,</td>
</tr>
<tr>
<td>searching information), but find that I do not start my work even when I am</td>
<td>learning, or searching information), but find that I have not started my work</td>
</tr>
<tr>
<td>about to turn the computer off.</td>
<td>even when I am about to turn the computer off.</td>
</tr>
<tr>
<td>I often click the links of interesting ads, pictures, or articles un</td>
<td>I often click the links of interesting ads, pictures, or articles uncons</td>
</tr>
<tr>
<td>consciously when using computers to search information for my project.</td>
<td>ciously when using computers to search information for my project.</td>
</tr>
</tbody>
</table>

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I had ever procrastinated my schoolwork due to using the computer for a long time (e.g., visit SNSs and play online games).

When studying, I often feel that there is something interesting happening on the Internet.

If I encounter difficulties when using the Internet to learn or write papers, I will unconsciously open other programs, websites, or use my smartphone.

I use strategies to help myself focus on my work (e.g., unplugging, closing unrelated windows, or limiting the speed of upload/download) when using the computers.

When studying, I log out my Facebook account or close instant message software, so that I can focus on my work.

In order to focus on learning on the Internet, I close unrelated websites or turn off the sounds.

If strategies help me accomplish what I should do with computer or the Internet, I use the same strategies afterwards.

I ask myself to complete the scheduled assignment first before visiting the websites or playing the online games that I like.

I have procrastinated my schoolwork by using the computer for a long time (e.g., visiting Social Networking Sites and/or playing online games).

When doing schoolwork, I often feel that there is something interesting happening on the internet.

If I encounter difficulties when using the internet for schoolwork, I will unconsciously open other programs, websites, or use my smartphone.

I use strategies to help myself focus on my work (e.g., unplugging, closing unrelated windows, or limiting the speed of upload/download) when using computers.

When doing schoolwork on the internet, I log out of my Facebook account or close instant messaging software, so that I can focus on my work.

In order to focus on learning while using the internet, I close unrelated websites or turn off the sounds.

If strategies help me accomplish what I need to do while on the computer or the internet, I use the same strategies again the next time.

I ask myself to complete my assignments first before visiting the websites or playing the online games that I like.
Appendix B

Original and Modified *Online Information Searching Strategy Inventory – Quick version.*

<table>
<thead>
<tr>
<th>Original Item</th>
<th>Modified Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I keep on evaluating the relationships among the information searched from the web</td>
<td>I continuously evaluate the relationships between pieces of information I find on the internet</td>
</tr>
<tr>
<td>I select the main ideas provided in each webpage as possible as I can</td>
<td>I select main ideas provided on each webpage</td>
</tr>
<tr>
<td>I look through titles or hyperlinks in a web in order to catch major information</td>
<td>I look through titles or hyperlinks on a webpage in order to find important information</td>
</tr>
<tr>
<td>I decide if the information provided in a website is work for reference</td>
<td>I decide if the information provided on a website is worth referencing in my work</td>
</tr>
<tr>
<td>I think of how to utilize the searched information</td>
<td>I think of how to utilize the information I find in my search</td>
</tr>
<tr>
<td>I do not know what to do during my searching</td>
<td>I do not know what to do while searching</td>
</tr>
<tr>
<td>I always feel lost while searching</td>
<td>I always feel lost while searching</td>
</tr>
<tr>
<td>I know how to utilize advanced-search functions provided by search engines</td>
<td>I know how to utilize advanced-search functions provided by search engines</td>
</tr>
<tr>
<td>I know how to use a web browser, like IE or netscape</td>
<td>I know how to use a web browser, like Google Chrome or Safari</td>
</tr>
<tr>
<td>I try some possible entrance websites when I cannot find enough information</td>
<td>I try other search terms or information portals when I cannot find enough information</td>
</tr>
<tr>
<td>I try other databases when I cannot get any information in one database</td>
<td>ITEM DELETED</td>
</tr>
<tr>
<td>I think of some resolutions when I am frustrated with searching problems</td>
<td>I think of resolution strategies when I am frustrated with search-related problems</td>
</tr>
<tr>
<td>I do my best to resolve any problem occurred during a searching</td>
<td>I do my best to resolve any problems that occur during a search</td>
</tr>
</tbody>
</table>