Too Anxious to Talk:
Social Anxiety, Communication, and Academic Experiences in Higher Education

by
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A dissertation submitted to the faculty of Graduate and Postdoctoral Affairs
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in Psychology

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Abstract

The first overarching goal of this doctoral dissertation was to develop and measure a new construct termed *academic communication*. Accordingly, Study 1 focussed on item development, pilot testing, and examining the psychometric properties of the newly developed *Academic Communication Inventory* (ACI). Undergraduate students ($N = 642$, $M_{age} = 19.5$) completed the ACI (assessing general communicative behaviours) along with other measures to investigate external validity. Results demonstrated that the best fitting structure of the ACI was a two-factor solution, consisting of the subscales: (1) communication with instructors; and (2) communication with peers. Study 2 assessed measure invariance across educational context (i.e., blended courses, online courses, offline courses), as well as gender differences in communication. Participants were undergraduate students ($N = 1074$, $M_{age} = 20.3$) who completed the ACI (assessing course-specific communicative behaviours), with 21% subset completing follow-up questionnaires (participants from Study 2 were also used in Studies 3 and 4 for different research purposes). Multi-group factor analyses suggested that the ACI could be used as both a general and course-specific measure of *academic communication* (i.e., the ACI was invariant across course contexts). Moreover, females and males reported different communication levels with instructors and peers. Study 3 focused on the utility of the ACI, by examining the links between social anxiety, communication, academic experiences (i.e., engagement, classroom connectedness, student satisfaction) and wellbeing. Among the results, academic communication accounted for significant variance in the links between social anxiety and academic experiences. Moreover, social anxiety was negatively related to academic experiences, and there was at least some

evidence that academic experiences explained part of the association between social anxiety and wellbeing. Study 4 supplemented the previous studies by asking students *who* they ask course related questions to and *why*. Emerging themes aligned with the subscales of the ACI (i.e., communication with *peers*, *instructors*, *peers and instructors*, and *no one*). Social anxiety scores in the theme of *no one* and *peers* were significantly higher than *instructors* and *peers and instructors*. Results from each study are discussed in the context of contemporary higher education and potential implications for educational practice.

Acknowledgements

The completion of this doctoral thesis would not have been possible without my amazing support system. To my advisor, Dr. Robert Coplan – thank you for the countless conversations about academia, research, and life in general. Rob, you never failed to provide advice that helped guide me through the throes of graduate school. Your wisdom, patience, encouragement, and unconditional support made this all possible. I am so lucky to call you my mentor and friend.

I would like to thank the Coplan lab (past and present), for being there for brainstorming sessions, to vent frustrations, and for all the games nights. You helped to create a safe and fun space during a time of immense stress and pressure. A special shout out to Laura – I won't ever forget the hundreds of hours spent on the phone (you're welcome, Rogers), the emotional support you provided, your problem-solving abilities, and conferences.

To my family, last but definitely not least. Thank you for always having faith in my abilities, and for always boosting my spirits when I needed it. Mom and Dad, throughout my life, you provided me with the tools I needed to excel. I would not be where I am without your unwavering support and encouragement. To my husband, Jason – thank you for encouraging me to move to Ottawa so many years ago, so I could pursue my MA and PhD with Rob. Even though we were not always in the same city, you were always there to support my aspirations, provide reassurance, and make me laugh. I am very fortunate to have a partner like you to experience life with. Finally, to my little Brielle – your presence gave me the final push I needed to finish my dissertation. And for that, along with all the joy and love you bring into my life, I will forever be grateful.

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Too Anxious to Talk:

Social Anxiety, Communication, and Academic Experiences in Higher Education

The university classroom is an inherently social context, where student success can be greatly enhanced by encouraging communication of high quality. Astin (1993) stated that “the single most important environmental influence on student development is the peer group” (p. 22), whereas other researchers highlight the critical role that student-instructor interactions play in student achievement (e.g., Kirk, Lewis, Brown, Karibo, & Park, 2016). Accordingly, the scholarship of teaching and learning often emphasizes the importance of an active learning environment, which ultimately fosters classroom communication in higher education. Educational environments rich in communication often lead to higher levels of student engagement (Balaji & Chakrabarti, 2010; Joksimovic, Gasevic, Loughin, Kovanovic, & Hatala, 2015; Prozesky, 2000), contributing to knowledge acquisition (Anderson, 2003), and ultimately academic success (Donnelly, 2010; Muirhead & Juwah, 2005).

Technological developments have created substantial change in the educational system and instructional platform, resulting in a continuously evolving classroom context. Therefore, it is not surprising that communication and interactions have been examined across a variety of learning environments, including offline (e.g., Doise & Mugny, 1984; Mehan, 1998; Moore, 1987; Norberg, 2012; Tirri & Kuusisto, 2013; Yee, 1971), online (e.g., Balaji & Chakrabarti, 2010; Gomez, Wu, & Passerini, 2010; Stewart, 2013), and blended learning courses (e.g., Bernard, Borokhovski, Schmid, Tamim, & Abrami, 2014; Fletcher & Bullock, 2015; Green, Whitburn, Zacharias, Byrne, & Hughes, 2017; Joksimovic, Gasevic, Kovanovic, Riecke, & Hatala, 2015; Shu & Gu, 2018).

Many studies have examined contemporary education with a focus on how technology positively impacts the quality of education (e.g., Artino, 2009; Bollinger & Halupa, 2012; Brooks & Young, 2016; Harasim, 2000; Keengwe & Wilsey, 2012; Lee & Tsai, 2010; Ng, 2007; Siampou, Komis, & Tselios, 2014). Others have examined educational context (i.e., offline, online, blended) in relation to essential classroom components such as classroom engagement (e.g., Henrie, Halverson, & Graham, 2015), participation (e.g., Czekanski & Wolfe, 2013; Murray & Lang, 1997; Smith, 1977), and collaboration (e.g., Caldwell, 2007; Friesen & Kuskis, 2013; Moore & Kearsley, 1996). Underlying each of these three constructs are aspects of social interactions and communications among students and instructors (e.g., Borokhovski, Bernard, Tamim, & Schmid, 2016; Henrie et al., 2015, Jaggars & Xu, 2016). The channels of these exchanges have undergone a drastic change with the rapid and ongoing integration of communicative technology into our daily lives (Amichai-Hamburger, Kingsbury, & Schneider, 2013). Generally speaking, communicating via technology has led to an increase in overall interaction (e.g., Brooks & Young, 2016; Chou, 2001; Klassen & Vogel, 2003; Cox & Orehovec, 2009). Therefore, it is vital to examine communication in higher education with an up-to-date lens, to understand how differential communication may impact upon academic experiences in higher education.

The overarching theme of this dissertation is communication in contemporary education. Therefore, student engagement, collaboration, and participation are examined, as extant literature highlights *communication* as the connective tissue binding these three constructs. Then, previous studies examining communication in different modalities (i.e., face-to-face; computer-mediated) and formalities (i.e., informal; formal) are examined, to

ultimately inform the development of a holistic measure of communication in higher education, being a primary goal of this dissertation. Next, Study 1 method, results, and a discussion are presented, which focuses on the development and validation of the *Academic Communication Inventory*. The second study examines the new measure of *Academic Communication* across educational contexts. Therefore, the second section of this document reviews the literature examining different course contexts in contemporary higher education to delineate offline, online, and blended learning. Study 2 method, results, and discussion to follow.

Along with examining differences in communication across classroom contexts, it is also imperative to consider predictors of *Academic Communication*. Individual differences among students in the classroom can contribute to distinctive styles of communication with their peers and instructors (e.g., Elffers, Oort, & Karsten, 2012; Sanchez, Bauer, & Paronto, 2006), classroom engagement (e.g., Douglas, Bore, Munro, 2016; Schaufeli, Salanova, Gonzalez-Roma, & Bakker, 2002), consolidation of knowledge (Rudestam, 2004), and academic performance (e.g., Chamorro-Premuzic, Furnham, & Ackerman, 2006; Farsides & Woodfield, 2006; Martin Montgomery, & Saphian, 2006). Moreover, individual differences appear to impact student performance and interactions in both the traditional classroom and in virtual environments (Rudestam, 2004). The predictor of interest in the current research is *social anxiety*, as social anxiety is likely associated with less academic communication, which may subsequently impact academic experiences.

Accordingly, the second overarching goal of this doctoral research is to examine the correlates and outcomes of social anxiety in higher education. The third portion of

this document provides an overview of social anxiety in higher education, followed by Study 3's method, results, and discussion. In Study 3, two structural equation models are examined linking social anxiety, academic communication, educational experiences (i.e., engagement; sense of community; satisfaction), and wellbeing. Finally, the last portion of this document presents a quasi-qualitative study, and reports on themes and subthemes of students' communicative preferences, and correlates with gender and social anxiety.

Conceptual Overview of Communication and Interaction

Although *communication* is a critical part of daily life, especially in the context of education (Prozesky, 2000), providing a singular and universally accepted definition proves difficult (Littlejohn & Foss, 2005). For example, Dance and Larson (1976) identified 126 different definitions of communication proposed by communication scholars - and the number of definitions of communication have continued to grow rapidly (Trenholm, 2008). For the purposes of the proposed research, the definition of communication will focus on the conceptualization of communication as a *process* (Bretts, 2009).

Tubbs and Moss (2006) suggest that "since human communication is an intangible, ever-changing process, many people find it helpful to use a tangible model to describe that process" (p. 10). In light of the advent of the Internet and the evolution of communication, it has become increasingly important to acknowledge that definitions of communication should be flexible (Amichai-Hamburger et al., 2013), in order to progress with the modernization of society. Therefore, it is appropriate to build upon the *Tubbs Communication Model* due to its generalizability across communication settings (Tubbs & Moss, 2006). This model asserts that most basic communication involves

“Communicator 1” who is the sender/receiver, and “Communicator 2” who is the receiver/sender, with communication comprised of both verbal and non-verbal messages. This model of communication can be applied to both face-to-face settings (i.e., in person) and computer-mediated settings (i.e., email; text-message; educational discussion board) (Bretts, 2009).

Communication is ubiquitous in education, occurring in a variety of ways (i.e., interactions; engagement; collaborations; and participation), and impacts the quality of education (Balaji & Chakrabarti, 2010; Joksimovic, Gasevic, Loughin, Kovanovic, & Hatala, 2015; Prozesky, 2000). For example, many researchers consider *interaction* to be one of the most important components of the learning environment (Woo & Reeves, 2007). Indeed, social interaction plays a crucial role in the construction of knowledge, and in discussion and collaboration between peers, which has a positive impact on learning (e.g., Dillenbourg, Baker, Blaye, & O’Malley, 1996; Doise & Mugney, 1984; Springer, Stanne, & Donovan, 1999). Similar to communication, the extant literature is comprised of many definitions of interaction (Joksimovic et al., 2015), from several different perspectives and contexts (Bernard, Abrami, Borokhovski, Wade, Tamim, Surkes, et al., 2009; Woo & Reeves, 2007). However, consistent across definitions of interaction within the educational setting is the noted inclusion of *communication*. For instance, Wagner (1994) examines interactions from the functional perspective, as an emerging process that involves communication in various forms. Moreover, Yacci (2000) argues for a student-centered perspective of interaction, meaning that interaction among students does not exist unless they obtain feedback – similar to the sender/receiver requirement in Tubbs Communication Model (Tubbs & Moss, 2006).

Interaction and communication build the foundation for several complimentary predictors of educational success – engagement, collaboration, and participation (e.g., Henrie et al., 2015; Jaggars & Xu, 2016; Yucel & Usluel, 2016). Although there is considerable overlap between these constructs, there are also notable differences (Balaji & Chakrabarti, 2010; Handelsman, Briggs, Sullivan, & Towler, 2005; Henrie et al., 2015). The following sections present theories of interaction in education, and expand on how extant literature situates engagement, participation, and collaboration in learning within an interaction based theoretical framework.

Interaction in education. Within the educational environment, having opportunities for interaction is critical, as the goal of such interactions is to positively change students' educational behaviors (Wagner, 1994; Woo & Reeves, 2007). More than a hundred years ago, John Dewey (1916) proposed that interaction was an essential factor in the educational process – occurring when one student transforms information they receive from another. Many researchers since have emphasized the importance of interactions in both traditional offline educational contexts (e.g., Johnson, 1981; Mehan, 1998; Tirri & Kuusisto, 2013; Yee, 1971) and in distance and online settings (Anderson, 2003; Bernard et al., 2009; Hironaka, 2002; Lou, Bernard, & Abrami, 2006; Moore, 1989; Muirhead & Juwah, 2005; Wagner, 1994; Woo & Reeves, 2007). As previously mentioned, there is an abundance of differing definitions of interaction within education literature. For example, Yacci (2000) defined interactivity as a loop of mutually coherent messages that should complete a cycle (from one student to another) in order for interaction to occur. Wagner (1994) examined interaction as a process that involves communication in various forms, including an event and two objects. Muirhead and

Juwah (2005) developed a similar understanding of interaction – representing an event where communication occurs between two or more subjects, with interactions being context specific, occurring synchronously and/or asynchronously. Among these definitions of interactions, Joksimovic and colleagues (2015) note underlying themes within the varying definitions: (1) the occurrence of an event (i.e., communication in any form); and (2) the presence of two or more subjects (i.e., participants or objects).

Moore (1989) developed a conceptual framework of interaction that carries the fundamental themes of communication and participants. Interaction in Moore's model is comprised of three types of interaction: (1) student-content; (2) student-student; and (3) student-instructor (Moore, 1989). The student-content relation highlights the core essence of education and learning, intending the participant to interact with the course material (Moore, 1989). However, more recently, researchers suggested that this paradigm is shifting to a greater emphasis on student-student interaction, in light of the importance of social constructivists' principles (e.g., Anderson, 2003; Moallem, 2003; Woo & Reeves, 2007). Specifically, social constructivists insist that learners obtain and acquire knowledge through participating in the social practices of a learning environment (Stage, Muller, Kinzie, & Simmons, 1998). Thus, a critical component of this framework is student-student interactions, which are comprised of both basic and complex communications with peers (Moore, 1989), including conversations, discussions, and negotiations (Confrey, 1995; Ernest, 1995). Finally, student-instructor interaction is a product of communication from the course instructor and participating students. This type of interaction is valuable, expensive, and the least accessible type of communication

(Anderson, 2003; Moore, 1989), as it requires extensive involvement of the instructor in course facilitation and direction (Garrison, Anderson, & Archer, 1999).

Meaningful learning and deep acquisition of knowledge can be supported if at least one of the three forms of interaction is present (Anderson, 2003). Interactions have proven to be a pivotal component of learning (Borokhovski et al., 2016; Cheng & Jiang, 2015; Moore, 1989; Sims, 1999), and are amongst the strongest predictors of academic success (Donnelly, 2010; Muirhead & Juwah, 2005). Indeed, interaction enables learner control and voice, which can assist in program adaptation, encourages various forms of participation, communication and collaboration, and facilitates the construction of knowledge (Sims, 1999). Moreover, as compared to other predictors (i.e., motivation, satisfaction), social interaction demonstrates a stronger relation to outcomes in learning (Jung, Choi, Lim, & Leem, 2002). It has been suggested that the most effective interaction type may differ across educational settings (Miyazoe & Anderson, 2010). However, results from several studies indicate that student-student and student-instructor interactions are the most powerful predictors of perceived learning, academic achievement, engagement, and participation (Arbaugh & Benbunan-Fich, 2007; Johnson, 1981; Joksimovic et al., 2015; Marks, Sibley, & Arbaugh, 2005; Mosser, 2010).

Accordingly, and considering the strong emphasis of communication within interaction, (Anderson, 2003; Moallem, 2003; Woo & Reeves, 2007), student-content interaction is not a primary focus of this research. The focus on communication emphasizes the importance of student-student and student-instructor interaction. The following subsections concentrate on engagement, collaboration and participation in the classroom, with a focus on the underlying components of student-student and student-

instructor interactions, ultimately highlighting the importance of communication in higher education (e.g., Borokhovski et al., 2016; Henrie et al., 2015, Jaggars & Xu, 2016).

Engagement. Student engagement in education is essential in producing learning (e.g., Henrie et al., 2015; Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Samruayruen, Enriquez, Natakatoong, & Samruayruen, 2013). As with other constructs described thus far, the term *engagement* carries with it a myriad of characterizations in contemporary education literature. For example, engagement has been conceptualized as students' involvement and participation in activities surrounding learning (Cole & Chan, 1994), the amount of time and energy committed to purposeful activities in education (Greene, Marti, & McClenney, 2008), and a psychological investment of motivations and goals, and thoroughly rooted in achievement goal theory (Jarvela, Veermans, and Leinonen, 2008). Henrie and colleagues (2015) conducted a meta-analysis on student engagement in online learning and noted the scarcity of definitional clarity among 113 articles. Accordingly, they provide evidence of underlying thematic indicators of engagement: (1) behavioural engagement; (2) cognitive engagement; and (3) emotional engagement (e.g., Fredricks, Blumenfeld, & Paris, 2004; Kuh et al., 2008; Ladd & Dinella, 2009).

Behavioural engagement encompasses a variety of students' actions that can be measured, such as participation, attendance, and involvement in learning (e.g., Boucheix, Lowe, Putri, & Groff, 2013; Peters, Shmerling, & Karren, 2011; Thompson, Klass, & Fulk, 2012). *Cognitive* engagement appears to include assessments of elaboration, reflective thinking, on-task behavior, focus, and critical thinking (e.g., Bangert-Drowns & Pyke, 2002; Guertin, Zappe, & Kim, 2007; Zhu, 2006). Finally, *emotional* engagement

emphasizes positive or negative emotions towards course material, classmates and instructors, as well as social collaboration, student interactions and sense of community (e.g., Kay, 2011; Missette, Reed, Scot, Callahan, & Slade, 2010; Sun & Rueda, 2012). Although extensive research has focused on student engagement, many researchers examine only one domain. Nevertheless, it has been proposed that multiple components must be examined to ensure human experience within education is understood (e.g., Fredricks et al., 2004; Guthrie & Wigfield, 2000; Henri et al., 2015). This is particularly crucial as student engagement is a robust predictor of a wide range of academic outcomes (Henrie et al., 2015; Kuh et al., 2008; Samruayruen et al., 2013) in student development from elementary school through university (e.g., Filak & Sheldon, 2008; Fredricks et al., 2004; Kuh et al., 2008).

Previous research has established associations between student engagement and important theoretical constructs such as self-regulation and motivation (Fredricks et al., 2004; Reschly & Christenson, 2012). In the education literature, self-regulation and motivation share some conceptual overlap, highlighting metacognition, goals and the drive for acquisition of knowledge (Brophy, 2004; Slavin, 1987; Zimmerman & Martinez-Pons, 1988). These constructs are robustly associated with academic success (e.g., Barak, Watted, & Haick, 2016; Samruayruen et al., 2013; You & Kang, 2014). Student engagement is connected to persistence in learning, educational satisfaction, and high rates of academic achievement (Filak & Sheldon, 2008; Hughes, Luo, Kwok, & Loyd, 2008; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007). Increased social engagement among students leads to less attrition in a learning environment (e.g., Ferguson & Clow, 2015; Halawa et al., 2014; Jordan, 2014). Henrie and colleagues

(2015) found that student engagement was linked to participation, attendance, and interactions with classmates or instructors.

Embedded within the broad construct of engagement are student *interactions*. Amongst other processes, emotional engagement is comprised of collaborative social interactions, student-student interactions, and sense of community (e.g., Kay, 2011; Missette et al., 2010; Sun & Rueda, 2012). Further, participation is an important feature of behavioural engagement (Henrie et al., 2015), in which communication is inherent. The theoretical and empirical literature related to student engagement frequently situates models within Moore's (1989) *interaction theory*. This is intuitive, as one of the underlying components of interaction is communication, which is strongly rooted in many indices of engagement (e.g., Bangert-Drowns & Pyke, 2002; Boucheix et al., 2013; Peters et al., 2011; Thompson et al., 2012; Zhu, 2006).

Collaborative learning. Although collaboration is often viewed as a feature of emotional engagement (see Henrie et al., 2015 for recent review), there is an abundance of literature solely dedicated to examining the impact of student collaborations on learning outcomes (e.g., Caldwell, 2007; Friesen & Kuskis, 2013; Moore & Kearsley, 1996; Roschelle & Teasley, 1995). Collaborative learning in the educational context refers to a process where learning occurs through mutual engagement among peers with a coordinating effort to solve a problem or complete a task (Roschelle & Teasley, 1995). Collaborative learning presents core requirements such as active learning and shared experiences among students, teacher as a facilitator, participation, student responsibility, critical thinking, reflection, and social team skills (Lethinen, Hakkarainen, Lipponen, Rahikainen, & Muukkonen, 1999). Moreover, collaborative learning involves the co-

construction of knowledge (Gachago, Morris, & Simmons, 2010). Although education researchers have attempted to make the distinction between collaborative learning and cooperative learning, many of the common themes underlying these two constructs render them relatively equivalent (Kreijns, Kirschner, & Jochems, 2003).

Theoretical frameworks supporting collaborative learning are often entrenched in the social constructivist approach to learning as well as interpersonal theories (e.g., Farmer, Lines, & Hamm, 2011; Slof, Nijdam, & Janssen, 2016; Yucel & Usluel, 2016). Certainly, collaborative learning involves students acquiring, restructuring, and solidifying information through discourse with peers and instructors, followed by insightful reflection (as opposed to repetition of content) (Perkins, 1999). Deeply intertwined within social constructivist perspectives and collaborative learning are student-student interaction, with an emphasis on meaningful communication (Anderson, 2003; Moallem, 2003; Woo & Reeves, 2007). Interpersonal theories in education emphasises the importance of student-instructor interactions to assist in facilitating a healthy, productive and collaborative environment (e.g., Farmer et al., 2011; Slof et al., 2016). Based on the characterization of collaborative learning (Lethinen et al., 1999), interactions are vital in order to integrate this pedagogical strategy within the classroom environment. Thus, various interactions *enable* individuals to engage in collaborative learning, which thereby facilitates construction of knowledge (Moore, 1989; Sims, 1999).

Collaborative learning can assist in developing a learning community that nurtures important skills such as critical thinking and problem solving, which ultimately fosters a deeper understanding of concepts and material learned throughout education (e.g., Friesen & Kuskis, 2013; Fulford & Zhang, 1993; Moore & Kearsley, 1996;

Picciano, 2001; Salmon, 2002; 2004; Scardamalia & Bereiter, 2006; Sherry, 1995). It can also increase student engagement in the learning process and help students to better understand course material through peer explanation of concepts with the use of colloquial language (e.g., Caldwell, 2007; Crouch & Mazur, 2001; Michaelson, Knight, & Fink, 2004). Certainly, the cumulating effect of collaborative learning positively impacts learning outcomes and academic development. However, it is important to consider that not every collaborative learning opportunity may result in beneficial outcomes. Situations may arise where certain students may dominate the collaboration process, eliminating the opportunity for all participants to benefit (Nielsen, Hansen, & Stav, 2014; Wolfe, 2012).

Interactions among students drive the underlying process of collaborative learning. In order to truly fulfill the requirements of this learning strategy, students must participate by opening lines of communication (Lethinen et al., 1999). When students are either over-active or under-active in collaborative learning, they are not reaping the benefits (Nielsen et al., 2014; Wolfe, 2014). Thus, communication is essential between multiple participants (Woo & Reeves, 2007). Accordingly, Tubbs Communication Model is applicable in a collaborative learning environment, as there are at least two communicators extending messages (Tubbs & Moss, 2006), which serves to foster the development of knowledge and enhance learning outcomes.

Participation. The construct of *participation* is largely subsumed within both student engagement and collaborative learning in education and psychology research (e.g., Henrie et al., 2015; Yucel & Usuel, 2016). With regards to student engagement, participation is examined as a key component of behavioural engagement (Boucheix et

al., 2013; Peters et al., 2011; Thompson et al., 2012). Undoubtedly, actively participating in a classroom environment regardless of context is a strong indicator of engagement (Henrie et al., 2015). Further, participation is essential in any collaborative environment (Lethinen et al., 1999), as a lack of participation would be detrimental to the process. However, some researchers have also examined participation as a distinct construct (e.g., Czekanski & Wolfe, 2013; Murray & Lang, 1997; Smith, 1977). Researchers highlight the importance of classroom participation to encourage meaningful understanding opposed to rote memorization (Meyers & Jones, 1993). Traditional models of participation in education emphasize several important components such as: (1) attendance; (2) asking questions; (3) answering questions; and (4) becoming involved in classroom discussion (Czekanski & Wolf, 2013). Although not all components warrant communication (i.e., attending class), it can be deduced that a variety of interactions take place within participation (Moore, 1989), as previous research has established a strong connection between the two (Yucel & Usluel, 2016).

It is well established that a variety of methods of participating in the classroom is connected to student success (Wright, 2014). Researchers have criticized the *instructional* paradigm in higher education (i.e., conceived of delivering content via lecture) that has been widely implemented for decades, instead encouraging a *learning* paradigm (i.e., encouraging high levels of active participation) within the classroom (Barr & Tagg, 1996). Murray and Lange (1997) raised questions regarding the effectiveness of the learning paradigm in a study conducted within their psychology course to assess the impact of active participation. They found that active participation among students (as assessed using observational methods) improved student learning of course content and

the development of problem solving skills. More recently, Ho and Swan (2007) conducted a qualitative study of online learning and found that the quality of participation in discussions predicted students' own grades in the course. Similarly, Balaji and Chakrabarti (2010) further demonstrated that perceived participation and interaction in discussion positively relates to self-perceived learning. It is evident that, by encouraging high rates of participation, students have the opportunity to cultivate critical thinking and develop communication skills (Wright, 2004).

Similar to student engagement and collaborative learning, participation in the classroom underscores the importance of interaction and communication in the classroom environment (e.g., e.g., Czekanski & Wolfe, 2013; Murray & Lang, 1997; Smith, 1977). Figure 1 depicts a conceptual model of the postulated inter-relations among the aforementioned constructs of engagement, collaboration, and participation. Overall, there appears to be considerable overlap between these constructs. However, an emergent theme from the extant literature is that *communication* represents an underlying feature that connects engagement, collaboration, and participation. Therefore, it is necessary to understand how communication independently relates to important outcomes in education, as it is a substantial component of three robust predictors of positive academic development. In the following sections, the focus is shifted to examine how communication is currently examined in the literature.

Figure 1. A conceptual model of the overlap among engagement, participation, and collaboration.

Contextual Differences in Communication

There are many contextual differences that may impact both the frequency and quality of interactions, which may thereby lead to differential outcomes associated with communication in education (Arbaugh & Benbunan-Fich, 2007; Henrie et al., 2015; Keengwe & Wilsey, 2012; Littlejohn & Pegler, 2007; Macdadyen & Dawson, 2010; Park & Bonk, 2007; Ramos & Yudko, 2008). Beyond traditional face-to-face forms of communication, interaction occurs in numerous computer-mediated settings (e.g., Ke & Kwak, 2013; Wei & Chou, 2014). Moreover, student-student and student-instructor communication may also differ in terms of formality (e.g., Brooks & Young, 2016; Nadler & Nadler, 2000; O’Keefe, 2013). However, not all of these modes of communication have been assessed in a holistic fashion. Consequently, a main goal of this doctoral research was to create a measure of communication in education, including both face-to-face and computer-mediated methods of communication, across settings of formality, which can be applicable to all educational contexts – to ultimately understand communication as a comprehensive construct. Accordingly, the following section investigates how communication in education is being examined in contemporary research.

Modality. As the popularity and sophistication of technology-based learning continues to grow (e.g., Means, Toyama, Murphy, & Baki, 2013; Parsad & Lewis, 2008; Rudestam & Schoenholtz-Read, 2010), there is an increase in the number of gateways to communicate with peers and instructors. For example, beyond traditional face-to-face forms of communication, interaction occurs in numerous computer-mediated settings

(e.g., Ke & Kwak, 2013; Wei & Chou, 2014). Subsequent sections examine research spanning both traditional and computer-mediated communications in education.

Face-to-face communication. Face-to-face communication is typically examined in terms of engagement within the physical classroom, which includes participatory and collaborative learning (e.g., Castle & McGuire, 2010; Martinez-Caro & Campuzano-Bolarin, 2011; Owston, York, & Murtha, 2013). Results from a series of studies indicate that participatory learning (e.g., verbally asking/answering questions) is positively linked to academic success (e.g., Czekanski & Wolfe, 2013; Murray & Lang, 1997; Smith, 1977). In an observational study, Murray and Lang (1997) found that participating in the classroom lead to greater knowledge acquisition (in terms of students' final grade), and positively impacted communication efficacy, critical thinking, and problem-solving ability. Classroom interactions that underscore participatory learning often involve a significant amount of communication with the instructor. For example, Kamhi-Stein (2000) found instructors play a large role in contributing to meaningful classroom discussions, which provide students opportunity for reflection and academic growth. Compared to participatory learning, collaborative learning involves more communication among peers, with the instructor performing a facilitating role. Face-to-face group collaborations often work to transform students into supportive teams. In a study conducted by Smith and colleagues (2011), students reported face-to-face group work was beneficial because of unambiguous communication (which assisted task delegation), and the immediacy it provides.

Another type of face-to-face communication that occurs within the educational setting is interaction during office hours. The traditional practice of office hours is a part

of instructors' duties and responsibilities as a teacher and is designed to provide students the opportunity for additional help outside of the classroom (Acitelli, Black, & Axelson, 2003). Office hours are thought to facilitate the relationship between students and the instructor – though many students rarely take advantage of these opportunities (e.g., Bippus, Kearney, Plax, & Brooks, 2003; Ku & Huh, 2001; Nadler & Nadler, 2000). For example, Jaasma and Koper (1999) found that fewer than half of the students in their study reported visiting their professor during office hours. Regardless, results indicate that higher levels of contact with faculty present a positive correlation with students' academic performance (Jaasma & Koper, 1999). Thus, it is important to include assessments of frequency of office hour attendance when examining student communication. Generally speaking, engaging in face-to-face interactions has clear benefits on student course outcomes.

Within large institutions with sizable classes, students often develop meaningful interactions with teaching assistants. For example, Cotton and Wilson (2006) found that students within large institutions feel they do not have quality communication with instructors, and therefore opt to contact teaching assistants. Moreover, students reported feeling awkward talking to instructors, and indicate that they only approached them regarding a grading issue. Therefore, it is important to also assess communication with teaching assistants when attempting to gain a better understanding of a wide-range of student communications. For example, several studies have found that meaningful informal interactions with teaching assistants appear to positively impact student achievement (e.g., Halawah, 2006; Iverson et al., 1984; Kuh & Hu, 2001; Pascarella & Terenzini, 2005).

To summarize, face-to-face communication facilitates the consolidation of knowledge and contributes to academic achievement. The examples provided demonstrate how different forms of face-to-face communication are strong predictors of academic success. As today's society and educational environments increasingly incorporate computer-mediated modes of communication (Bahati, 2010), it is important to examine how these channels of communication also contribute to academic outcomes.

Computer-mediated communication. Across different types of educational context, research suggests that students find multimodal communication to be extremely beneficial to their academic success (e.g., Bower et al., 2015; Gecer & Dag, 2012; Hill, 2012; Usta, 2007). In the past, offline courses did not incorporate many forms of computer-mediated communication, with the exception of email. However, modern education often integrates various forms of online communication beyond email into traditional instructional contexts (e.g., An & Frick, 2006; Bower et al., 2015; Li & Pitts, 2009). According to Wingard (2004), the use of technology in the traditional classroom is extremely prevalent, as it may encourage student learning and support interaction outside of the classroom. There are many ways that technology can ease communication within the educational context including synchronous (e.g., chat, instant message, virtual office hours) and asynchronous (e.g., discussion boards, email) communication (Li & Pitts, 2009).

One of the most frequently used forms of computer-mediated communication with instructors and peers is email. For example, Li and Pitts (2009) found that over half of the students in their study used email to ask and answer questions relating to course work. They further suggest that students who more frequently communicate via email

may have higher motivation for academic achievement. Furthermore, students often report that virtual office hours are advantageous, and contribute to academic success (Meyers, 2003). For instance, Hooper, Pollanen, and Teismann (2006) found that the use of virtual office hours was positively associated with increased class participation and course confidence among students enrolled in a mathematics course. Researchers postulate that students prefer contemporary computer-mediated channels of interacting with their instructors and teaching assistants (Myers, 2003).

Discussion boards are often implemented within the educational environment, as they provide an outlet for student questions, discussions, and help seeking (e.g., Lee, Schallert, Song, Park, Chiang, Vogler, et al., 2011; Schallert, Reed, & the D-Team, 2003-2004; Volger et al., 2013). Researchers have similarly found that discussion boards enhance student collaboration, participation, interpersonal experiences, interactions, and predict student grades (e.g., Balaji & Chakrabarti, 2010; Baran & Correia, 2009; Ho & Swan; Jaggars & Xu, 2016). For example, Goldberg and colleagues (2015) reported that students partaking in a massive open online course who communicated via discussion board were more likely to complete the course, compared to those who did utilize the discussion board.

Additionally, engaging in discussion board communications may open up alternate modes of interaction. For instance, Veletsianos and colleagues (2015) found that engaging in discourse mediated by discussion boards increased interactions, and ultimately created a broader social network. It was suggested that forming a larger educationally based social network might reinforce learning. It is also important to consider the influence of an instructor participating and monitoring discussion boards, as

instructor presence can alter student interactions (e.g., Faigley, 1992; Maor, 2003). For instance, research asserts that having a high instructor presence increases *meaningful* online communication (e.g., Park et al., 2015). Accordingly, it is important to assess interactions on discussion boards with and without the presence of an instructor.

Another form of computer-mediated communication that has received attention is instant messaging (IM) (e.g., Cox, Carr, & Hall, 2004; Vu & Fadde, 2013). Some students may prefer free and popular communication technologies such as IM via an institutional platform. For instance, McGee and Carmean (2006) found that IM fosters interaction between students and instructors, as well as increases collaboration with peers. Studies also find that IM or “chat” functions have the potential to increase feelings of social connectedness amongst students (e.g., Cameron & Webster, 2005; Hu, Wood, Smith, & Westbrook, 2004; Quan-Haase, Cothrel, & Wellman, 2005). Indeed, Vu and Fadde (2013) suggest that allowing direct messaging or a similar feature in the classroom has the potential to foster peer interaction. However, it is important to note that students do not necessarily replace face-to-face communication but may use these modalities in conjunction. For example, Spencer and Hiltz (2003) present findings from a field study indicating that student satisfaction was the highest when synchronous chat sessions were offered in addition to face-to-face sessions.

Although there are many benefits to communication with these methods, such as ease, convenience, increased engagement (e.g., Brooks & Young, 2016; Chou, 2001; Klassen & Vogel, 2003; Cox & Orehovec, 2009), there are also issues to consider. For example, many forms of computer-mediated communications involve the written word (Betts, 2009). For written communication to be effective, they must contain richness and

substance. For example, Balaji and Chakrabarti (2010) argue that for online discussion to be effective, students must perceive their interactions to be of high quality. One of the key issues with written communication is the lack of verbal cues, which can lead to misunderstanding (Jeong, 2007). Thus, it is imperative that students, as well as faculty, communicate in a clear and unambiguous way to reap the rewards that this communication affords.

Both face-to-face and computer mediated communication can vary in terms of formality. For example, while meeting an instructor during office hours may carry an air of formality, talking with an instructor outside of class may present as relatively informal. Similarly, submitting a query to a discussion board on an institutional platform may seem more formal than making a post to a course Facebook group. The subsequent section focuses on communication in education, while considering differences in formality.

Formality. Face-to-face and computer-mediated communications also differ in terms of formality, with some being formal (i.e., virtual office hours), and others being informal (i.e., chatting after class). Outcomes associated with formal modes of student-student and student-instructor communication have long been investigated (Ku & Huh, 2001; Nadler & Nadler, 2000; Smith et al., 2011). However, more recently studies examine the benefits of informal interactions between students and their classmates and instructors (Bippus et al., 2001; Martin, Mottet, & Myers, 2000; Myers, Martin, Mottet, 2002). These interactions are often referred to as *outside of class* communications. Communication opportunities in each of these contexts are important to consider, given their unique contributions to positive educational outcomes (e.g., Acitelli et al., 2003; Czekanski & Wolfe, 2013; Murray & Lang, 1997; O’Keefe, 2013).

Formal communications. Communications that carry a sense of formality often occur within the confines of a classroom. These interactions often take place during collaborative and participatory learning activities. As previously discussed, both collaborative and participatory learning are associated with a host of positive educational outcomes (e.g., Friesen & Kuskis, 2013; Moore & Kearsley, 1996; Picciano, 2001; Salmon, 2002; 2004; Scardamalia & Bereiter, 2006; Wright, 2014). For example, researchers have found that actively participating in class and engaging in collaborative learning tasks with peers positively impacts academic achievement (e.g., Castle & McGuire, 2010; Czekanski & Wolfe, 2013; Murray & Lang, 1997; Owston, York, & Murtha, 2013; Smith, 1977).

Any student-student or student-instructor interactions that are *expected* or institutionally mandated within a given course can be considered formal. Therefore, other types of formal communication may occur during scheduled office hours, via institutional email or learning management systems. These modes of communications have similarly demonstrated positive outcomes. For example, attending office hours, communicating by email, and communicating on discussion boards have been linked to increased relationship quality with peers and instructors, higher academic motivation, and general course success (e.g., Ku & Huh, 2001; Hooper et al., 2006; Li & Pitts, 2009; Nadler & Nadler, 2000; Park et al., 2015).

Informal communications. Informal communications generally refer to anything that is not part of a lesson or is not planned by an instructor (Brooks & Young, 2016), and can occur during student-student and student-instructor interactions (Bippus et al., 2003). These opportunities provide an additional platform for students to interact with both their

peers and instructors. Recent research has noted that informal communication can occur across all learning contexts. For example, Brooks and Young (2016) found that the frequency of informal communications was not influenced by educational context, but it did relate to the duration of communications. Students were more likely to engage in on-going communications with others in face-to-face courses. Moreover, Bippus and colleagues (2003) suggest that in light of increases in student population, as well as hybrid and online courses, students should be taking advantage of informal interactions as it may positively contribute to the student learning experience.

Researchers highlight the importance of informal communications as they are found to relate to students' overall academic success and overall retention (Jaasma & Koper, 1999; O'Keefe, 2013; Pascarella & Terenzini, 1991). Results from a series of older studies suggest that the benefits of informal communication include positive student-student and student-instructor relationships, and the promotion of learning (Kuh, 1995; Pascarella & Terenzini, 1991; Terenzini, Pascarella, & Bliming, 1996). For example, Nadler and Nadler (2000) reported a positive correlation between levels of informal contact between students and instructors and students' academic performance (Nadler & Nadler, 2000). These informal interactions also have a positive impact on students' feelings of value and importance, which in turn results in student persistence (Cox & Orehovec, 2007). Moreover, in a qualitative study, Cotton and Wilson (2006) found that following the formation of a less formal relationship between a student and an instructor, students report feeling more inclined to maintain their marks.

Students often meet with classmates outside of the formal classroom to participate in study groups (e.g., Aamodt, 1982; Hong et al., 2015; Zhao & Kuh, 2004). Educational

experiences outside of the classroom with peers can serve to reinforce course content and is beneficial to overall learning. For example, Aamodt (1982) found that participating in a study group enhances communication regarding course material, produces repetition and clarification of material, and ultimately aids course achievement. Groups of students who frequently engage in out-of-class communication and socialization have been referred to as “learning communities” (Zhao & Kuh, 2004). When peers spend an abundance of time together, conversations surrounding their academic courses may transpire. For instance, Gabelnick and colleagues (1990) found that when students frequently see their peers outside of class, they tend to engage in intellectual discussions, which positively impacts their coursework (Gabelnick, MacGregor, Matthews, & Smith, 1990). Similarly, when students engage in informal collaborative activities such as study groups, they may experience academic benefits. For instance, Hong and colleagues (2015) reported that when students participate in productive and effective group work, they are more likely to develop a sophisticated understanding of course material. Further, group work has also been linked to the formation of interpersonal bonds with peers, which positively relates to student grades (Jaggars & Zu, 2016).

Historically speaking, informal communications took place in-person, outside of classrooms, or during unscheduled office hours. However, because of the advances in communicative technologies, informal communications are now multimodal. Text messaging is a form of communication that is frequently used among college and university students (e.g., Johnson, 2007; Lauricella & Kay, 2013). Unlike forgetting to check email, students check their text messages and almost immediately respond upon receipt (e.g., Harley, Winn, Pemberton, & Wilcox 200; Jones, Edward, & Reid, 2009;

Naismith, 2007). For instance, Hill, Hill, and Sherman (2007) found, in addition to student-student interaction, students use text messages to interact with tutors, which in turn enhances understanding of course content (Hill et al., 2007). Researchers argue that text messaging enhances interactions and fosters the development of rapport and social connectedness among students and instructors (e.g., Holley & Dobson, 2008; Lauricella & Kay, 2013; Rau, Goa, & Wu, 2008). Moreover, a study by Frisby and Martin (2010) found that increased rapport with instructors increases social connectedness, which in turn increases participation in the classroom.

Similar to text messaging, it is well documented that students use informal instant messaging to facilitate learning (e.g., Johnson, 2007; Kennedy et al., 2008; Lauricella & Kay, 2013). Instant messaging (otherwise known as Direct Messaging, or Private Messaging – depending on platform of use) involves sending brief, typed messages over the Internet, directly from one device to another. As students are constantly connected to different electronic devices, it provides an easy platform for communication. Results from several studies suggest that students easily integrate academic pursuits in their social message system (e.g., Contreras-Castillo, Perez-Fragoso, & Favela, 2007; Jeong, 2007; Lauricella & Kay, 2013). Researchers postulate that one of the main advantages of instant messaging is immediacy of replies, as it may impact both time management and academic outcomes (e.g., Allen, Witt, and Wheelless, 2006; Martinez-Torres, Toral, Barrero, & Gallardo, 2007; Yao, 2011). However, after a thorough review of the extant literature, there are no studies that show an association between informal instant message use and superior academic outcomes. Furthermore, Cheng and Jiang (2015) found that students view instant message discourse as inferior to face-to-face discourse. This may be

in part due to the lack of verbal cues and ambiguity that may accompany instant messaging. Although there is a lack of empirical support for the associations between informal instant messaging and academic achievement, it remains a channel of communication that warrants inclusion in a broad measure of communication in higher education.

Cloud services are another type of technology that enables informal communication by providing individuals with access to documents, in which they can write comments to others. Cloud services are becoming widely used in education (Gonzalez-Martinez, Bote-Lorenzo, Gomez-Sanchez, & Cano-Paraa, 2015). Programs such as Google Documents and Dropbox are examples of cloud paradigms that are intended to create connectivity and file sharing (e.g., Arpaci, Kilicer, & Bardakci, 2015; Huang, Wang, Guo, Shih, & Chen, 2013). Although cloud services do not solely focus on communication like text or instant messaging, students can still relay messages to one another via shared documents in an asynchronous manner. For example, Al-Zoube (2009) proposes that Google Docs facilitates collaboration among students, as it enables students to manage different versions of documents and exchange them with peers. Research examining cloud services often explore the social presence among students who use cloud services (Huang, 2016).

Social networking sites may be a digital comfort zone for many students (Sarapin & Morris, 2016), which is likely why there has been an influx of studies examining the impact of social media on education (e.g., Ainin et al., 2015; Goh, Rasli, Tan, & Choi, 2019; Greenhow & Gleason 2014; Manca & Ranieri, 2016; Marker, Gnambs, & Appel, 2018; Sharmin, Ahmed, & Sharmin, 2019). Out of class communication (informal

communication) often takes place in virtual settings on social media platforms (Brooks & Young, 2016). Studies examining the association between social media use (such as Facebook) and academic achievement demonstrate positive associations (e.g., Ainin et al., 2015; Junco, 2012), null results (Kolek & Saunders, 2010), and negative associations (Kirschner & Karpinski, 2010). However, when students utilize Facebook as a platform to specifically discuss coursework and connect with peers, there may be more obvious benefits. For example, Bahati (2015) conducted a study where students in a face-to-face class used a private Facebook group for course-related discussions. Results demonstrated that Facebook served as a platform to enhance engagement and promote collaboration.

More recently, it has been suggested that Twitter represents a communication gateway in which faculty and students can provide assistance, comment on tweets, and network with peers (Greenhow & Gleason 2014; Li & Greenhow, 2015). Although it has been established that students connect with their peers on sites such as Facebook and Twitter (Bahati, 2015; Greenhow & Gleason, 2014; Veletsiantos, 2012), researchers have also been investigating the role of the instructor in social media communication. For instance, Imlawi, Gregg, and Karimi (2015) found that engagement, motivation, and satisfaction among students increased significantly when an instructor creates a social network page as an additional platform for students to communicate. Social networks can additionally offer the instructor-student paradigm a unique way to communicate, which may result in a positive experience for both parties (Mazer, Murphy, & Simond, 2007). Therefore, both student-student and student-instructor communication via social media can contribute to greater academic outcomes. Social networks are particularly important

to examine as an additional mode of communication, as they are prevalently used within today's society.

From the review herein, it is evident that many studies examine student-student and student-instructor interaction in distinct modes of communication across modality, which vary in term of formality. Results from these studies indicate that both formal and informal face-to-face and computer-mediated communication are associated with a host of positive academic outcomes (e.g., Acitelli et al., 2003; Balaji & Chakrabarti, 2010; Bower et al., 2015; Czekanski & Wolfe, 2013; Halawah, 2006; Jaasma & Koper, 1999; Li & Pitts, 2009; Smith et al., 2011; Volger et al., 2011; Vu & Fadde, 2013). Therefore, it is important to consider a diverse range of distinct modes of communication when creating a measure of communication.

Putting it All Together: The Concept of Academic Communication

Engagement, participation, and collaboration represent important constructs in higher education. Each of these three constructs have been measured independently and collectively and are predictive of important educational outcomes. From a close examination of these constructs, a common theme of *communication* emerged. However, in the extant literature, there is not currently a measure of communication that spans across modalities and formalities, taking into consideration unique forms of communication. Although studies often delve into detail in one specific niche of communication (i.e., impact of text messaging; class group-work; attending office hours), a broad measure of communication does not exist (i.e., examining multiple communicative modalities). As students continue to be “plugged in”, it is important to examine a multifaceted approach to student communication. Accordingly, a primary goal

of this dissertation research was to develop a new measure of communication in education.

This proposed new construct was labelled *Academic Communication* (AC). AC is conceptualized as encompassing multidimensional forms of student-student and student-instructor communication, including multiple modalities, across formal and informal contexts. AC can be characterised as student communication for the purposes of academic advancement and is based on the sender-receiver paradigm (Tubbs & Moss, 2006), with the underlying expectation that when a student communicates either verbally or non-verbally, a response is warranted.

In previous research, questionnaires have been developed to assess aspects of conceptually related constructs including engagement, participation, and collaboration. However, these overlapping constructs captures only minor components of AC. Accordingly, different forms of communication (as reviewed above) were taken into consideration when developing a questionnaire assessing AC, in order to understand how communication holistically impacts academic experiences. To accomplish this goal, Study 1 involved measure development for the *Academic Communication Inventory* (ACI), including item development, consultations with focus groups, data collection, and extensive psychometric testing.

Study 1

Development and Validation of the Academic Communication Inventory

The following sections describe the development of the *Academic Communication Inventory* (ACI), which occurred in three phases. Next, the factor

structure of the ACI was examined, and an Item Response Theory approach was implemented. Finally, psychometric evaluations of the ACI are presented.

Establishment of Content Validity

Generation of the *Academic Communication Inventory* (ACI) and content validation was conducted in several phases. Phase 1 involved an exhaustive literature search (Simms, 2008), which provided a foundation to develop test items. Completion of this phase also produced appropriate facets and construct domains (Nunnally & Bernstein, 1994). Phase 2 involved sampling two distinct groups of population experts in open-ended interviews (Haynes, Richard, & Kubany, 1995), followed by initial item development. During Phase 3, content validity was assessed through responses to formalized scaling procedures (Hambleton & Rogers, 1991; Haynes et al., 1995). Moreover, careful consideration was given to the weight of measure domains (Haynes et al., 1995). Phases followed the *Standards for Educational and Psychological Testing* (American Educational Research Association, 1999). A detailed description of each phase is presented below.

Phase 1. The development of the ACI arose out of an extensive literature review focussing on engagement, participation, and collaboration across educational environments. The positive association between these constructs, academic success, and satisfaction has been well established (Filak & Sheldon, 2008; Hughes et al., 2008; Kuh et al., 2008). Although engagement, participation, and collaboration are considered to be three distinct constructs, they share significant conceptual and methodological overlap. For example, participation and collaboration appear to be nested within subtypes of engagement (Henrie et al., 2015). By disentangling these constructs, one main connective

theme emerged – *communication*. Interestingly, a multi-faceted measure of communication in the educational context does not appear to exist.

A review of the extant literature revealed three facets of communication in education: (1) context (i.e., face-to-face vs. computer mediated); (2) formality (i.e., formal vs. informal); and (3) communicators (i.e., peers vs. instructors/TAs). These facets, along with studies that examine distinct forms of communications (e.g., frequency of emails - Li & Pitts, 2007; participation- Murray & Lang, 1997; out of class communication – Brooks & Young, 2016) served as the foundation for the initial item pool.

Phase 2. During this phase, two groups of experts were informally interviewed with a simple open-ended question (i.e., “How do students communicate with peers and instructors”). The first group consisted of individuals who specialize in blended learning and Carleton University’s *learning management system*. Experts were chosen due to their extensive knowledge of the Scholarship of Teaching and Learning, and awareness of emerging technologies in higher education. The second group consisted of 10 students (a combination of graduate and undergraduate students) who participated in a focus group. In addition to answering open-ended questions, they also provided additional information regarding preferences in communicative modalities, and opinions regarding how communication impacts academic outcomes. Undergraduate students were considered “experts” as they are part of the sample of interest. They provided insight into innovative communication tools utilized in their cohorts, beyond communication modalities reported in empirical investigations. Graduate students were able to report on their personal communications with undergraduate students during their teaching assistantships.

Results from these focus groups mostly corroborated results from the literature review in terms of effective forms of student-student, student-TA, and student-instructor communication. Many communications, such as in-person and online participation (Murray & Lang, 1997; Smith, 1977), classroom discussions (Kamhi-Stein, 2000), face-to-face and virtual office hours (Kuh & Hu, 2001; Nadler & Nadler, 2000), study groups (Aamodt, 1982; Zhao & Kuh, 2004), email (Li & Pitts, 2009), both online and offline discussions (Ho & Swan; Jaggars & Xu, 2016), and text messaging (Lauricella & Kay, 2013) remained of interest. Expert groups informed minor revisions to the initial item pool from Phase 1.

Phase 3. This phase focussed primarily on content validity. In order for a scale to be considered *valid*, empirical support demonstrating that the scale measures what it claims must be provided (Lawshe, 1975). Thus, additional focus groups were held with three separate groups of students at Carleton University to gather preliminary evidence of the validity of the *Academic Communication Inventory*. The first focus group was relatively unstructured (i.e., no formal scaling procedure), and included 12 Psychology graduate and undergraduate students. Participants provided verbal feedback regarding the content and clarity of the initial pool of 36 items. Based on this feedback, 4 items were dropped and 6 were reworded to increase clarity, resulting in a revised pool of 32 items.

Following this, a second (structured) focus group was conducted with 20 undergraduate students from a fourth-year undergraduate Psychology class. Following a 15-minute presentation on the construct *Academically Communication*, participants were presented with the ACI. Participants rated each of the items for face validity to ensure the variables were assessing the construct of interest (Holden, 2010). Some questions were

raised regarding items assessing informal modes of electronic communications between students and instructors (i.e., “How would we contact an instructor through text message?”). Therefore, two items assessing informal communications with instructors and TAs were dropped from the item pool. Participants also assessed the items for *clarity* ($1 = unclear$ to $5 = very\ clear$), which resulted in further rewording of several items.

The final focus group was conducted with a class of graduate students from an advanced statistics course (*Scale Development and Psychometrics*). Seven peers with knowledge of scale development completed a content validation questionnaire on the 30 items remaining in the ACI. Participants received the ACI and instructions, a definition of *Academic Communication*, facets assessed, and proceeded to complete an item-by-item analysis. Relevance ($1 = not\ very\ relevant$ to $3 = very\ relevant$) and clarity ($1 = not\ very\ clear$ to $3 = very\ clear$) were assessed, and suggestions were provided. Based on feedback, several changes were made to the items. For example, some items were reworded for clarity (e.g., changing “Post on a course discussion board about coursework” to “I post questions on course discussion boards”). Finally, adhering to further suggestions, an additional item was dropped due to lack of relevance (i.e., “I find peers online and add them to social networks for communication”)¹.

The final pool for the ACI was comprised of 29 items (see Appendix C). There were no issues raised with the 5-point scale. Participants responded to ACI items on a scale ranging from $1 = strongly\ disagree$ to $5 = strongly\ agree$, with the original scale wording proposed.

The Current Study

¹ Other changes were later suggested, which were not incorporated into this version of the ACI as data collection was underway (i.e., wording of the questions and likert-scale).

The primary goal of the current study was to examine the factor structure, psychometric properties, reliability and validity for the newly created *Academic Communication Inventory Scale*. Following the literature review and results of the content analyses, a conceptual model was hypothesized.

Hypotheses. Based on the divide in communication modalities (i.e., face-to-face versus computer-mediated communication), a two-factor structure was anticipated (see Figure 2). Alternatively, there is some research to suggest that formal and informal communications (e.g., Brooks & Young, 2016; Jaasma & Koper, 1999; Nadler & Nadler, 2000) might fall on distinct factors. Research also suggests that students differentially communicate with instructors compared to their peers (e.g., Brooks & Young, 2016; Gabelnick, MacGregor, Matthews, & Smith, 1990; Hermann, 2013), and thus it is possible that factors may represent interactions with instructors, TAs, or peers, supporting the student-student, student-instructor interaction dichotomy (Moore, 1989).

In terms of validity, a measure of student engagement was used to examine convergent validity. It is well documented that aspects of communication are robustly associated with student engagement (e.g., Bangert-Drowns & Pyke, 2002; Boucheix et al., 2013; Thompson et al., 2012; Zhu, 2006), and therefore it was anticipated that *Academic Communication* and student engagement would be positively associated. Further, it was expected that a measure of sample bias would demonstrate discriminant validity. Researchers have used similar deception scales (e.g., PDS; Paulrus, 1991) as measures of discriminant validity in education research with samples of university students (Slagter van Tryon & Bishop, 2012).

Figure 2. Hypothesized factor loadings for the *Academic Communication Inventory*. A

two-factor solution may consist of different *communication contexts*.

The unique contribution of AC to social connectedness and life satisfaction were also examined. It was anticipated that AC would be uniquely associated with both social connectedness and life satisfaction over and above that of student engagement, demonstrating AC as a differentiated construct.

Study 1 – Method

Participants

Participants were $N = 642$ undergraduate students (24.2% male; 75.5% female; 0.3% other) enrolled at a post-secondary institution in south-eastern Ontario, Canada. Participants completed online questionnaires for course credit. The sample consisted primarily of individuals between the ages of 17-24 (94%), with a mean age of 19.5. Over half of the sample indicated a Caucasian ethnicity (63.7%), followed by Asian or Pacific Islander (13.9%), then African-Canadian (4.2%), Hispanic (2.5%), Aboriginal (.9%), and other (13.1%). Finally, the majority of participants' parents had either a community college, university or graduate school degree (80.1%). The full sample was (randomly) split into two in order to conduct both an Exploratory Factor Analysis ($n = 321$, $M_{age} = 19.15$) and a Confirmatory Factor Analysis ($n = 321$, $M_{age} = 20$).

Procedure

Data for this study was collected via online questionnaire through Carleton University's SONA system. Students enrolled in a first- or second-year psychology course have the opportunity to participate in psychological research for additional course credit. Following institutional ethics approval, measures were posted online to a secure survey website (Qualtrics). After reading the information page and providing informed consent (Appendix A), participants completed a series of questionnaires. Upon

completion of the survey, respondents were debriefed on the purpose of the study and were provided mental health resources in case they experienced any adverse effects while participating (Appendix B). Participants were compensated .5 percent towards a first- or second-year Psychology course that they were enrolled in. Data collection took place across two semesters (Summer 2017 and Fall 2017).

Measures

All measures were completed online through Qualtrics. Qualtrics is a secure survey site, which uses multi-layer security to protect privacy of the data.

Demographic information. Participants were asked to provide basic demographic information including gender, age, ethnicity, parental education, and schooling.

Communication. Participants were asked to fill out the newly created *Academic Communication Inventory* (ACI), which was developed to assess the amount of general communication for the purposes of academic advancement. As indicated in the previous section, this measure has undergone extensive content validity (see Appendix C for proposed measure). The ACI consists of 29 items that span across three different dimensions (i.e., context, formality, communicators). Participants were asked to rate the extent to which they agree with a variety of statements regarding methods of communications on a 5-point scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*). Participants were asked to answer questions with their *typical* communication with peers, instructors and TAs. Summary scores were computed by adding variables that load together on the same factor(s), with higher scores indicating higher levels of communication.

Engagement. To assess *student engagement*, participants completed the *Educationally Purposeful Activities* subscale from the *National Survey of Student Engagement (NSSE)* (Kuh et al., 2008 – See Appendix D). Items assessed various domains of engagement, specifically interactions with faculty, student experiences with diverse others, and involvement in opportunities for active and collaborative learning. Sample items include “asked questions in class or contributed to class discussion”, “worked with classmates outside of class to prepare class assignments” and “used electronic medium (listserv, chat group, internet) to discuss or complete an assignment”, which were responded to on a 4-point scale (ranging from 1 = *never* to 4 = *very often*). This subscale of the *NSSE* has been frequently used with university students and presents good convergent validity and internal consistency, $\alpha = .82$ (Kuh et al., 2008), and demonstrated good internal consistency with the current sample, $\alpha = .88$. Summary scores were computed by aggregating all items, with higher scores indicating higher levels of engagement.

Sample bias. To assess *sample bias*, participants completed the Impression Management Scale of the *Balanced Inventory of Desirable Responding*, version 6 (BIDR-6; Paulhus, 1991; See Appendix E). This measure consists of 20 items that are rated on a 7-point scale (1 = *not true* to 7 = *very true*), which reflects participants’ agreement to statements (e.g., “I never cover up my mistakes”, “I never swear”, “I have never dropped litter on the street”), and has demonstrated good internal consistency, $\alpha = .75$ to $.86$ (Paulhus, 1991). This measure demonstrated acceptable internal consistency with the current sample as well, $\alpha = .72$. Participants who give exaggeratedly desirable responses typically attain higher scores.

Social connectedness. Social connectedness was assessed using the *Social Connectedness Scale – Revised* (SCS-R, Lee, Draper, & Lee, 2001), which consists of 20 items examining participants' feelings of closeness with others in their conventional social world (see Appendix F). Items were rated on a 5-point scale ranging from 1 = *strongly agree* to 5 = *strongly disagree* (e.g., “I am able to connect with other people”, “I feel understood by the people I know”, “I see people as friendly and approachable”). This measure has previously shown good psychometric properties and validity (Lee et al., 2001). Internal reliability in the present sample was excellent, $\alpha = .95$.

Life satisfaction. Participants completed the *Satisfaction with Life Scale* (Diener, 1985), containing 5 items designed to measure global life satisfaction. Items were rated on a 7-point scale ranging from 1 = *strongly agree* to 7 = *strongly disagree* (e.g., “The conditions of my life are excellent”, “If I could live my life over, I would change almost nothing”, “In most ways my life is close to my ideal”), see Appendix G. Items were reverse-coded, and therefore higher scores indicate greater satisfaction with life. Internal consistency of this scale has been high, and positive correlations with other measures of subjective wellbeing have been reported (Diener, 1985). Internal reliability in the present sample was $\alpha = .86$.

Study 1 – Results

Preliminary Analyses

Missing data. Following protocol set out by Tabachnik and Fidell (2013), missing data was addressed for all variables of interest. Participants were deleted from the dataset based on completion of critical study variables. For example, if participants did not complete the majority of the *Academic Communication Inventory*, or responded

consistently with a “2”, then data was further inspected and subject to deletion. Following preliminary data screening, more explicit missing data analyses were implemented. Data were found to be missing completely at random, $p = .071$ (MCAR test; Little, Jorgenson, Lang, & Moore, 2014). Thus, full-information maximum likelihood (FIML) was used to handle missing data (Enders, 2010). FIML is currently considered one of the most appropriate and respectable methods of dealing with missing data (Little, Jorgenson, Lang, Whitney, & Moore, 2014).

Detecting outliers. The next set of analyses examined univariate and multivariate outliers. A univariate outlier is determined by an extreme value on one variable (Tabachnik & Fidell, 2013). Univariate outliers were examined by investigating standardized scores in conjunction with graphical representation. No standardized scores exceeded 3.29 and no issues were found through visual inspection of data points (Tabachnik & Fidell, 2013).

Multivariate outliers occur if there is a strange combination of scores on two or more variables, resulting in distorted statistics (Tabachnik & Fidell, 2013). Multivariate outliers were investigated via diagnostic statistics examining mahalanobis’ distance. Mahalanobis distance measures the extent to which cases are multivariate outliers based on a chi-square distribution, using $p < .001$. Results indicated two participants with a mahalanobis’ distance greater than the critical chi-square cut-off, and therefore two cases were removed from the dataset ($df_{critical} = 16.27$; $\alpha_{critical} = .001$).

Assumptions. The next set of analyses tested the assumption of multivariate normality linearity, and homoscedasticity. As indicated below, no major issues were found.

Normality. Multivariate normality is the assumption that each variable and all combinations of variables are normally distributed (Tabachnik & Fidel, 2013). Distributions of all study variables were assessed by statistical and graphical methods. Kolmogorov-Smirnov Test of Normality was conducted and yielded non-significant results for all study variables (all $p > .05$). In a large sample (i.e., greater than 300), statistically significant skewness often does not deviate enough from normality to make a substantive difference in analyses (Tabachnik & Fidell, 2013). Additional descriptive statistics were examined to further investigate absolute values of skewness and kurtosis for each study variable. All study variables remained within the suggested confines of the absolute value ± 2 (Field, 2009; Trochim & Donnelly, 2006), and were therefore deemed normally distributed. Visual inspection of histograms and P-P (probability-probability) plots confirmed that all study variables presented normal distributions.

Linearity. The association between ACI and other study variables was of interest to provide convergent, discriminant, and predictive validity. Therefore, bivariate scatterplots were examined to assess linear relationships between study variables. Bivariate scatterplots of ACI and other variables were examined individually (i.e., ACI and engagement). Upon visual inspection, scatter plots appeared oval-shaped in the anticipated direction, and therefore did not depart from Linearity (Tabachnik & Fidell, 2013).

Homoscedasticity. Homoscedasticity was visually examined through bivariate scatterplots and was not deemed problematic. The Runs Test was conducted to examine the assumption of randomness. Study variables presented p values ranging from .56 to .84. Therefore, it was determined that the sample observations were at random. Next,

multicollinearity was examined and was not found to be of concern. Bivariate correlations of all study variables yielded no coefficients with magnitudes greater than .80, r 's ranging from .041 to .420 (Berry & Feldman, 1985). When inspecting the Variance Inflation Factor (VIF) of study variables, VIF's ranged from 1.06 to 1.82, respectively. Researchers suggest that a VIF exceeding 5 is indicative of multicollinearity (Kutner, Nachtsheim, Neter, & Li, 2004).

Descriptive statistics. For the newly developed *Academic Communication Inventory*, descriptive analyses were conducted at the item level (see Table 1).

Factor Structure of the ACI

To ensure data were suitable for exploratory factor analyses (EFAs), correlations among ACI variables were first examined. Tabachnick and Fidell (2013) suggest only variables that indicate a pattern of associations should be retained in the item pool. Most variables indicated a significant pattern of relations, with several inter-item correlations of $r = .50$ or higher (Tabachnik & Fidel, 2013). Therefore, all original variables were retained.

Issues regarding multicollinearity and singularity were investigated by examining Squared Multiple Correlation (SMC) (Tabachnick & Fidell, 2013). SMCs were examined by investigating tolerance diagnostics (tolerance = $SMC - 1$) of ACI items through iterative regression analyses. Approximations of tolerance statistics and SMC are presented in Appendix H. No items approached a SMC close to 0 or 1, indicating no issues with singularity or multicollinearity (Yong & Pearce, 2013). Thus, the 29 original items were retained.

Table 1

Descriptive statistics of ACI items

	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
ACI 1	3.21	1.25	1.00	5.00
ACI 2*	3.04	1.26	1.00	5.00
ACI 3	4.10	0.90	1.00	5.00
ACI 4*	2.71	1.25	1.00	5.00
ACI 5*	2.47	1.16	1.00	5.00
ACI 6*	2.53	1.17	1.00	5.00
ACI 7	3.42	1.23	1.00	5.00
ACI 8*	2.60	1.15	1.00	5.00
ACI 9	3.76	1.15	1.00	5.00
ACI 10	2.79	1.22	1.00	5.00
ACI 11	3.48	1.23	1.00	5.00
ACI 12	3.48	1.26	1.00	5.00
ACI 13*	3.59	1.21	1.00	5.00
ACI 14*	2.64	1.14	1.00	5.00
ACI 15	2.13	1.09	1.00	5.00
ACI 16	2.08	1.08	1.00	5.00
ACI 17*	2.46	1.23	1.00	5.00
ACI 18	2.18	1.11	1.00	5.00
ACI 19	2.24	1.09	1.00	5.00
ACI 20	2.23	1.11	1.00	5.00
ACI 21	2.76	1.24	1.00	5.00
ACI 22	3.22	1.29	1.00	5.00
ACI 23	3.24	1.28	1.00	5.00
ACI 24	3.18	1.27	1.00	5.00
ACI 25*	3.58	1.35	1.00	5.00
ACI 26*	3.36	1.40	1.00	5.00
ACI 27	1.66	0.96	1.00	5.00
ACI 28*	3.20	1.38	1.00	5.00
ACI 29*	3.00	1.41	1.00	5.00

* Denotes items that were retained in the final ACI.

Next, *Bartlett's Test of Sphericity* was examined to confirm an adequate pattern of relations among variables, $\chi^2(406) = 10197.71, p < .001$. Therefore, variables are likely related and suitable for a factor analysis. Finally, in order to determine if the sample is adequate for an EFA, the *Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy* was examined, $KMO = .90$, which indicates the proportion of variance among items may be caused by an underlying factor structure (Yong & Pearce, 2013).

Exploratory factor analyses. Principal Axis factor analyses were performed using a Promax oblique rotation to determine the initial factor structure of the 29 items of the ACI. Although orthogonal rotations are typically used in EFA's (Yong & Pearce, 2013), it was expected that different forms of communications would be inter-correlated, rendering orthogonal rotations inappropriate. Number of factors retained was determined following *Kaiser's Criterion* (retaining number of factors with an eigenvalue > 1). This method of factor retention is standard in EFA's using SPSS, and indicated a six-factor solution. The six-factor solution accounted for 65.97% of variance of dimensionality.

From a theoretical perspective, there is no clear conceptualization or interpretability of factors in the six-factor solution. The factors deviate considerably from hypotheses. Statisticians suggest that an interpretability criterion is essential in factor analyses. For example, Suhr (2006) emphasized that items on a factor must share some conceptual meaning, and that variables loading on different factors should measure different facets of a construct. One item did not load on any one factor (i.e., "I answer questions posed by instructors on online polling systems"). Other items cross-loaded on several factors (i.e., "I drop by my instructor or TAs office without making an appointment", "I send peers emails to ask questions about coursework", "I send TAs

emails to ask questions/clarification about coursework”, and “I send instructors emails to ask questions/clarification about coursework”). Therefore, these items presented issues that warranted close consideration (Costello & Osborne, 2005), and were subsequently dropped from the ACI.

After removing problematic items from the original measure (e.g., low-loadings, cross loadings), the data was re-analysed (Costello & Osborne, 2005). A second EFA was conducted to assess the factor structure of the remaining 24 items. A six-factor solution was once again proposed, accounting for a total of 70.61% variance of dimensionality. Similar to the initial EFA, there was no conceptual model accounting for the different factors, and therefore items were once again inspected. One item was dropped due to poor factor loadings (“I stop my TAs outside of class to discuss the course”). Three more items were dropped due to cross loadings on multiple factors (“I send TAs instant messages on social networks about coursework”, “I talk to the instructor before/after class about course work”, and “I post on discussion boards that are not monitored by an instructor). After inspection of remaining items, the item regarding “question and answer sessions” was dropped, due to relevance with the remaining items. Finally, two items presented high factor loadings but were almost identical in nature and therefore the item with the higher factor loading was retained.

A third EFA was conducted with the remaining 18 items. A four-factor solution was proposed, accounting for a total of 66.49% variance of dimensionality. Items on unique factors appeared to share conceptual overlap, with a factor consisting of communications with *peers*, and another factor consisting of communications with *instructors*. Researchers argue that following *Kaiser’s Criterion* may result in an

overestimation of factors extracted (e.g., Costello & Osborne, 2005; Field, 2009; Velicer & Jackson, 1990). For example, Costello and Osborne (2005) tested this assertion by conducting a Monte Carlo analysis and found that 36% of their sample retained too many factors by using this criterion. Therefore, researchers have been suggested considering theoretical foundation (Slocum-Gori & Zumbo, 2011). Thus, it is possible that a smaller number of factors may be more appropriate, especially when considering theory. Upon visual inspection of Cattell's Scree test (see Figure 3) in conjunction with theoretical underpinnings, there is an argument for a one-, two- or three-factor solution.

Fixed-factor analyses. Following protocol suggested by Costello and Osborne (2005), data was re-analysed with factors fixed to a four-, three-, two-, and one-factor solution. As mentioned, the four-factor solution accounted for a total of 66.49% variance of dimensionality but presented a few issues with poor factor loadings and cross loadings and was therefore deemed unsuitable. The fixed three-factor model accounted for 59.78% of variance of dimensionality, with clear loadings on each factor ranging from .340 to .831 on factor 1, .456 to .826 on factor 2, and .409 to .898 on factor 3 (see Appendix I). The fixed two-factor solution accounted for a total of 50% variance of dimensionality, with factor loadings ranging from .396 to .793 on factor 1, and .300 to .804 on factor 2 (see Appendix J). Finally, the fixed one-factor solution only accounted for a total of 34.42% variance of dimensionality, with loadings ranging from .351 to .668 (see Appendix K).

Figure 3. Cattell's Scree Plot examining the factor structure of the ACI

There is clear conceptual framework for the three-, two-, and one-factor solutions. The three-factor solution presented good factor loadings and can be interpreted as *communication with instructors/TAs* (Factor 1), *communication with peers* (Factor 2), and *communications in class* (Factor 3). Similarly, the two-factor solution presented acceptable loadings and can be interpreted as *communication with instructors/TAs* (Factor 1) and *communication with peers* (Factor 2). The one-factor solution can be interpreted as *academic communication*, with all loading appropriately on a single factor, with the exception of one item. However, the one-factor solution presented issues with variance accounted for, as the suggested cut-off is 50% variance of dimensionality (Maroof, 2012). Factor structures are further compared in subsequent analyses.

Confirmatory Factor Analysis

Confirmatory factor analyses (CFA) were conducted to further validate the ACI and to determine the most appropriate factor structure. It has been suggested that CFA's can greatly enhance confidence in the structural and psychometric properties of a new scale (Noar, 2003). As it is not appropriate to conduct both EFA and CFA on the same data, a different subset of the data was used, $n = 321$ (Noar, 2003; Van Prooijen & Vender Kloot, 2001). CFAs were conducted in Mplus with variances on each factor constrained to 1, with standard program defaults used (i.e., estimator ML; FIML; 20 iterations).

Fit indices were examined for each CFA to examine model fit, including: (1) Chi-Square (non-significant demonstrating good fit); (2) Root Mean Square Error of Approximation (RMSEA; less than .08 for acceptable fit, MacCullum, Browne, and Sugawara, 1996); (3) Standardized Root Mean Square Residual (SRMR; a value less than

.08 indicates good fit, Hu & Bentler, 1999); (4) Comparative Fit Index (CFI; close to .90, Kline, 2005); and both (5) Akaike Information Criteria (AIC); and (6) Bayesian Information Criteria (BIC), which are comparative measures, with lower values indicating better fit.

First, a single factor CFA was examined. Modification indices did not suggest any changes that were theoretically justifiable, and therefore the originally specified single factor CFA was retained. Researchers including Tabachnik and Fidell (2013) and Comrey and Lee (1992) have posited a stringent approach to acceptable CFA factor loadings, with loadings ranging from .32 (poor), .45 (fair), .55 (good), .63 (very good), or .71 (excellent). Based on these guidelines, the single factor ACI demonstrated poor to high factor loadings (See Appendix L), ranging from .313 to 1.041. Factor loadings exceeding 1.00 are not problematic as factors are considered oblique, and thus loadings represent regression coefficients and not correlation coefficients (Jöreskog, 1999)². Fit indices demonstrated poor fit for the one-factor solution (see Table 2).

A second CFA was then conducted to examine the two-factor solution. Both the ACI *instructors* and *peers* subscale presented adequate to excellent factor loadings, ranging from .499 to 1.088 (see Appendix M). Compared to the one-factor solution, the two-factor solution presented improved fit indices (see Table 2). Similar to the one-factor CFA, a handful of factor loadings on the *peers* subscale exceeded 1.0. Although the Chi-square test of model fit was significant ($p < .001$), the CFI was within appropriate range for acceptable model fit, the RMSEA indicated moderate fit, and the SRMR value was

² Factor loading over 1.00 may be problematic if error variances are *negative*. All error variances from both the 1 and 2 factor CFA were positive.

Table 2

Fit indices of the one-factor and two-factor CFA

	χ^2	CFI	RMSEA	SRMR	AIC	BIC
One-factor	.001	.732	.144	.147	16318.05	16536.80
Solution						
Two-factor	.001	.90	.080	.073	14646.20	14870.06
Solution						
Three-factor	.001	.90	.087	.067	14652.25	14876.11
Solution						

less than .08, indicating good fit (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; McDonald & Ho, 1990; MacCallum et al., 1996). Further, the AIC and BIC values were substantially lower for the two compared to one-factor solution, indicating better fit.

Finally, a third CFA was examined to test the three-factor solution. Results were comparable to the two-factor CFA. All subscales presented good to excellent factor loadings (see Appendix N) – with some values exceeding 1.0. Fit indices were *relatively* similar to those found for the two-factor solution. For example, CFI was found to be the same, while the RMSEA was slightly higher (indicating poorer fit), but the SRMR was lower (indicating better fit). Both the AIC and BIC values were found to be slightly elevated in the three-factor solution compared to the two-factor solution, indicating that the two-factor solution presents a *marginally* better fit overall. Accordingly, the two-factor solution was retained moving forward, comprised of *communication with peers* and *communication with instructors* subscales.

IRT Analyses

In IRTPRO Version 4.0, a 2PL Item Response Theory (IRT) using a graded response model (GRM) was conducted on the CFA sample ($n = 321$) under the assumption that no guessing was involved in participant responses, and that items varied in terms of location and discrimination (Thissen & Orlando, 2001). Due to the assumption of unidimensionality, individual IRT analyses were conducted for each factor (i.e., subscale) of the ACI, including *peers* (8 items) and *instructors* (10 items).

Unidimensionality. To support the assumption of unidimensionality of each subscale, please refer to the aforementioned CFA results. Items distinctly loaded on two factors of the ACI. Furthermore, each factor provided good internal consistency ($\alpha = .88$,

.86). Additionally, results of the CFA demonstrated that a two-factor fit was more appropriate compared to a one-factor solution. Bivariate correlations were conducted in SPSS to examine the interrelations among items for each subscale, all yielding significantly positive inter-item associations. The ACI *communications with instructors* subscale (i.e., Factor 1) presented significant inter-item associations ranging from $r = .32$ to $.89$ and the ACI *communication with peers* subscale (i.e., Factor 2) presented significant inter-item associations ranging from $r = .28$ to $.79$. Taken together, these findings demonstrate support for unidimensionality of individual subscales, and local dependence of items within each subscale (Chen & Thissen, 1997).

IRT ACI subscales. Table 3 displays discrimination (α) and threshold parameter values (β 's) for all items within the *peers* and *instructors* subscales. Table 4 presents item and test information values at different levels of the latent traits.

Instructors subscale. The discrimination values for most items on the ACI *instructors* subscale were moderate to high (α ranging from $.65$ to 1.34 is considered moderate, 1.35 and above is considered high; Baker, 2001), with the values ranging from 0.86 to 2.03 . Only one item fell below the acceptable range ("I attend my instructors' virtual office hours to ask questions", item 20; $\alpha = 0.55$). Therefore most items present good ability to discriminate people at different levels of the underlying trait. The β_1 values for all items had a wide range from 2.37 to $.98$ below the mean, while β_2 values ranged from $.08$ below the mean to $.31$ above the mean. The β_3 values ranged from $.71$ to 1.48 above the mean, and the β_4 values ranged from 2.16 to 4.69 above the mean trait level. Relative to other threshold parameter estimates, the same item presenting low discriminability (item 20) demonstrated outstanding threshold values.

Table 3

IRT parameter estimates for the ACI subscales

	Item parameter estimates				
	α	β_1	β_2	β_3	β_4
<i>Instructors Subscale</i>					
I participate in classroom discussions	0.86(.10)	-1.78(.21)	-0.08(.10)	1.01(.14)	3.47(.39)
I answer questions posed by instructors during class	1.22(.12)	-1.38(.14)	0.01(.08)	0.96(.11)	2.72(.25)
I ask questions during lecture or seminar	1.55(.14)	-1.07(.10)	0.09(.07)	0.90(.09)	2.19(.17)
I attend TA office hours to ask questions	2.03(.18)	-1.00(.09)	0.06(.06)	0.71(.07)	1.95(.13)
I attend instructors office hours to ask questions	1.62(.14)	-1.13(.10)	0.04(.07)	0.86(.08)	2.16(.16)
I make appointments to meet with instructors/TAs	1.76(.16)	-0.98(.09)	0.13(.06)	0.90(.08)	2.25(.17)
I talk with the instructor/TA outside of class to discuss the course	1.45(.13)	-1.03(.11)	0.31(.07)	1.20(.10)	2.81(.24)
I post on discussion boards that are monitored by the instructor	0.99(.10)	-1.42(.16)	0.10(.09)	1.26(.14)	3.31(.34)
I attend TA virtual office hours to ask questions	0.91(.10)	-1.46(.18)	0.09(.10)	1.36(.16)	3.34(.37)
I attend instructors' virtual office hours to ask questions	0.55(.09)	-2.37(.39)	0.00(.15)	1.48(.26)	4.69(.74)

Peers Subscale

I contribute to conversations with peers during group-work	0.25(.13)	-8.13(2.8)	-4.04(1.5)	-2.05(.76)	4.38(1.52)
I talk with peers before/after class about coursework	0.23(.18)	-7.03(.23)	-2.96(1.1)	-0.62(.42)	5.84(2.2)
I meet with peers to discuss coursework outside of class	0.41(.20)	-5.24(.11)	-2.77(.61)	-1.50(.37)	2.73(.61)
I talk with peers outside of class to discuss the course	1.06(.11)	-2.41(.24)	-1.48(.16)	-0.90(.12)	1.33(.15)
I send peers text messages about coursework	1.89(.18)	-1.79(.13)	-1.10(.09)	-0.58(.07)	0.90(.09)
I send peers instant messages on social networks about coursework	2.18(.20)	-1.69(.11)	-0.98(.08)	-0.45(.06)	0.92(.08)
I use “online groups” to discuss coursework with peers	1.93(.18)	-1.57(.12)	-0.99(.09)	-0.45(.07)	0.99(.09)
I create/use “shared online documents” for communication about coursework/studying	1.40(.13)	-1.76(.15)	-1.08(.11)	-0.52(.08)	1.03(.10)

Table 4

Item and test information for the ACI subscales

	θ				
	-2.4	-1.2	0.0	-1.2	2.4
<i>Communication with</i>					
<i>Instructors</i>					
I participate in classroom discussions	0.18	0.22	0.23	0.22	0.21
I answer questions posed by instructors during class	0.26	0.43	0.46	0.45	0.42
I ask questions during lecture or seminar	0.24	0.64	0.73	0.72	0.61
I attend TA office hours to ask questions	0.21	1.03	1.24	1.13	0.85
I attend instructors office hours to ask questions	0.26	0.70	0.80	0.77	0.66
I make appointments to meet with instructors/TAs	0.22	0.78	0.94	0.89	0.80
I talk with the instructor/TA outside of class to discuss the course	0.22	0.55	0.63	0.63	0.59
I post on discussion boards that are monitored by the instructor	0.20	0.28	0.31	0.30	0.28
I attend TA virtual office hours to ask questions	0.18	0.24	0.26	0.26	0.24
I attend instructors' virtual office hours to ask questions	0.09	0.09	0.10	0.10	0.09

Peers scale

I contribute to conversations with peers during group-work	0.02	0.02	0.02	0.02	0.02
I talk with peers before/after class about coursework	0.02	0.02	0.02	0.02	0.02
I meet with peers to discuss coursework outside of class	0.05	0.05	0.05	0.05	0.05
I talk with peers outside of class to discuss the course	0.32	0.35	0.31	0.30	0.21
I send peers text messages about coursework	0.66	1.11	0.93	0.84	0.19
I send peers instant messages on social networks about coursework	0.69	1.46	1.22	1.09	0.17
I use “online groups” to discuss coursework with peers	0.52	1.16	1.00	0.92	0.21
I create/use “shared online documents” for communication about coursework/studying	0.42	0.62	0.58	0.51	0.22

Inspection of the ACI *instructor* items category response curves (CRC) demonstrated that generally speaking, there was moderate separation in the response options. For the majority of the *instructors* subscale items (i.e., items 2, 4, 5, 6, 8, 14, and 17), the first response option mostly covered the area below the mean trait level, while the second, third, and fourth response option mostly covered below and above the mean trait level. The fifth response option mostly covered the area above the mean trait level (see Figure 4, row 1 for an illustration). However, when examining the CRCs for the remaining items (i.e., items 1, 19, and 20) there was considerable overlap between response options (see Figure 4, row 2 for an illustration).

When examining the *instructor* subscale estimates in Table 4 along with Figure 6 (total information curve), results indicated the *instructor* subscale test information was adequate for 1.5 SD below the mean trait level to 3 SD above the mean trait level. However, there was a degree of variability in the item information, which subsequently impacts the reliability. Items “I participate in class discussions” – item 1, “I attend TA virtual office hours to ask questions” – item 19 and “I attend my instructors’ virtual office hours to ask questions” – item 20, showed relatively low information values. The remaining items demonstrated relatively high information values, particularly between 1 SD below the mean and 2.5 SD above the mean trait level. Taken together, the *Instructors* subscale was reduced to 7 items.

Figure 4. Items illustrating category response curves (CRCs) and Item Information

Function for selected items in the *Instructors* subscale. Row 1 displays sample items with good separation and information. Row 2 displays items with comparably poor separation and information.

Figure 5. Total Information Curve for the ACI *Instructors* subscale.

Peers subscale. The discrimination values for several items range from moderate to high (Baker, 2001), α ranging from 1.06 to 2.18 (i.e., items 13, 25, 28, 30, and 31), see Table 6. Therefore, these items presented good ability to discriminate people at different levels of the underlying trait. However, the first three items in the *peers* subscale presented poor discriminability (“I contribute to conversations with peers during class discussion”, item 3; “I talk to peers before/after class about coursework”, item 10; and “I meet peers to discuss coursework outside of class”, item 11). The threshold parameters mirror these results, with these three items presenting outstanding β values (i.e., β_1 ranging from -8.13 to -5.24; β_2 ranging from -4.40 to -2.77; β_3 ranging from -2.05 to -0.45; and β_4 ranging from 2.73 to 5.84). The β_1 values for the remaining items ranged from 2.41 to 1.57 below the mean, and the β_2 values ranged from 1.48 to .98 below the mean. The β_3 values ranged from .90 to .45 below the mean, and the β_4 values ranged from .90 to 1.33 above the mean trait level.

Inspection of the CRCs for ACI *peers* items showed that there was fairly good separation in the response options for the same items that presented a moderate ability to discriminate among individuals and consistent threshold parameters. For these items, the first, second, and third response options covered mostly the area below the mean trait level, the fourth response item generally covered areas above and below the mean, while the fifth response option covered mostly the area above the mean trait level (see Figure 6, row 1 for an illustration). Items that presented issues with discriminability and threshold parameters demonstrated poor separation in response options, generally covering both above and below the mean trait level (see Figure 6, row 2 for an illustration).

Figure 6. Items illustrating category response curves (CRCs) and Item Information Function for selected items in the *Peers* subscale. Row 1 displays sample items with fairly good separation and information. Row 2 displays items with poor separation and information.

Figure 7. Total Information Curve for the ACI *Peers* subscale.

When examining Table 4 (item information parameters) and Figure 7 (total information curve), was demonstrated that generally speaking, the *peers* subscale test information was good for 2 SD below the mean trait level to 2 SD above the mean trait level. Furthermore, many items showed reasonable item information functions (and therefore good reliability). However, it should be noted that problematic items aforementioned did not contribute substantial information to the subscale as a whole. Taken together, the *Peers* subscale was reduced to 5 items (See Table 5 for the final subscales).

Reliability Analyses

Cronach's alpha was computed for the final version of the ACI subscales. Coefficient alpha refers to the internal consistency of items within each scale, with some suggesting that values above .70 provide adequate internal consistency (Nunnally, 1978). Internal consistency is important to examine in the development of a new scale. For instance, internal consistency refers to how well items on a test measure the same construct (Steiner, 2003), and is therefore essential to examine in measure development. It is important to note that coefficient alpha may be impacted by several conditions, most notably inter-item correlations (Cronbach, 1951).

Using SPSS, Cronbach's alpha was calculated for each subscale of the ACI. *Communication with Instructors* (7 items) demonstrated good internal consistency ($\alpha = .87$). *Communication with peers* (5 items) also demonstrated good internal consistency ($\alpha = .85$).

Table 5

Final items retained on the Instructors and Peers subscales

Communication with Instructors

- I answer questions posed by instructors during class
- I ask questions during lecture or seminar
- I attend TA office hours to ask questions
- I attend instructors office hours to ask questions
- I make appointments to meet with instructors/TAs
- I talk with the instructor/TA outside of class to discuss the course
- I post on discussion boards that are monitored by the instructor

Peers scale

- I talk with peers outside of class to discuss the course
 - I send peers text messages about coursework
 - I send peers instant messages on social networks about coursework
 - I use “online groups” to discuss coursework with peers
 - I create/use “shared online documents” for communication about coursework/studying
-

Construct Validity

Construct validity was assessed to determine the degree to which the *Academic Communication Inventory* (ACI) measures what it intends to. Both convergent and discriminant validity were examined.

Convergent validity. To assess convergent validity, the associations between the subscales of the ACI and *Student Engagement* (SE) were examined, utilizing the Pearson product-moment correlation coefficient (Messick, 1989). Variables must be at least modestly associated to support convergent validity (Garson, 2001). Both subscales of the two-factor solution demonstrated a modest correlation with SE (*peers* subscale: $r = .437$; *instructors* subscale: $r = .424$).

Divergent validity. To assess discriminant validity, ACI subscale total scores were correlated with BIDR-6, also utilizing the Pearson product-moment correlation coefficient (Messick, 1989). Following guidelines of Farrell and Kotrlik (2003), for the presence of discriminant validity evidence associations between constructs must be low. There was no significant correlation found between either subscale of the two-factor solution and the BIDR-6 (*peers* subscale: $r = .002$; *instructors* subscale: $r = .046$).

Unique contributions of the ACI. The purpose of the next set of analyses was to examine the unique contribution of the ACI to outcome variables over and above *Student Engagement* (SE). For example, SE has been found to be positively associated with social connectedness and satisfaction. A series of hierarchical regressions were computed for each outcome of interest (i.e., social connectedness and satisfaction). For each regression equation, main effect variables (i.e., engagement, communications with instructors, communication with peers, and gender) were entered at Step 1, and the interactions of

interest (instructors x gender, peers x gender) were entered at Step 2. Results discussed below indicate that the subscales of ACI uniquely contribute to other outcome variables.

Social connectedness. In the prediction of self-reported *social connectedness*, results indicated a significant main effect of *student engagement* and *peers*, but not *instructors* or *gender* at Step 1. Student engagement was found to be positively associated with social connectedness. Communication with peers was positively related to feelings of social connectedness. At Step 2, there were no significant interactions of *instructors* x *gender* or *peers* x *gender*. For full results, see Table 6.

Satisfaction with life. In the prediction of self-reported *satisfaction with life*, results indicated no significant main effects of *student engagement*, *instructors*, *peers*, or *gender*. At Step 2, there were no significant interactions of *instructors* x *gender* or *peers* x *gender*.

Table 6.

Hierarchical Regression Analyses Predicting Self-Rated Indices of Wellbeing

Outcome Variable	Predictor Variables	β	ΔR^2	ΔF
Connectedness 5.998**	Step 1		.042	
	<i>Student engagement</i>	.099*		
	<i>Instructors</i>	-.061		
	<i>Peers</i>	.160*		
	<i>Gender</i>	.036		
	Step 2		.001	.187
	<i>Instructors x Gender</i>	.012		
	<i>Peers x Gender</i>	-.029		
Satisfaction	Step 1		.008	1.178
	<i>Student engagement</i>	.168		
	<i>Instructors</i>	-.009		
	<i>Peers</i>	.041		
	<i>Gender</i>	-.023		
	Step 2		.003	.782
	<i>Instructors x Gender</i>	-.062		
	<i>Peers x Gender</i>	.004		

* Significant at a .05 level

Study 1 – Discussion

The main goal of Study 1 was to examine the psychometric properties, reliability, and validity of the newly developed *Academic Communication Inventory* (ACI).

Therefore, the ACI underwent rigorous statistical testing. The results demonstrated that the best fitting (theoretically and statistically) structure of the ACI was a two-factor solution, consisting of the subscales: (1) communication with instructors; and (2) communication with peers. Suhr (2006) highlights the importance of interpretability of factors, with a clear theoretical basis pertaining to factor loadings, which guided the decision relating to the final factor structure of the ACI. The *instructor* subscale involves any communications where the instructor of the course is present³, whereas the *peers* subscale consists of items involving direct communications with classmates.

A confirmatory factor analysis demonstrated acceptable-to-high factor loadings (Stevens, 1992), and adequate-to-good fit indices for the two-factor solution (Byrne & Bentler, 1999; Hu & Bentler, 1999; MacCallum et al., 1996; McDonald & Ho, 1990). Next, IRT analyses were conducted on each unidimensional subscale, with the both subscales presenting good items. Items that did not meet the minimum requirements of the IRT analyses were removed (as suggested by Baker, 2001; Thissen & Orlando, 2001), resulting in the *communication with instructors* subscale consisting of 7 items, and the *communication with peers* subscale consisting of 5 items. Next, the final subscales demonstrated good reliability, convergent and divergent validity, and unique contributions above and beyond a similar construct (i.e., student engagement). The

³ There were some items in this subscale that included Teaching Assistants, but for ease of interpretability the subscale was titled *communication with instructors*.

following sections discuss the resulting factor structure of the ACI and communication across modality and formality.

ACI Factor Structure

Several exploratory factor analyses were conducted to determine which items to retain and which to remove. Items that loaded on their own unique factor were critically inspected, and if deemed necessary, were deleted. For example, “I send peers emails to ask questions about coursework” was removed from the ACI. With the advancement of technological systems for student-student interactions (Borokhovski et al., 2016), communicating with peers via email may be viewed as less efficient. In support of this notion, there is evidence to suggest that students choose other forms of computer-mediated communication over institution-based email, such as direct messaging and text messaging (Cheng & Jiang, 2016; Imlwai, Gregg, & Karimi, 2015; Manca & Ranieri, 2016). It is possible that students may classify email as more formal, and associate emailing with instructor-based communication.

Items were also removed due to poor loadings. For example, “contribute to conversations with peers during group-work” was removed from the communication with peers factor due to the absence of a factor loading of .4 or higher (see Costello & Osborne, 2005). Depending on an individual’s exposure to different course formats (i.e., small seminar vs. lectures), students may not have experienced much opportunity for group work early in their university career. Moreover, it has been suggested that many university courses and large lectures engage in a passive teaching format, with a lack of active learning opportunities (Barr & Tagg, 1996). Items like these and many others were

removed from earlier versions of the ACI based on a combination of empirical and theoretical support when finalizing items on each subscale.

The final subscales of the ACI align with educational theory on communication and interactions in higher education. The theories of communication in education often focus on a student-student and student-instructor dichotomy when referring to interactions with persons (Moore, 1989), which is consistent with the structure of the ACI. Similarly, the *Tubbs Communication Model* lends itself to the results of the ACI factor structure breakdown. According to this model, communication consists of a *communicator 1* (i.e., the sender/receiver), and a *communicator 2* (i.e., the receiver/sender “) (Tubbs & Moss, 2006). With regards to the ACI, the participant completing the questionnaire would be considered *communicator 1* (reporting on their communications with others), and those who the ACI items refers to (i.e., I send peers text messages about coursework) would be *communicator 2* (i.e., peers). Therefore, in reference to this model, the ACI breaks down via *communicator 2* (the original recipient). This model also asserts that communication may take place both verbally and nonverbally. The ACI represents a combination of both verbal and nonverbal forms of communication (i.e., face-to-face; computer-mediated), representative of contemporary education (Bretts, 2009).

It is documented that students often communicate with their peers and instructors in different ways (e.g., Henrie et al., 2015), which may result from levels of comfort, the purpose for the interaction, or accessibility (Gabelnick et al., 1990; Hermann, 2013). For example, communication between students and an instructor may occur because a student requires assistance on an assignment. Researchers suggest that interactions between

students and instructors are often problem focussed and result in the development of higher order learning outcomes, which can assist in the acquisition of deep understanding (Means, Toyama, Murphy, Bakia, & Jones, 2010; Moore, 1989). On the other hand, student-student communications are often collaborative in nature, and focussed on knowledge-sharing (Sher, 2009). Since communications between students and instructors and students and peers may take place for different reasons and may result in different outcomes, the ACI is a novel statistical tool to examine the correlates and outcomes of communications with both peers and instructors uniquely.

Communicative Contexts

It was hypothesized that the ACI may be comprised of subscales featuring different *modalities* (i.e., face-to-face communication; computer-mediated communication). Different modalities are often used for different purposes, and individual differences may contribute to a communicative preference. While students may prefer face-to-face communication as it often facilitates social connection and is unambiguous (Bippus et al., 2003; Hong et al., 2015; Smith et al., 2011; Zhao & Kuh, 2004), they may choose computer-mediated communication for short questions due to efficiency and convenience (e.g., Allen et al., 2006; Cox & Orehovec, 2009; Martinez-Torres et al., 2007; Yao, 2011; Klassen & Vogel, 2003). Moreover, subgroups of students may have a preference for one type of communication over the other. For example, research shows that individuals who experience social anxiety demonstrate a preference for online versus offline communication (see Prizant-Passal et al., 2016 for review), as characteristics of computer-mediated communication serves to reduce stress, enables anonymity, and allows for a rehearsed response (e.g., Bonetti, Campbell, & Gilmore,

2010; Caplan, 2007; Cuhadar, 2012; Lee & Stapinski, 2012; McKenna & Bargh, 2004; Suler, 2004; Walther, Loh, & Ganka, 2005). Contrary to initial speculations, items on the ACI did *not* load of separate factors based on modality.

Since technology is so ubiquitous in our modern world, it is possible that there is no longer a clear divide between communicative modality. For example, it has been documented that people communicate in both face-to-face and computer-mediated modalities simultaneously (Rezaee & Ahmadzadeh, 2012). Harrison and Gilmore (2012) examined college students' texting behaviours. Among their results, they found that 93% of students indicated they have texted someone while they were engaged in a face-to-face conversation with others. It has even been suggested that online communication is invading face-to-face interactions (Kneidinger-Müller, 2017). Students have reported higher levels of course satisfaction when provided with synchronous online chat in addition to face-to-face communication (Spencer & Hiltz, 2003), therefore spanning modality.

Students may engage in academic communication in face-to-face *and* computer-mediated modalities concurrently. For example, it is plausible that students talk to their peers outside of class (face-to-face), while asking another peer a question via text message (computer-mediated). This split-attention form of social interaction is known as parallel communication (Jin & Park, 2012; Kasesniemi & Rautiainen, 2002). The factor structure of the ACI adds to the evidence suggesting that the division of face-to-face and computer-mediated communication may not be as pronounced as it once was (e.g., Jin & Park, 2012; Katz & Aakhus, 2002; Kneidinger-Müller, 2017), and these forms of communication may not be considered differential in modern day education.

Interestingly, the distribution of communication modalities on the *peers* subscale weighed heavier on the computer-mediated side, as compared to face-of-face communication. This may suggest that computer-mediated modes of communication may be more relevant to students with regards to effective academic communications with classmates. Consistent with this, research demonstrates that computer-mediated communications in education are often more task-oriented, effective in reducing anxiety, conducive to idea generation, convenient, and positive with regards to overall task performance (e.g., AbuSeileek, 2012; Campbell & Strasser, 2006; Zhan, Xu, & Ye, 2011; Zornoza, Ripoll, & Peirro, 2002), while face-to-face communications tend to be more social, personal, and effective in building bonds among classmates (e.g., Condon & Cech, 1996; Jonassen & Kwon, 2001; Qiu & McDougall, 2013). For example, results from a study comparing face-to-face and computer-mediated discussion groups indicated that online discussions are more focussed, as there is less time spent socializing (Qiu & McDougall, 2013). Therefore, there may be more items pertaining to computer-mediated forms of communication on the ACI because of the utility and ability to *get straight to the point* when discussing aspects of a course (i.e., asking questions, knowledge sharing, discussing an assignment, etc.).

There was no emergent distinction between formal and informal communication with peers and instructors on the ACI. It is likely that students who have higher levels of communication with their classmates and instructors do so across both contexts. For example, a student who engages in communication with their instructor during office hours (i.e., formal communication) may be more likely to engage in an unscheduled conversation outside of the class (i.e., informal communication). A parallel can be drawn

between this hypothetical situation and the *rich get richer hypothesis*, which is often cited in the computer-mediated communication literature (e.g., Kraut, Kiesler, Boneva, Cummings, Helgeson, & Crawford, 2002; Merton, 1968; Valkenburg, Schouten, & Peter, 2005; Walther, 1996). This hypothesis states that individuals who are already comfortable in social situations use online networks to enhance their social networks (Gross et al., 2002; Kraut et al., 2002; Peter et al., 2005). Similarly, individuals who are already comfortable engaging in formal modes of communication may also use informal contexts to enrich their academic communications. As such, we do not see a distinction between formality.

Contributions of the ACI

The ACI was initially developed out of a thorough literature review of engagement, participation, and collaboration in higher education. By examining these three inter-related predictors of university success (e.g., Filak & Sheldon, 2008; Henrie et al., 2015; Hughes et al., 2008; Kuh et al., 2008), academic communication was found to be an underlying mechanism connecting engagement, participation, and collaboration. For the ACI to be a valuable construct in and of itself, it was important to demonstrate that academic communication uniquely accounts for variance in outcome variables. Among the results, it was found that *communication with peers* was uniquely and positively associated with social connectedness.

Social connectedness is defined as closeness with others in their social world (Lee et al., 2001). Therefore, the positive association between communication with peers (over and above student engagement) and social connectedness makes conceptual sense. For example, a few items retained on the final version of the ACI *peers* subscale (e.g., “I send

peers text messages about coursework”) were developed out of research finding that communicating via instant or text messaging enhances overall interaction and increases feelings of connectedness and rapport among students (Cameron & Webster, 2005; Hu et al., 2004; Quan-Haase et al., 2005). Therefore, it is important to foster communication among students, as higher levels of communication may lead to positive outcomes both inside and outside of the classroom.

Conclusions and Caveats

The purpose of the present study was to examine the validity and reliability of the *Academic Communication Inventory*. Several methods of construct validity were examined, including content validity, substantive validity (i.e., theoretical foundation), structural validity and external validity (Messick, 1989). Results from exploratory factor analyses and confirmatory factor analyses yielded a two-factor solution of *communication with instructors* and *communication with peers*, which fits soundly with theoretical underpinnings. IRT analyses provided evidence of quality items on the *peers* and *instructors* subscales, but also rationale for removing a few problematic items (i.e., poor information and discriminability). The final version of the ACI subscales provided evidence of high reliability estimates as well as good external validity. The ACI is a valuable instrument that can be used in the prediction of academic outcomes in higher education. By examining *academic communication*, we can further our understanding of how communication with instructors and/or peers contributes to a diverse range of academic successes among students.

A few caveats should be mentioned. First, the sample was comprised of only 24.2% males. There is evidence to suggest that males and females place different

importance on communication in the educational setting (Kirkup & von Prummer, 1990), which may subsequently impact the representativeness of the items. Therefore, it would be beneficial to replicate this study design with an equal distribution of males and females, to ensure the ACI upholds the same factor structure. Furthermore, the subscale *communication with instructors* contains one item that refers directly to communication with teaching assistants, and two items that include “instructor/TAs” (e.g., “I talk with the instructor/TA outside of class to discuss the course”). Therefore, high scores on this subscale may likewise indicate higher levels of communication with teaching assistants, though caution should be executed when generalizing.

Next, participants in this study completed the ACI with regards to their *general* communication style. Many studies examine communication in either offline (e.g., Doise & Mugny, 1984; Mehan, 1998; Moore, 1987; Szeto & Cheng, 2014; Tirri & Kuusisto, 2013; Yee, 1971), online (e.g., Balaji & Chakrabarti, 2010; Eid & Al-Jabri, 2016; McLoughlin & Lee, 2007; Stewart, 2013), or blended learning environments (e.g., Park & Bonk, 2007; Rogers, Graham, Rasmussen, Campbell, & Ure, 2003). Therefore, it was of interest to examine the ACI with a context-specific lens, and therefore to assess the ACI across course context (i.e., offline, online, and blended learning courses) to understand if it is a malleable measure of communication. Accordingly, the following study (Study 2) examines the ACI across course context in higher education.

Study 2

Academic Communication across Educational Contexts

Different educational contexts (i.e., offline, online, blended) may provide unique platforms in which students communicate with each other and instructors. Such platforms often provide opportunities for computer-mediated and/or face-to-face interactions, spanning across formality (e.g., Bower et al., 2015; Brooks & Young, 2016; Jaasma & Koper, 1999; Nadler & Nadler, 2000). As the popularity and sophistication of online and blended learning continues to grow (Means, Toyama, Murphy, & Baki, 2013; Parsad & Lewis, 2008; Rudestam & Schoenholtz-Read, 2010), there is an increase in the number of gateways to communicate with peers and instructors. Therefore, Study 2 of this doctoral dissertation examined *academic communication* across educational contexts. The following sections provide an overview of offline, online, and blended learning environments, followed by Study 2's method, results, and discussion.

Educational Contexts

The context in which communications occurs is an essential factor to consider when examining interactions in higher education. There is an abundance of literature examining the advantages and disadvantages between *offline* (i.e., face-to-face, in-person) and *online* education. Overall, results have been somewhat mixed in terms of clearly establishing the most advantageous context for education (e.g., Castle & McGuire, 2010; Dewhurst, Macleod & Norris, 2000; Satterthwait, 2010; Williams & Gani, 1992). However, regardless of the educational context, researchers consistently place a strong emphasis on student-student and student-faculty communication, which facilitates social cohesiveness (e.g., Butz et al., 2014; Szeto & Cheng, 2014). Therefore,

this study examined differences in communication across three distinct instructional contexts: (1) traditional offline learning (face-to-face); (2) online learning (often referred to as distance learning); and (3) blended learning (otherwise known as hybrid learning).

Offline education. The terms *traditional* and *offline* education are often used synonymously. However, it is important to acknowledge the meaning of “traditional education”, as it may carry with it an important connotation. Researchers have argued that traditional education focuses on distributing, producing, and applying knowledge (e.g., Brown & Duguid, 2000; Duderstadt, 2000). It is certainly possible to incorporate these fundamental features of traditional education within the online learning environment. Thus, the term “offline education” was employed predominantly herein, as it is both intuitive and accurate when differentiating educational contexts. Artino and Jones (2012) explain that in an offline classroom setting, instruction occurs in a structured physical environment at a pre-determined time and place with a receptive teacher. Although tech-based pedagogical tools are often utilized within offline education, such as the use of an institutional web-platform, email, and supplementary audio/visual aids (Harasim, 2000), primary teaching and learning occurs within a physical, synchronous environment (Artino & Jones, 2012).

The shift towards online and blended learning has fuelled research to understand the differences in students’ beliefs about learning modalities (e.g., Bower et al., 2015; Castle & McGuire, 2010; Keengwe & Wilsey, 2012), as such cognitions may impact academic experiences. Studies demonstrate mixed findings when examining students’ academic outcomes in offline courses, compared to other course formats (e.g., Castle & McGuire, 2010; Dewhurst, Macleod & Norris, 2000; Satterthwait, 2010; Williams &

Gani, 1992). However, there are several studies that demonstrate student *preference* for offline courses, noting the benefits. For example, Keengwe and Wilsey (2012) reported that students prefer the logistics of offline compared to online learning. Students may perceive it as less stressful to locate a physical classroom compared to navigating through a foreign institutional based platform. Further, Castle and McGuire (2010) found that undergraduate students perceive greater knowledge consumption in face-to-face classrooms as compared to online contexts. Students at the undergraduate level are often overwhelmed and may struggle to manage competing temporal demands (James, Kruase, & Jennings, 2010). Accordingly, some students may benefit from heightened structure in their learning environments. Researchers argue that subgroups of undergraduate students, for example, those low in self-regulated learning (i.e., low internal motivation and self-discipline), may particularly benefit from the organization of a structured synchronous environment (Pintrich, 2000; Zimmermann, 2000).

One of the central advantages that offline learning offers is the inherent social nature of the physical classroom, which positively contributes to frequency and quality of communication (e.g., Doise & Mugny, 1984; Mehan, 1998; Yee, 1971). High levels of social presence in offline learning may satisfy the need for immediate and real-time communication, and often leads to rich spontaneous conversations (Garrison et al., 1999). Norberg (2012) noted that when technology is removed, a teacher must be in the same room with students to build a learning environment. Therefore, conventional learning environments are comprised of strong communication and interaction among physical classroom participants (Mehan, 1998; Moore, 1987; Tirri & Kuusisto, 2013). Accordingly, researchers have argued that social and emotional connectedness cannot be

taken for granted when moving towards online and blended learning (e.g., Butz et al., 2014; Szeto & Cheng, 2014).

Online education. Contemporary education systems increasingly incorporate the use of technology within the classroom environment (Aagaard, 2015). However, technology has also become a channel in which students acquire knowledge within their academic discipline. Artino and Jones (2012) explain that, by its very nature, online learning occurs through the use of technology and the Internet, without temporal and spatial restraints. Additionally, they assert that online learning may often occur without intellectual supports that are present within the traditional offline classroom. Accordingly, online learning relies on the use of synchronous and asynchronous teaching, learning, communication, and interaction within the virtual classroom (Ku & Chang, 2011). Indeed, the vast majority of students are *digital natives* (Parkes, Stein, & Reading, 2015), encompassing a generation who has grown up with access to computers. As a result, such students have developed academically alongside the advancement of technology – and are thus inherently “technology savvy” (e.g., Margaryan, Littlejohn, & Vojt, 2011; Parkes et al., 2015). Consequently, it seems that online learning would be more appropriate for digital natives, as they are likely primed for information intake via computer-mediated means (e.g., Margaryan et al., 2011; Prensky, 2001). However, there continues to be research conducted to test whether virtual environments offer essential components of learning such as social interactions and connectedness (e.g., Anderson, 2003; Borokhovski, Bernard, Tamim, Schmid, & Sokolovskaya, 2016; Butz et al., 2014; Grieve, Padgett, & Moffit, 2016; Szeto & Cheng, 2014).

Major theoretical approaches to contemporary research in online learning all include a focus on the importance of interactions. For example, according to the *Theory of Online Learning* (Anderson, 2004), effective virtual learning environments must encompass a myriad of modalities that enhance interactions. These interactions are described as critical for effective learning and take place when the learning environment is learner-centred, assessment-centred, and community-centred. There is growing evidence to support the tenets of this theory, indicating that with increased interaction comes increased success (e.g., Balaji & Chakrabarti, 2010; Eid & Al-Jabri, 2016; McLoughlin & Lee, 2007; Stewart, 2013). For example, Balaji and Chakrabarti (2010) report that perceived richness of online discussions has a significant positive effect on student participation and interaction, and thereby learning.

The study of online learning can also be rooted in Moore's (1989) *Interaction Theory* (e.g., Henrie et al., 2015), with awareness of the vast implications that student interactions have on education. From this perspective, it is argued that in the online environment, it is crucial that students experience interactions and open communication to foster their intellectual growth (e.g., Wagner, 1994; Woo & Reeves, 2007), especially with the absence of face-to-face interaction. However, just because opportunities for interaction are consciously incorporated into online learning environments does not necessarily translate into student interactivity (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011).

Researchers suggest that there are specific benefits to online learning. For example, some researchers have noted that a particular advantage of online learning is the flexibility and accessibility that it offers, without the demand for a physical environment

(e.g., Waschill, 2001), and that web-based learning presents a fiscally efficient, opportunistic, and asynchronous education (Coopers, 2005; Scanlon, Morris, Di Paolo, & Cooper, 2002). It has also been argued that online learning may help to better meet the needs of a more diverse population of students (e.g., Burdette, Greer, & Woods, 2013; Coy, 2014), provides more opportunities to learn, and increases access to resources (U.S. Department of Education, 2009).

On the other hand, researchers have also highlighted several potential disadvantages to online education. Although students are considered digital natives, they may be unprepared for online learning (Arif, 2001). For example, Parkes et al. (2015) found that students struggle with clarity of responses, synthesizing ideas, making arguments, planning strategies and working with classmates in the online learning environment. Finally, a major disadvantage of online learning is the lack of *real-time communication*. Results from studies suggest that student difficulties in the online environment can be combatted with increased communication and quality interactions with peers and instructors (e.g., Barak et al., 2016; Gomez, Wu, & Passerini, 2010).

Blended learning. A persistent focus of educators is to enhance the learning outcome of students and to reduce attrition in higher education. As such, there has been an emergence of blended learning courses, which offer unique ways to produce and distribute knowledge in an effort to deeply immerse students by combining physical and simulated digital worlds (Orton-Johnson, 2009). Blended learning is an integration of traditional face-to-face learning combined with e-learning activities (i.e., web-based materials) (Garrison & Kanuka, 2004; Graham, 2006; Macdonald, 2008; López-Pérez, Pérez-López, Rodríguez-Ariza, 2011), which has demonstrated positive educational

outcomes among university students (Bernard et al., 2014; Green et al., 2017; Fletcher & Bullock, 2015; Joksimovic et al., 2015; López-Pérez et al., 2011; Shu & Gu, 2018). As such, it is not surprising that the prevalence of blended learning courses has been on the rise for more than a decade (Allen & Seaman, 2006; Garrison & Vaughan, 2007) and is now considered typical in terms of higher education delivery (Norberg, Dziuban, & Moskal, 2011; Porter, Graham, Bodily, Sandberg, 2015).

Moore's (1989) conceptual framework of interaction continues to be influential, specifically with regards to blended learning environments. Three types of interaction (i.e., student-content, student-student, and student-instructor) are encouraged not only in the face-to-face paradigm, but also in the e-learning context. When opportunities for interactivity is increased (i.e., two-way communication), the teaching and learning process is ultimately enhanced (Çardak & Selvi, 2016). The nature of a mixed-modality learning environment such as blended learning courses allows students to discuss, explore, and engage in cooperative learning in diverse ways, and encourages a wide range of learning experiences (Littlejohn & Pegler, 2007). This learning context can present many advantages when compared to both traditional and online learning.

There is growing evidence of substantive benefits to the blended learning context (e.g., Bower et al., 2015; Cunningham, 2015; White, et al., 2010). Generally speaking, students are found to perform slightly better in blended learning courses compared to other formats (Bernard, Borokhovski, Schmid, Tamim, & Abrami, 2014; Northey, Bucic, Chylinski, & Govind, 2015; Ryan, Kaufman, Greenhouse, She, & Shi, 2016). Noteworthy benefits to blended learning environments include reductions in attrition and improving exam grades (López-Pérez et al., 2011), increasing student engagement

(Green, Whitburn, Zacharias, Byrne, & Hughes, 2017) and sense of belonging (Fletcher & Bullock, 2015; Joksimovic et al., 2015). Moreover, blended learning provides opportunities for valuable peer and instructor interaction; increase communication and support, and knowledge sharing without the barrier of a strictly asynchronous environment (Park & Bonk, 2007; Rogers, Graham, Rasmussen, Campbell, & Ure, 2003).

While blended learning environments have many advantages, there have also been some disadvantages found. One of the major barriers includes insufficient technological literacies, which may prevent learners from reaping the rewards of e-learning (Bonk, Olsen, Wisher, & Orvis, 2002). Difficulties may also emerge as a function of learner characteristics. For example, students who are easily distractible, lack self-regulation, or require live guidance may experience increased struggle in a blended learning course, when compared to an offline course format (Hamdan, McKnight, McKnight, & Arfstrom, 2013; Milman, 2013). Finally, research suggests there is often a disconnect between online and offline course content and activities, which may be detrimental to the learning experience (Chigeza & Halbert, 2014; Fedynich, Bradley, & Bradley, 2015).

Interactions across learning contexts. Interactions are an essential component in offline, online and blended learning (e.g., Lau & Tsui, 2009; Liu & Wang, 2010). In offline classes, interactions among students and instructors can be observed through classroom participation, self-reports, and qualitative interviews (e.g., Keengwe & Wilsey, 2012; Murray & Lang, 1997). In a qualitative study, Keengwe and Wilsey (2012) discuss a response from a participant who described his online learning experience as positive but emphasized his eagerness to return to the traditional classroom, where there is more ease

in socializing and interacting with peers. Thus, offline learning satisfies the need for instant communication and ample face-to-face interactions (e.g., Mehan, 1998; Moore, 1987; Tirri & Kuusisto, 2013).

In the online context, researchers often assess students' interaction in terms of their frequency logging into course management system, discussions posts, emails deployed, and private messages exchanged (which is often obtained through trace data and self-report) (e.g., Agudo-Peregrina, Iglesias-Pradas, Conde-Gonzalez, & Hernandez-Garcia, 2014; Arbaugh & Benbunan-Fich, 2007; Macdadyen & Dawson, 2010; Ramos & Yudko, 2008). For instance, Joksimovic and colleagues (Joksimovic, Gasevic, Loughlin, Kovanovic, & Hatala, 2015) examined the impact of interactions on academic achievement in online courses by investigating posts on discussion boards, sharing comments on blogs, exchanging messages within the learning management system, chats, and wikis. Their findings showed that the positive effect of student-student interactions on final grade for core and elective courses was stronger than all other types of interactions.

Communication within offline, online, and blended learning courses are often represented as aspects and/or components of other constructs in the education literature, such as engagement (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Samruayruen, Enriquez, Natakatoong, & Samruayruen, 2013), collaboration (e.g., Caldwell, 2007; Friesen & Kuskis, 2013; Moore & Kearsley, 1996; Roschelle & Teasley, 1995), and participation (e.g., Czekanski & Wolfe, 2013; Murray & Lang, 1997; Smith, 1977). As communication contributes to positive educational experiences across all learning

contexts, it was of interest to determine if the *academic communication inventory* can be utilized in a variety of educational contexts.

The Current Study

The aim of Study 2 was to further examine the reliability and validity of the newly developed ACI in specific course contexts by: (1) conducting Confirmatory Factor Analyses and assessing measure invariance across educational context (i.e., blended courses, online courses, offline courses); (2) examining gender differences in communication; and (3) assessing stability of the ACI subscales (i.e., instructors, peers) over time.

First, it was expected that the ACI's factor loadings and fit indices would be acceptable in each educational context. Moreover, it was anticipated that measurement invariance would be established, which would indicate the ACI has the same factor structure, variances and covariances, and item intercepts across contexts (Chen, 2007). More tentatively, women were also expected to report higher communication scores than men, based on previous literature suggesting that women value communication in education more than men (Kirkup & von Prummer, 1990).

Finally, in term of *temporal* effects, communication scores were expected to increase over time (i.e., at the mean level), as students become familiar and comfortable talking with peers and instructors. However, with regard to rank order, it was anticipated that the ACI would demonstrate moderate stability over time (i.e., students who tended to communicate more at the start of the term would also be those who communicated more later in the term).

Study 2 – Method

Participants

Participants were $N = 1074$ undergraduate students (21.6% male; 77.9% female; 0.5% other) enrolled at a post-secondary institution in south-eastern Ontario, Canada. The sample consisted primarily of individuals between the ages 17-25 (92%), with a mean age of 20.3. Over half of the sample identified as Caucasian (57%), followed by Asian or Pacific Islander (17%), then African-Canadian (7.3%), Hispanic (2.2%), Aboriginal (1.9%), and other (14.6%). The majority of participants' parents had a community college, university or graduate school degree (77%), and most reported living off campus (74.6%). Approximately 54% of the sample reported they were in their first year of university, followed by 30% in their second year, 9% in their third, and 7% in their fourth year or more. In terms of study major, 30% of participants indicated they were in Psychology, followed by 24% in Computer Science, 15% in Finance, 6% in Cognitive Science, and the remaining 25% were dispersed across a wide array of disciplines. Respondents had a typical distribution of GPA, extending to the A range (32.4%), B range (39.2%), C range (22.4%), and D range (4%). About 38.5% of the participants had recent experience with blended, online, and face-to-face course format, whereas 25.8% of participants had recent experience with online and face-to-face format, and 35.4% had recent experience with only face-to-face learning.

A subset of participants ($n = 229$, representing 21% of the original sample) also completed Part 2 follow-up assessments (18% male; 82% female). An attrition analysis was conducted to explore possible biases in the sample as a result of the high attrition. Crosstabs were examined using the variables follow-up (“yes” or “no”), and demographic

characteristics to assess if the sample remained similar in terms of age, gender, ethnicity, and GPA. Of note, there were no significant differences in sample characteristics between those participated in the follow up analyses and those who did not.

Procedure

Data collection for Study 2 occurred in two parts. Part 1 took place at the start of the semester. Students who completed Part 1 were then given the opportunity to participate in Part 2 (which took place about halfway through the semester). Four cohorts of data were collected across four semesters: Cohort 1 in Winter 2018; Cohort 2 in Winter 2019; Cohort 3 in Spring 2019; and Cohort 4 in Summer 2019). The primary reason for these additional cohorts were to increase the number of participants in Part 2.

Prior to data collection, ethical approval was granted through The Carleton University Research Ethics Board-B (CUREB-B), project # 108238. As previously mentioned, data was collected online via Carleton's University's SONA system through a secure survey website (Qualtrics). After participants signed up for Part 1 of this study on SONA (*Exploring the links between communication, education, and wellbeing – Part 1*), they read the information page and provided informed consent (see Appendix O). Next, participants completed a series of questionnaires at their own pace and were told they could skip any question they choose or withdraw from the study at any point. Upon completion of Part 1, respondents were debriefed on the purpose of the study and were provided with mental health resources in case they experienced any adverse effects while participating (see Appendix P and Q). Participants were compensated .5% towards their Psychology course for completing Part 1. Participants who consented to being contacted for Part 2 of the study (*Exploring the links between communication, education, and*

wellbeing – Part 2) were notified via email when the study was posted to SONA (approximately halfway through the semester). Part 2 followed the same procedure as Part 1.

Responses from this large data collection were analysed for different research purposes. For example, the current study examines the ACI in different educational contexts and examines measure stability. Subsequent studies examine open-ended responses to questions posed, and the utility of the ACI in mediation analyses and longitudinal designs. In the following sections, only data and questionnaires specific to the purposes of Study 2 are included.

Measures

All measures were completed online for course credit through Qualtrics. Qualtrics is a secure survey site, which uses multi-layer security to protect privacy of the data.

Demographic variables. Participants completed questionnaires about their demographic information (see Appendix R), including their gender, age, ethnicity, and parental education. Additionally, participants were asked questions about their university experience (i.e., living accommodations, year in university, major, GPA, and course context exposure).

Context. Participants reported if they were currently taking a course in a blended learning format (i.e., online *and* face-to-face). If they selected “yes”, they were instructed to think about a blended learning course they were currently taking when completing the questionnaires. If they selected “no”, they were asked if they were currently taking a course that was fully online. If they selected “yes”, they were instructed to think about an online course they were currently taking when completing the questionnaires. If they

selected “no”, they were instructed to think about an offline course they were currently taking while completing the questionnaires. Based on this information, participants were coded into one of three course contexts (blended course, $n = 414$; online course, $n = 278$; offline course, $n = 382$). This new variable “context” was used in subsequent analyses.

Academic communication. Participants completed the finalized version of the *Academic Communication Inventory* (see Appendix S), to assess their communication for the purposes of academic achievement (consisting of 12 questions) at two time points. The first time point was at the beginning of the term, where they reported on their academic communication in their current course. The second time point was near the end of the term, where they reported on their academic communication again. This time point assessment was used to test the stability of academic communication.

The ACI is comprised of two subscales, including *communication with instructors* (7 questions – e.g., “I attend instructor office hours to ask questions) and *communication with peers* (5 questions – e.g., “I send peers text messages about course work”), and is rated on a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Summary scores were computed by aggregating all items on each subscale, with higher scores indicating more communication. Internal reliability was high in this sample for both the *communication with instructors* ($\alpha = .87$) and *communication with peers* ($\alpha = .88$) subscales. Differing from the previous instructions in Study 1, this time participants were asked to complete the ACI with reference to a particular individual course, in order to assess their *course specific* communication style (i.e., for either a blended, online, or offline course).

Study 2 – Results

Preliminary Analyses

Data management techniques were implemented to clean the data prior to main analyses. Participants were deleted from the dataset based on completion of study variables. For example, if participants only completed demographic variables, they were removed from the dataset. Descriptive analyses were computed to examine the means, standard deviations, and minimum and maximum values to ensure data were in the plausible variable range.

Missing data. For most variables of interest (i.e., ACI subscales, gender, age, course), there was minimal missing data (< 5%). Little's MCAR test was examined and data were found to be missing completely at random for the combination of variables in each set of analyses, p ranging from .225 to .824 (MCAR test; Little, Jorgenson, Lang, & Moore, 2014). Therefore, missing data were imputed using multiple imputation in SPSS – fully conditional specification, which has been shown to work well with both missing completely at random and missing at random (Azur, Stuart, Frangakis, & Leaf, 2011; Sulis & Porcu, 2017). Auxiliary variables were inputted on a theoretical and statistical basis (i.e., moderate to high correlations) to predict missing data, which included a measure of social connectedness (Lee, 2001), and stress (Cohen, 1994). Following recommendations to increase computational power, $m = 20$ imputed data sets were created (Graham, Olchowski, & Gilreath, 2007; White et al., 2011). Results presented reflect pooled estimates.

Outliers. Univariate outliers were examined by investigating standardized scores in conjunction with graphical representation for each variable of interest. There were

univariate outliers found via graphical representation (boxplot), but none were below 3.29 for any variable (Tabachnik & Fidell, 2007), and were therefore retained.

Multivariate outliers were investigated for variables of interest via diagnostic statistics examining mahalanobis' distance. Results indicated three participants with a mahalanobis' distance greater than the critical chi-square cut-off, and therefore three cases were removed from the dataset ($df_{critical} = 18.846$; $\alpha_{critical} = .001$).

Assumptions. Assumptions of multivariate normality, linearity, and homogeneity were examined. Distributions of all study variables of interest were assessed by statistical and graphical methods. Multivariate normality was not considered an issue due to the large sample size. To examine univariate normality, the Kolmogorov-Smirnov Test of Normality was conducted, and produced significant results for all variables (all $p < .001$), meaning that normality was violated. Fortunately, analyses conducted herein (i.e., MANOVA) are fairly robust to deviations from normality with respect to Type I error (Bray & Maxwell, 1985; Weinfurt, 1995). To further investigate, histograms, normality probability plots, and absolute values of skew and kurtosis were examined. All variables remained within the suggested confines of the absolute value ± 2 for skew and kurtosis (Field, 2009; Trochim & Donnelly, 2006), however some variables appeared to be slightly non-normal. Relevant transformations were made (Templeton, 2011), resulting in distributions that approached normality. The pattern of results for subsequent analyses did not differ when comparing original vs. transformed data, and therefore analyses are presented with non-transformed data to ease interpretation.

The assumption of linearity was assessed by visual inspection of bivariate scatterplots for all combinations of continuous variables of interest, and by values of the

residuals against the values of the outcome predicted by the models. The scatterplots appeared to be oval shaped and in the anticipated direction, and there appeared to be no systemic relation between the errors and predicted model (Tabachnik & Fidell, 2007), thus linearity was assumed.

The Runs Test was conducted to examine the assumption of randomness. Study variables presented p values ranging from .59 to .91. Therefore, it was determined that the sample observations were at random. Next, bivariate correlations were examined with no coefficients presenting a magnitude greater than .80 (r 's ranging from .110 to .450) (Berry & Feldman, 1985). Multicollinearity was investigated by inspecting the Variance Inflation Factor (VIF) of relevant variables through an iterative process. VIF's ranged from 1.29 to 2.35, indicating no issue (Kutner, Nachtsheim, Neter, & Li, 2004).

In terms homogeneity of variances and covariances, Box's M test was conducted and found to be non-significant ($p = .672$), indicating that there is homogeneity of covariance matrices. Levene's test of Equality of Error Variances was found to be non-significant for communication with instructors and peers in both time 1 and time 2 ($p = .115$ to $p = .823$), suggesting equal error variances between dependent groups.

Regardless, in subsequent analyses, Pillai's Trace will be interpreted in the subsequent MANCOVA and Repeated Measures MANOVA, as it is considered the most powerful and robust statistic (Pillai, 1955; Seber, 1984).

Examining the ACI across Educational Contexts

Factor structure. The next set of analyses examined the ACI in three different educational contexts. A Confirmatory Factor Analysis (CFA) was conducted for blended, online, and offline courses to ensure the factor structure and fit indices were comparable

and acceptable for each context. Among the results, the ACI demonstrated good to excellent factor loadings in blended courses, online courses, and offline courses on both the *communication with instructors* and *communication with peers*, see Table 7 (Tabachnik & Fidell, 2007). The ACI demonstrated good model fit across all indices with the exception of the Chi-Square (see Table 8), which was significant. Of note, the Chi-Square statistic is very sensitive to sample size (Schlermelleh-Engel, Moosbrugger, & Müller, 2003; Vandenberg, 2006), and therefore cannot be relied upon in the current set of analyses.

Therefore, the ACI demonstrates consistent factor structure across academic contexts. Together with results from Study 1, the ACI can be used to measure a *general* communication style (i.e., how one communicates for academic purposes across all courses), as well as *course specific* communication style (i.e., how one communicates in a specific course context).

Measure invariance. A Multi-group CFA was then conducted to assess measurement invariance across educational context to determine if between-group comparisons can be made in subsequent analyses. Thus, a model specifying *configural* invariance was examined to determine if the underlying factor structure is equivalent across contexts, in which no statistical constraints were applied across groups. Model fit indices demonstrated good fit across educational context, $\chi^2(153) = 433.42$, $p < .001$, RMSEA = .072 [.064, .080], CFI = .958, TLI = .950, SRMR = .061, AIC = 39283.68, BIC = 39866.24, indicating that different groups conceptualized academic communication in the same way.

Table 7
ACI Factor Loadings Across Context

	Blended		Online		Offline	
	Instruct	Peers	Instruct	Peers	Instruct	Peers
I answer questions posed by instructors during class	.545		.543		.479	
I ask questions during lecture or seminar	.619		.705		.555	
I attend TA office hours to ask questions	.828		.803		.745	
I attend instructors office hours to ask questions	.832		.870		.810	
I make appointments to meet with instructors/TAs	.862		.865		.837	
I talk with the instructor/TA outside of class to discuss the course	.806		.775		.733	
I post on discussion boards that are monitored by the instructor	.576		.583		.455	
I talk with peers outside of class to discuss the course		.745		.785		.732
I send peers text messages about coursework		.917		.843		.839
I send peers instant messages on social networks about coursework		.827		.917		.841
I use “online groups” to discuss coursework with peers		.530		.661		.656
I create/use “shared online documents” for communication about coursework/studying		.517		.667		.541

Table 8

Fit indices of the ACI across educational contexts

	χ^2	CFI	TLI	RMSEA	SRMR
Blended	.001	.945	.957	.077	.053
Online	.001	.964	.952	.073	.063
Offline	.001	.945	.956	.077	.053

Statistics in bold meet minimum required cut-off.

Next, *metric* invariance was examined by constraining factor loadings to be equivalent across groups. Similar to configural invariance, results indicated good fit, $\chi^2(175) = 468.85$, $p < .001$, RMSEA = .068 [.061, .076], CFI = .956, TLI = .950, SRMR = .069, AIC = 39275.12, BIC = 39748.14. Thus, differences in factor variances and covariances are not due to course context (Chen, 2007), and participants have a similar interpretation of the underlying latent construct of academic communication.

The ACI was then tested for *scalar* invariance, and demonstrated adequate-to-poor fit $\chi^2(197) = 598.63$, $p < .001$, RMSEA = .075 [.069, .082], CFI = .939, TLI = .939, SRMR = .095, AIC = 39360.89.12, BIC = 39750.37, with only RMSEA and CFI values in the acceptable range. Therefore, *partial* scalar invariance was examined, in which constraints on factor loadings and intercepts were removed through an iterative process. For example, based on the size of item intercepts, constraints were freed on 3 item intercepts on the *communication with peers* subscale, and 2 intercepts on the *communication with instructors* subscale. Researchers note that as long as there are at least two factor loadings and intercepts constrained to be equal across groups, valid inferences can be made about the differences between latent factor means (Bryne, Shavelson, & Múthen, 1989). The ACI obtained adequate, $\chi^2(187) = 520.63$, $p < .001$, RMSEA = .071 [.064, .078], CFI = .949, TLI = .950, SRMR = .079, AIC = 39298.15, BIC = 39681.54. Therefore, the ACI subscales can be meaningfully compared across educational context in subsequent analyses.

Mean differences. The next set of analyses examined mean differences in ACI contexts and subscales and gender. Therefore, a MANOVA was conducted with *communication* (instructors, peers) serving as within subject variables, *gender* (male,

female) and *context* (blended, online, offline) serving as independent variables.

Bonferroni corrections were made with comparisons within each effect considered a family of comparisons (Tabachnik & Fidell, 2007).

There was a statistically significant main effect of communication $F(1, 1072) = 210.55, p < .001$, partial $\eta^2 = .166$ and context $F(2, 1073) = 18.38, p < .001$, partial $\eta^2 = .033$, but not gender, $F(1, 1073) < .001, p = .976$, partial $\eta^2 = .001$. The main effect of communication was superseded by a significant interaction effect for communication X by gender $F(1, 1073) = 13.64, p < .001$, partial $\eta^2 = .013$ and communication X context $F(2, 1072) = 6.20, p = .002$, partial $\eta^2 = .012$. There was no interaction effect of gender by context $F(2, 1072) = 2.27, p = .104$, partial $\eta^2 = .004$ or three-way interaction of communication X gender X context, $F(2, 1072) = .920, p = .339$, partial $\eta^2 = .002$.

For the main effect of communication, results from post-hoc analyses (one-sample *t*-test) indicated that students reported significantly more communication with peers ($M = 3.09, SD = 1.22$) than with instructors ($M = 2.28, SD = 1.00; t = -20.59, p < .001$). Then, a one-way ANOVA with multiple comparisons was conducted to examine the main effect of context. Results demonstrated higher levels of overall communication in both blended ($M = 2.82, SD = .885$) and offline courses ($M = 2.77, SD = .853$) compared to online courses ($M = 2.35, SD = .98$), $F(2, 1072) = 25.49, p < .001$. There was no statistical difference in communication scores between blended versus offline courses.

Independent sample *t*-tests were conducted to examine the interaction term of communication X gender. Results indicated that females ($M = 3.14, SD = 1.24$) reported significantly more communication with peers than did males ($M = 2.92, SD = 1.15; t = 2.15, p = .032$), whereas males ($M = 2.41, SD = 1.02$) reported significantly more

communication with instructors than did females ($M = 2.25$, $SD = 1.00$; $t = -2.31$, $p = .021$), as displayed in Figure 8.

Finally, one-way ANOVA with multiple comparisons was conducted to assess the communication X contexts interaction. Results indicated significant between group comparisons for both communication with instructors $F(2, 1072) = 3.91$, $p = .020$, and communication with peers $F(2, 1072) = 29.78$, $p < .001$. Participants reported significantly more communication with instructors in blended courses ($M = 2.33$, $SD = .983$) compared to online courses ($M = 2.13$, $SD = .995$), but no significant differences between either blended and offline courses ($M = 2.30$, $SD = .992$) or online and offline courses. In terms of communication with peers, significantly more communication was reported in both blended ($M = 3.29$, $SD = 1.13$) and offline courses ($M = 3.13$, $SD = 1.16$) (not differing significantly) compared to online courses ($M = 2.61$, $SD = 1.18$), as displayed in Figure 9.

Figure 8. Gender differences in communication with instructors and peers. Asterisks denote significant difference at $p < .001$.

Figure 9. Context differences in communication with instructors and peers. Differing letters denote significant difference at $p < .001$.

Temporal Effects of the ACI across a Semester

The final set of analyses explored temporal effects of the ACI sub-scales across two time points in the same semester. First, with a subset of participants⁴, a Repeated Measures MANOVA was conducted to assess mean level changes in ACI scores across time. *Communication* (with instructors and peers) and *time* (Time 1, Time 2) served as within-subjects variables and *gender* as the between-subject variable.

Results indicated a multivariate main effect of communication, $F(1, 228) = 5.69$, $p = .018$, partial $\eta^2 = .025$, time $F(1, 228) = 40.68$, $p < .001$, partial $\eta^2 = .152$, but not gender $F(1, 228) = 1.46$, $p = .228$, partial $\eta^2 = .006$. Significant main effects were superseded by a time X gender interaction $F(1, 228) = 5.83$, $p = .017$, partial $\eta^2 = .025$ and a time X communication interaction $F(1, 228) = 3.96$, $p = .048$, partial $\eta^2 = .017$. There were no significant interaction effects of communication X gender, $F(1, 228) = .225$, $p = .637$, partial $\eta^2 = .001$. Finally, there was no three-way interaction effect of time X communication X gender $F(1, 228) = .002$, $p = .961$, partial $\eta^2 = .001$.

Overall communication scores were computed for Time 1 and Time 2 by aggregating communication with instructors and communication with peers at each assessment. Next, a paired sample *t*-test was conducted comparing communication at Time 1 and Time 2. Consistent with hypotheses, results indicated that communication scores were higher at Time 2 ($M = 2.63$, $SD = .88$) compared to Time 1 ($M = 2.41$, $SD = .85$; $t = 3.44$, $p < .001$).

For the main effect of communication, aggregates were made of communication with instructors and peers at both Time 1 and Time 2. Results from post-hoc analyses

⁴ A subset of $n = 229$ participants completed a follow-up questionnaire to assess the stability of the ACI. These analyses were conducted for participants who completed *both* Part 1 and Part 2 of the study.

(paired-sample *t*-test) indicated that students reported significantly more communication with peers ($M = 3.05$, $SD = 1.18$) than with instructors ($M = 2.27$, $SD = .96$; $t = -20.90$, $p < .001$).

Next, post-hoc analyses were conducted to examine the time X communication interaction. Paired-sample *t*-tests indicated no significant differences between communication with instructors at Time 1 ($M = 2.08$, $SD = .87$) compared to Time 2 ($M = 2.19$, $SD = 1.00$; $t = 1.60$, $p = .110$). However, communication with peers at Time 2 ($M = 3.06$, $SD = 1.25$) was significantly higher than at Time 1 ($M = 2.73$, $SD = 1.20$; $t = 3.82$, $p < .001$), as displayed in Figure 10.

Paired sample *t*-tests were then conducted to examine the interaction effect of time X gender. Females reported more communication at Time 2 ($M = 2.60$, $SD = .90$) compared to Time 1 ($M = 2.37$, $SD = .83$; $t = -19.78$, $p < .001$). Males communication did not differ between Time 1 ($M = 2.54$, $SD = .81$) and Time 2 ($M = 2.66$, $SD = .95$; $t = -6.71$, $p < .001$).

Finally, to assess rank order stability, bivariate correlations were examined (see Table 9). Communication with instructors and peers was correlated at Time 1 ($r = .354$, $p < .001$) and at Time 2 ($r = .323$, $p < .001$). Further, communication with instructors at Time 1 and Time 2 was positively associated ($r = .450$, $p < .001$), and communication with peers at time 1 and time 2 was positively associated ($r = .437$, $p < .001$). Overall, both subscales of the ACI demonstrated moderate stability over time.

Figure 10. Interaction effect of time X communication. Asterisks denote significant difference at $p < .001$.

Table 9

Descriptive Statistics for all Study Variables

Variable	Instructor T1	Peers T1	Instructor T2	Peers T2
Instructor T1	-			
Peers T1	.354**	-		
Instructor T2	.450**	.110*	-	
Peers T2	.155**	.437**	.323**	-
N	1074	1074	229	229
Mean (<i>SD</i>)	2.08 (.876)	2.73 (1.20)	2.28 (1.00)	3.09 (1.22)
Range	1-5	1-5	1-5	1-5

Notes: * $p < .05$ ** $p < .01$

Values in italics represent stability coefficients

Study 2 – Discussion

The primary goal Study 2 was to examine the psychometric properties and factor structure of the ACI as assessed pertaining to a *specific course*, and across offline, online, and blending learning environments. This study also investigated mean differences in communication with peers and instructors across educational contexts, between genders, and over time. Results indicated that the ACI is useful in assessing communication styles in specific courses. Measurement invariance across learning context was established, and therefore meaningful group differences could be examined. Overall, students were found to communicate more with peers than instructors, and communication with peers increased over time. Furthermore, results indicated more overall communication in offline and blended courses compared to online courses, and mean differences were found in communication with peers versus instructors as a function of course context. Gender differences were also evident, with females and males reporting different communication levels with peers and instructors. Finally, the ACI subscales were found to be moderately stable across a semester.

Invariance across Context

The ACI appears to be a valuable tool to measure not only general academic communication (as demonstrated in Study 1), but also as a measure of communication in a specific course. The first portion of this study focussed on establishing measurement invariance of the ACI across educational contexts, to ensure the ACI assesses the same construct among respondents in different educational contexts. Results indicated that the ACI demonstrated partial scalar invariance, which translates to participants having a similar understanding of the underlying latent construct of *academic communication*.

Thus, subscales of the ACI could be compared across academic contexts. It is critical for a newly developed measure of communication to be invariant across contexts to produce comprehensive and broadly applicable results (Lee, 2018).

In current literature, communication is often assessed differently within each educational context. As previously discussed, measures of communication or interaction often include a broader assessment of engagement, collaboration, or participation (e.g., Keengwe & Wilsey, 2012; Murray & Lang, 1997). Therefore, these measures are not examining the unique variance which communication accounts for in outcome variables. Other studies examine more specific interactions within individual educational contexts, and thus results cannot be compared across learning platforms. For example, in the online context, interactions are often examined by frequencies of initiations (i.e., logging onto a platform, posting discussion posts, sending direct messages or emails) (e.g., Agudo-Peregrina et al., 2014; Arbaugh & Benbunan-Fich, 2007; Macdadyen & Dawson, 2010; Ramos & Yudko, 2008), which may also place emphasis on student-context interactions. Moreover, these frequencies cannot be compared to interactions in offline courses. In the extant literature, there is currently no other multi-context measure of communication that can be utilized to examine the unique role of communication in the prediction of academic outcomes. Therefore, the ACI represents a novel and statistically sound assessment of communication across contexts, where participant scores can either be examined as between-group differences (i.e., comparing communication scores between context) or pooled together (i.e., all educational contexts used in the prediction of outcomes).

Academic Communication across Educational Contexts

Students reported higher academic communication in offline and blended courses, compared to online courses. One of the advantages of participating in an offline course is the immediacy of real-time communication and social presence (Doise & Mugny, 1984; Garrison et al., 1999; Mehan, 1998; Tirri & Kuusisto, 2013). This may contribute to the higher levels of communication found in offline compared to online courses. Although many online courses are purposefully designed to promote student-student interaction (Abrami et al., 2011), this does not necessarily mean that all students in online courses engage with tools that help facilitate communication with others.

Blended learning environments incorporate both face-to-face and online learning, thereby providing ample opportunity for student-student and student-instructor interaction across modality (Park & Bonk, 2007; Rogers et al., 2003). Providing multi-modal synchronous and asynchronous communication may benefit a wider array of students, which may result in higher levels of overall communication – particularly when compared to communication that is purely computer-mediated. This may help explain the higher levels of academic communication found in blended compared to online course.

Online education can be an effective way for students to meet their learning goals, if implanted thoughtfully. For example, a recent meta-analysis demonstrated that increasing communication can result in excellent outcomes in online learning environments (Borokhovski et al., 2016). Increasing instructor immediacy – referring to communication behaviours that reduce social and psychological distance between people (Mehrabian, 1971), may help to increase student-student and student-instructor communication in online courses. Instructor communication behaviours such as using

humour when teaching, self-disclosure, soliciting students' opinions, and using inclusive pronouns (Gorham, 1988) may create a community in which students feel comfortable and more inclined to engage in reciprocal communication with others.

It is critical for educators to strive to provide online learning environments that incorporate as much communication as possible, as increased communication with both instructors and peers may contribute to *social presence*. Social presence highlights the importance of intimacy (i.e., the extent to which non-verbal behaviours and discussion fosters a sense of closeness) and immediacy (i.e., the presentation of social cues that demonstrates an individual is available to others) (Shorts, Williams, & Christie, 1979). Results from several studies demonstrate that social presence is connected to peer interaction, learning satisfaction, and engagement in course material (e.g., Bangert, 2008; Gunawardena & Zittle, 1997; Richardson & Swan, 2003). Social presence has been found to be even more important in online compared to offline courses in predicting course achievement and student satisfaction (Zhan & Mei, 2013). Therefore, creating opportunities for communication may enhance social presence, which can in turn result in higher academic outcomes in online courses.

Communications with Instructor versus Peers

Students often communicate with instructors and peers for different reasons (Gabelnick et al., 1990; Hermann, 2013; Means et al., 2010; Sher, 2009), which may subsequently impact communication frequency. In the current study, students reported higher levels of communication with peers compared to instructors. The reason for the elevated communication with peers may be the result of many factors including socio-constructivist approach to teaching, learning communities, and the availability and

accessibility of peers (e.g., Harley et al., 2000; Jones et al., 2009; Naismith, 2007; Rovai, 2002; Vu & Fadde, 2013; Vygotsky, 1978).

Principles of teaching are often rooted in *social constructivism*, which emphasizes the importance of social interaction in learner cognition in higher education (e.g., Garrison, Anderson, & Archer, 2000; Gredler, 2009; Kurucay & Inan, 2017; Vygotsky, 1978). Therefore, since teachers are encouraged to develop instructional designs which foster interactions, educational settings should be social in nature. Following a socio-constructivist approach to learning often results in learning communities, which requires students to collaborate with one another to accomplish a group goal both inside and outside of the classroom (e.g., Garrison & Anderson, 2003; Garrison, 2011). Though learning communities may sometimes involve an instructor presence (Garrison et al., 2000), instructors often facilitate and guide collaborative learning activities. Therefore, socio-constructivist teaching designs (combined with the instructor to student ratio) may account for the higher levels of communication with peers, as compared to communication with instructors.

Students may report higher levels of communication with their peers because of mere availability and accessibility. Many of the items on the ACI *peers* subscale refer to informal computer-mediated forms of communication (i.e., text messaging; direct messaging; online groups), which presents an easy and efficient way to talk with others. For example, research finds that students check their text messages frequently and often respond immediately (Harley et al., 2000; Jones et al., 2009; Naismith, 2007). Previous studies also demonstrate that students use direct messaging and online groups when discussing academic work (Bahati, 2015; Contreras-Castillo et al., 2007; Greenhow &

Gleason, 2014; Irwin, Ball, Desbrow, & Leveritt, 2012; Jeong, 2007; Lauricella & Kay, 2013; Thai, Sheeran, & Cummings, 2019; Veletsiantos, 2012), which facilitates student-student interaction. Therefore, students may find it easier to communicate with their peers.

Results from the current study demonstrated that while communication with peers was significantly higher at Time 2 compared to Time 1, communication with instructors remained similar at both timepoints. It is possible that barriers exist between students and instructors, which may result in static low levels of student-instructor communication. For example, there may be communication barriers between international students and their instructors (Campbell, Strawser, & George, 2016), large class sizes may impact opportunities for one-on-one communication between instructors and students (Marbach-Ad & Sokolove, 2002), and instructional context may also play a factor. For example, Vonderwell (2003) reported that instructors teaching an online course often connect with students via institutional email or learning management systems, which are not guaranteed to result in two-way interactions. It is likely a wide variety of communication barriers limit the amount of communication between students and instructors, and the duration of the course may not reduce barriers. The topic of communication with *peers* versus *instructors* was a major component of Study 4 and was examined in more detail in subsequent sections of this document.

Course Context and Recipient

Interesting interaction effects were found when examining communication with peers and instructors across educational contexts. Student reported less academic communication with instructors in online courses compared to blended learning courses.

This may be due to the quality of communications in computer-mediated settings. For example, in a previous study (Vonderwell, 2003), students in an online course reported that they do not experience the same one-on-one relationship with an instructor as they do in courses with face-to-face components. Since online communications occur in written form, there is a higher chance of misunderstanding and communications may be of lower quality (Balaji & Chakrabarti, 2010; Jeong, 2007), which may impact communication with instructors. Blended learning courses provide multiple platforms for communication, including both in-person and online, which may result in more academic communication.

Interestingly, there were no differences found in communication with instructors between blended and offline, and offline and online courses. It is important that students engage in communication with instructors in all course contexts, as student-instructor interaction has a large positive effect on achievement outcomes, particularly in online education (Bernard et al., 2009). Easton (2003) suggests that online educators need to develop course management techniques that are parallel to those implemented in face-to-face classes; such as defining a virtual “time and space”. This can be integrated into the online format via formal virtual office hours (Hooper et al., 2006; Li & Pitts, 2009; Meyers, 2003; Rempel, 2019), which is now considered a common e-learning tool which has proven to enhance student learning.

Students in both offline and blended courses reported more communication with peers compared to those in online courses. Again, this may be because both offline and blended course create ample opportunity for students to engage in face-to-face conversations with peers. Research finds that in-class group work can lead to positive academic outcomes (Smith et al., 2011), perhaps because of the unambiguous

communication. In class activities such as collaborative group work may serve to increase overall levels of communication between students. Furthermore, students often meet with their classmates outside of class hours to work on course material (Aamodt, 1982; Hong et al., 2015; Zhao & Kuh, 2004). Having a mandatory formal meeting time (i.e., offline or blended course) in which face-to-face interactions arise may help to facilitate the planning of additional interactions between peers (i.e., study groups), or to increase the social bond between students.

It is important to ensure there is maximum communication between students and their classmates across all educational settings. Student-student interaction has been proven to be a powerful predictor of a variety of positive academic experiences (Borokhovski et al., 2016; Cheng & Jiang, 2015; Donnelly, 2010; Moore, 1989; Muirhead & Juwah, 2005; Sims, 1999), above and beyond student-content and student-instructor interactions in online education (Bernard et al., 2009; Joksimovic et al., 2015). This places an emphasis on social constructivist principles of the learning environment, which insists knowledge is largely acquired through participating in social practices (i.e., class participation, group work, student collaborations) (e.g., Anderson, 2003; Moallem, 2003; Stage et al., 1998; Woo & Reeves, 2007). Therefore, online course developers should continue to integrate novel communication channels and activities into their course designs to ultimately foster student communication.

Communication and Gender

Some gender differences were also found. First, females reported higher levels of overall academic communication than males. This findings is in keeping with the *learning styles model* (Belenky, Clinchy, Goldberger, & Tarule, 1986), which suggests

that there are students who prefer to learn either in a *separate* manner (associated with autonomy, control, and certainty – often male), or a *connected* manner (which emphasizes relationships, empathy, and cooperation – often female). Females may learn best when an environment is rich in social connectedness (MacKeracher, 1994). Accordingly, it is possible that females engage in reciprocal communication with instructors and peers as *connection* with others may benefit their learning, while males may learn better in solitude.

Further, females' levels of communication were found to increase over time, whereas male levels of communication were static. Studies find that in terms of frequency, females are more likely than males to raise their hand and participate in the classroom (Burns & Myhill, 2004). There is also evidence that females provide more help-seeking and help-providing behaviours in education (Younger, Warrington, & Williams, 1999), which may result in higher levels of collaborative learning and knowledge sharing. Over time, it is possible that these behaviours may result in females experiencing increased feelings of familiarity with others, which in turn may encourage more communication as the semester progresses.

Males were also found to communicate more with instructors compared to females, whereas females were found to communicate more with peers, as compared to males. As previously mentioned, females have been found to engage in higher levels of prosocial behaviour with peers (Younger et al., 1999), which may contribute to this finding. Moreover, it has been well-documented that male students have more interactions of all kinds (i.e., positive and negative) with their teachers than female students across the lifespan (Hillmann & Davenport, 1978; Hutchinson & Beadle, 1992;

Jones & Dindia, 2004; Karp & Yoels, 1976; Sternglanz & Lyberger-Ficek, 1977).

Finally, it has been suggested that teachers are more accepting of males asserting their dominance (Sadker & Sadker, 1985), which may encourage males (but perhaps discourage females) to approach instructors with questions.

Conclusions and Caveats

Results from the current study demonstrated that the *Academic Communication Inventory* (ACI) is a multi-faceted measure of communication that can be implanted similarly in multiple educational contexts. Indeed, multi-group confirmatory factor analyses indicated that students across course contexts conceptualized academic communication in a similar way. Among the results, students communicated more with peers than instructors, and overall communication was higher in blended and offline courses compared to online courses. Moreover, females and males reported different levels of academic communication with both instructors and peers, suggesting their needs for academic communication may differ. The ACI can be implemented in future research to further explore the essential role communication plays in academic experiences of students in higher education.

Some caveats should be considered. For example, as in Study 1, the gender distribution represented significantly more females than males. It is not uncommon for there to be more female respondents in university samples, given the significantly higher ratio of females to males in higher education institutions in Canada (Statistics Canada, 2019). Future studies may wish to examine subscales of the ACI across educational context with an equal distribution of males and females to ensure results are replicable, which would allow for generalizability.

Finally, some results should be interpreted with caution. For example, lower levels of academic communication found in online courses may possibly be a function of the items that were retained in the final version of the ACI. The ACI may not include some communication mediums that may be more frequently used in online courses compared to others. For example, *emailing* is a form of communication that is often relied upon in the online environment (Vonderwell, 2003), which was not included in the final version of the ACI. Students in both offline and blended learning environments have the opportunity to ask questions face-to-face, while students in online courses do not – and therefore emailing could be more pertinent to academic communication in online courses. Therefore, it is possible that the ACI underestimates communication in the online context. Future studies may wish to include an item specific to *emailing* peers and instructors in revised versions of the ACI.

Nevertheless, this study provides evidence that the ACI can be used in higher education to assess levels of communication for the purpose of academic advancement. A crucial next step in the examination of academic communication is to examine individual differences, which may impact students' communication with instructors and peers, as well as outcome variables (i.e., student engagement, classroom community, and student satisfaction. Accordingly, the goal of Study 3 was to examine a conceptual model linking undergraduate students' *social anxiety*, academic communication, academic experiences in a specific course, and general wellbeing.

Study 3

Social Anxiety, Communication, Academic Experiences, and Wellbeing

It has been well established that interactions with peers and instructors are important predictors of classroom success (e.g., Bernard et al., 2009; Borokhovski et al., 2016; Cheng & Jiang, 2015; Donnelly, 2010; Joksimovic et al., 2015; Moore, 1989; Muirhead & Juwah, 2005; Sims, 1999). Findings from Study 1 and Study 2 have established the *Academic Communication Inventory* as a potentially effective tool in assessing communication with others. In Study 3, attention shifts to the examination of potential *predictors* of academic communication in higher education – with focus on social anxiety.

Social anxiety is an important individual difference to consider due to the high prevalence among university students in many countries (Baptista et al., 2012 – Brazil; Bella & Omigbodun, 2012 – Nigeria; Gultekin & Dereboy, 2011 – Turkey; Hakami et al., 2017 – Saudi Arabia; Russell & Shaw, 2009 – United Kingdom; Shah & Kataria, 2010 – India; Tillfors & Furnmark, 2007 – Sweden). Data from the Canadian Community Health Survey suggests approximately 21% of the Canadians experience heightened levels of social anxiety, with 8.1% above clinical cut-off levels (MacKenzie & Fowler, 2013). However, there appear to be no studies examining prevalence rates among students in Canadian higher education institutions.

Despite the heightened levels of social anxiety found among Canadians (MacKenzie & Fowler, 2013), there appears to be a lack of research examining the correlates and outcomes of social anxiety and academic experiences among Canadian university students, defining a clear gap in the literature. Therefore, Study 3 investigated

a conceptual model linking university students' social anxiety, academic communication, course experiences, and indices of wellbeing.

Overview of Social Anxiety

Social anxiety disorder (SAD, also referred to as *social phobia*) is conceptualized as distress and feelings of discomfort when meeting and talking to people (e.g., members of the opposite sex, strangers, or friends) (Mattick & Clark, 1998). More specifically, SAD is characterized by a “marked and persistent fear of one or more social or performance situations involving exposure to unfamiliar people or possible scrutiny by others” (Schneier, 2006, p. 1030). Milder symptoms of social anxiety materialize as social apprehension, occurring often in response to social-evaluative situations. As severity of social anxiety increases, social fears may become disabling and pervasive, and individuals may engage in social avoidance (e.g., Crozier, 2001; Liebowitz, 2003).

Mattick and Clarke (1998) explain that central concerns of individuals with SAD includes fears of: (1) being inarticulate; (2) sounding boring; (3) sounding stupid; (4) not knowing what to say or how to respond within social interactions; and (5) being ignored. SAD is relatively common with typical lifetime rates of 7-13% for adolescents and adults (e.g., Furmark, 2002; Russell & Shaw, 2009). Although it is prevalent among a minority of students, SAD is a persistent and often hidden disability that impacts learning and wellbeing (Russell & Topham, 2012).

Although SAD is sometimes diagnosed in childhood, first onset most often occurs during mid-to-late adolescence, when many young people are engaged in full or part time education (e.g., Tillfors & Furmark, 2007; Russell & Topham, 2012; Shaw, 2009). SAD may manifest when individuals desire to present a positive public image but doubts their

ability to do so (Schlenker & Leary, 1982). Results from epidemiology studies indicate that SAD is the most prevalent anxiety disorder and is also found to be one of the most common psychiatric disorders (Hidalgo et al., 2001; Schneier, 2006). Several etiological factors may play a role in the development of SAD including parenting practices and attachment, parental psychopathology, adverse life events, SES, social pain, and temperament (e.g., Fung & Alden, 2016; Green & Goldwyn, 2002; Grover, Ginsburg, & Ialongo, 2005; Hudson & Rapee, 2000; Neal & Edelmann, 2003; Ollendick & Hirshfeld, 2002; Rapee, 1997; Rapee & Spence, 2004; Schneier, 1992). Moreover, SAD often co-exists with difficulties in relationships, depression (Schneier, Johnson, Hornig, Leibowitz, & Weissman, 1992; Stein, Tancer, Gelernter, Vittone, & Uthe, 1990), and substance abuse (Kushner, Sher & Beitman, 1990; Schneier et al., 1992), and often restricts socialization (Dodge, Heimberg, Nyman, & O'Brien, 1987; Turner, Beidel, Dancu, & Keys, 1986), all of which compound its impact on functioning and quality of life (e.g., Fehm, et al., 2005; Keller, 2006).

Previous research underscores a need to consider individuals who report elevated but subclinical levels of social anxiety (Crozier & Alden, 2005). Many students experience heightened symptoms of social anxiety (i.e., not meeting diagnostic criteria), and still experience an adverse impact on their life and educational experiences (Topham, Moller, and Davies, 2016). Indeed, there is growing literature linking heightened symptoms of social anxiety with a wide range of negative socio-emotional experiences in young adulthood (e.g., Felm, Beesdo, Jacobi, & Fiedler, 2008; Merikangas, Avenevoli, Suddhasatta, Zhang, & Angst, 2002; Rapee, 1995; Schneier, Blanco, Antia, & Leibowitz, 2002; Stein, Walker, & Forde, 1994). Moreover, gender differences have been reported.

Among university students, females have been found to experience higher levels of social anxiety compared to males (e.g., MacKenzie & Fowler, 2013; Merikangas et al., 2002; Russell & Shaw, 2009).

Theoretical models. There are several conceptual models of social anxiety. For example, the Clark and Wells (2000) model of social anxiety predicts that it is maintained through a negative feedback loop, consisting of poor self-expectations, anticipatory anxiety, cognitive impairment, and poor performance, all of which reinforce negative self-beliefs. In this regard, socially anxious individuals engage in safety behaviours (e.g., minimizing eye contact or avoidance) to decrease interaction with “social danger”, thus reinforcing negative beliefs and preventing individuals from experiencing a positive opportunity to modify distorted thinking (Skocic, Jackson, Hulbert, & Faber, 2016).

Rapee and Heimberg (1997) proposed a *cognitive-behaviour* model of anxiety with the notion that individuals assume that others will negatively appraise them, placing high importance on social evaluations. Therefore, when they encounter a social situation, socially anxious individuals form a mental representation of their own social behaviours, assuming that others see it the way they themselves experience it. They also focus their cognitive resources on possible threats, such as negative facial expressions from those around them (Rapee & Heimberg, 1997). In support of this, researchers have reported that social anxiety is associated with the tendency to interpret even positive social events in threatening ways (Alden, Mellings, & Laposa, 2004; Alden, Taylor, Mellings, & Laposa, 2008; Kashdan, Weeks, & Savostyanova, 2011; Vassilopoulos & Banerjee, 2010; Voncken, Bogels, & de Vries, 2003).

Another relevant model of social anxiety for the academic context is the *self-presentation model* (Schlenker & Leary, 1982), where the drive for creating a good impression on others is combined with low expectations of obtaining that goal. Based on early experiences, individuals develop a range of negative assumptions that relate to themselves and their social world (Clark, 2001). This theory is often applied when examining behaviors of socially anxious individuals across different communicative modalities (e.g., Burke & Ruppell, 2016; Fernandez, Levinson, & Rodebaugh, 2012), and is applicable when examining socially anxious individuals within the educational context (Pierce, 2009).

Social anxiety in education. The academic context appears to be particularly stressful for socially anxious students. For example, Topham (2009) found that students report social anxiety as emotionally painful, which often inhibits learning experiences. Students in the same study also explained that their social anxiety tends to be overlooked within the educational environment, which further exacerbates distress. Bernstein and colleagues (2007) reported that severity of social anxiety is correlated with deficits in communication skills, attention difficulties, and learning problems within the school setting. Results from several other studies indicates socially anxious students have impaired functioning within the educational environment, which often lead to increases in exam failure, lower grades, greater likelihood of leaving school prematurely, and a lower likelihood of graduating from their program (e.g., Ameringen, Mancin, & Farvolden, 2003; Stein & Kean, 2000; Wetterberg, 2004; Wittchen, Stein, & Kessler, 1999; Zukerman, Yahav, & Ben-Itzhak, 2019).

When students' transition to higher education, social anxiety may be triggered by an increase in the demands relating to social interaction or educational performance (Bruce & Seed, 1999). Topham (2009) asserts that students are expected to interact with people they do not know, involve themselves in discussions within the classroom, and potentially receive criticism from their peers and tutors. It has been found that students experience anticipatory anxiety prior to learning, fears of negative evaluation within the classroom, physiological indicators of anxiety (i.e., quaky voice, blushing, blanking mind), shyness and embarrassment during learning activities, self-consciousness in front of a group of peers, and post event rumination (Topham, 2009). These events may exacerbate pre-existing feelings of self-consciousness and reduce both social and cognitive functioning in higher education (Topham et al., 2016). Generally speaking, social anxiety negatively impacts on students in learning situations, contributes to decreased engagement, and is associated with lower rates of retention (e.g., Kessler, 2003; Wittchen, 1999). Therefore, it is important to examine mechanisms which may lead to positive academic experiences and increased wellbeing among socially anxious students.

Social anxiety in face-to-face education. Despite these findings, there is still much to learn about the experiences of social anxious students in the context of higher education (Russell & Topham, 2012). For example, previous research has focused primarily on the experiences (and struggles) of socially anxious students within the *physical* classroom (e.g., Topham 2009; Topham et al., 2016; Topham & Russell, 2012). Difficulty may arise in the face-to-face context due to socially anxious students' persistent fear of negative evaluation (Topham, 2009). Moreover, pedagogical strategies

that are used to increase classroom participation and engagement and may enhance anxiety for individuals who are not comfortable speaking in front of others (e.g., Czekanski & Wolf, 2013). Topham and colleagues (2016) conducted thematic analyses on socially anxious individuals' experiences within face-to-face environments (including lectures, seminars, and group presentations). Participants reported experiencing negative physiological responses, fearful self-consciousness, and distress. However, over time the familiarity with peers and the classroom environment reduced anxiety for some individuals (Topham et al., 2016). Other research suggests that socially anxious individuals should engage in public speaking and group interaction, which may in turn build self-confidence and may help manage anxiety (e.g., Chartier, Hazen, & Stein, 1998; Russell & Topham, 2012).

There are many positive aspects of face-to-face learning. For example, an advantage of the offline classroom is the inherent social nature and the presence of spontaneous conversations (e.g., Mehan, 1998; Yee, 1971; Garrison et al., 1999). However, these benefits may not be desirable for socially anxious individuals. For instance, spontaneous conversations may be stressful for socially anxious students as they may be uncomfortable talking to unfamiliar peers, thereby interfering with their information processing (Topham et al., 2016). Moreover, stressful situations may cause some individuals to further withdraw. Therefore, compared to their non-anxious counterparts, individuals with social anxiety may engage in less student-student and student-instructor interaction when in the physical presence of others. Conversely, having the opportunity to combat these negative experiences with heightened exposure to face-

to-face education may bode well for anxious students (e.g., Chartier et al., 1998; Russell & Topham, 2012), and increase functioning in other domains of their life.

It has been established that social anxiety negatively impacts academic outcomes, engagement, and participatory learning within the physical classroom (e.g., Topham, 2009; Topham et al., 2016; Russell & Shaw, 2009; Russell & Topham, 2012; Zukerman et al., 2019). However, the online environment presents a unique context for interactions among students. For socially anxious individuals, some communication difficulties that appear offline seem to diminish in the online environment (see Prizant-Passal et al., 2016 for a review).

Social anxiety in computer-mediated education. A review of the extant literature only revealed one study specifically examining social anxiety and computer-mediated education. Grieve, Kemp, Norris, and Padgett (2017) explored the role of social anxiety in online learning activities among university students. Interestingly, results indicated that social anxiety did not contribute to a preference for online practical activities, but students with lower levels of social anxiety were more favourable to face-to-face activities. The authors suggested that computer-mediated learning activities may have limited compensatory effects for students who experience social discomfort. However, given the dearth of empirical evidence, these conclusions must be considered tentative in nature.

Other studies have explored different forms of anxiety and online learning. For example, some researchers have examined the links between test and computer anxiety in online learning environments (e.g., Conrad, 2010; Kamhi-Stein, 2000; Perkins, 1995; Reed & Overbaugh, 1993; Shermis & Lombard, 1998). More recently, Wombacher and

colleagues (2017) explored the links between computer-mediated communication anxiety (CMCA), perceived learning, and quiz performance. Results indicated that CMCA was negatively associated with perceived learning but not quiz performance, suggesting that CMCA may affect student attitudes more than their ability to learn (Wombacher, Harris, Buckner, Frisby, & Limperos, 2017).

Other researchers have considered more general aspects of anxiety in this context. For example, Solimeno, Mebane, Tomai, & Francescato (2008) found that students who are successful within an asynchronous online collaborative learning environment are typically low anxiety (identified as a basic anxiety and difficulty in controlling emotional reactions) with high problem solving and time management skills (Solimeno et al., 2008). Conrad (2010) reported that many students experience anxiety at the beginning of an online course, and students may feel anxious about being behind in coursework when logging onto the course platform. More recently, Bolliger and Halupa (2012) examined doctoral students' feelings of satisfaction in an online course and found that students who felt anxious when using an online platform experienced anxiety within other domains of life. Therefore, feelings of anxiousness or nervousness pertaining to online courses may not bode well for academic outcomes. However, there are reasons to specifically consider individuals with *social anxiety* in these contexts, as they may feel more comfortable in online environments (e.g., Caplan, 2007; Cuhadar, 2012; Lee & Stapinski, 2012).

Overall, students appear to find online learning advantageous, as it is an efficient and convenient way to learn in an asynchronous environment (e.g., Burdette et al., 2013; Coopers, 2005; Coy, 2014), whereas a commonly cited disadvantage is the lack of face-to-face communication (e.g., Raevaara, 2007; Souleles, 2011). However, socially anxious

individuals tend to find the Internet as a more comfortable medium for communication (e.g., Prizant-Passal et al., 2016). Thus, social anxiety could potentially be associated with more positive communications when mediated via technology. Although no previous studies have specifically examined the communication styles of socially anxious students, there is an extensive literature on the more general topic of social anxiety and virtual communication (e.g., Baker & Oswalk, 2010; Caplan, 2007; Lee & Stapinski, 2012; Mazalin & Moore, 2004; Pierce, 2009; Sheldon, 2008; Shephard & Edelman, 2005).

Links between social anxiety and computer-mediated communication can be conceptualized within the context of the *self-presentation* theory (Burke & Ruppell, 2016; Fernandez, Levinson, & Rodebaugh, 2012; Pierce, 2009). According to Leary and Allen (2011), self-presentation is a way in which people seek approval and avoid disapproval, which is easier to do in an online environment. Thus, socially anxious individuals may find communicating via online discourse more comfortable than face-to-face communication (Caplan, 2007; Gross, Juvonen, & Gable, 2002; Lee & Stapinski, 2012; Shephard & Edelman, 2005). Socially anxious individuals often hold beliefs that their self-presentation online is easier to control compared to offline settings (Caplan, 2007) – which can lead to more positive outcomes.

Socially anxious individuals also find computer-mediated communication more effective in building and maintaining relationships (Pierce, 2009; Valkenburg & Peter, 2007). Characteristics of computer-mediated communication often enable more control and increase the probability of making a good first impression (Leary & Kowalski, 1995; Schlenker & Leary, 1982). For example, there is less emphasis on auditory and visual

cues, reducing stress that may relate to physical appearance, enables anonymity, and asynchronous communication allows for time to prepare an appropriate or rehearsed response (e.g., Bonetti, Campbell, & Gilmore, 2010; Caplan, 2007; Cuhadar, 2012; Lee & Stapinski, 2012; McKenna & Bargh, 2004; Suler, 2004; Walther, Loh, & Ganka, 2005). These positive attributes may enhance socially anxious individuals' interactions in an online platform.

Because social anxiety is prevalent among Canadians (MacKenzie & Fowler, 2013), it is important to better understand how students with social anxiety communicate with others, and the impact this may have on academic experiences. Therefore, Study 3 examined the potential mediating role of the multi-modal measure of *Academic Communication* in the links between social anxiety and important predictors of student success. Further, the mediating role of academic experiences is examined in the links between social anxiety and indices of wellbeing. Understanding these links can shed light on potential pedagogical practices that can be implanted in education, as there is a need for increased awareness among educators and students about social anxiety in higher education.

The Current Study

Study 3 evaluated two conceptual models linking social anxiety, academic communication, academic experiences, and wellbeing. The first model utilized the entire sample at one time point ($N = 1073$). The second model serves to replicate the first, with a smaller sample at two time points ($n = 229$). In the second model, social anxiety and academic communication were measured at *Time 1*, whereas academic experiences and

wellbeing were measured at *Time 2*. All variables were the same in both models with the exception of the indicators of wellbeing.

The overarching purpose of this study was to understand if academic communication helps to explain the negative association between social anxiety and academic experiences (i.e., multiple mediation). Moreover, the links between social anxiety and wellbeing have been well established, but it was of interest to understand if academic experiences could explain variance in this negative relation. Therefore, two structural equation models were specified, in which both direct and indirect links among study variables were examined (see Figure 11). Gender differences were also examined to understand if the pattern of associations differed for males compared to females.

Figure 11. Conceptual model (multiple mediation) linking social anxiety to academic experience (i.e., student engagement, classroom community, course satisfaction) via academic communication (i.e., communication with instructors and peers), and social anxiety to wellbeing via academic experiences (i.e., student engagement, classroom community, course satisfaction).

Hypotheses

Hypotheses presented were the same for both conceptual models. Social anxiety was expected to be negatively associated with communication with instructors and peers. Individuals who experience social anxiety are more often worried about performance in social situations, and experience concerns about being articulate or sounding unintelligent (Furmark, 2002; Mattick & Clarke, 1998; Russell & Topham, 2012). These characteristics were thought to lead to less active engagement in academic communication due to socio-evaluative concerns. The negative association between social anxiety and academic communication was expected to be *weaker* for communication with peers compared to instructors, as the majority of the items on the communication with peers subscale involve communicative modes mediated by technologies. Individuals with social anxiety may feel more comfortable and willing to chat via computer-mediated forms of communication than face-to-face (Caplan, 2007; Cuhadar, 2012; Lee & Stapinski, 2012).

As performance demands are often placed on students in university, it was expected that social anxiety would negatively predict indices of academic experience (i.e., student engagement, feelings of classroom community, course satisfaction). It has previously been established that social anxiety negatively impacts upon classroom engagement, student learning, and retention (Berstein et al., 2007; Kessler, 2003; Wittchen, 1999). Moreover, social anxiety has an adverse impact on quality of life (Fehm et al., 2005; Keller, 2006), and was therefore expected to be negatively associated with wellbeing.

Communication and interaction are deeply imbedded within classroom engagement (e.g., Czekanski & Wolfe, 2013; Peters et al., 2011; Thompson et al., 2012; Zhu, 2006), and so it was expected that communication with both instructors and peers would be significantly and positively associated with student engagement. It was expected that compared to communication with instructors, communication with peers may play a stronger role in students' perceptions of classroom community. It has been previously demonstrated that student-student interactions (but not student-instructor interactions) are related to students' sense of community (Drouin, 2008). On the other hand, communication with instructors may be more strongly associated with student course satisfaction. Previous research has linked student satisfaction to course components that are under the control of the instructor, such as assessment and course content (Dong & Lucey, 2013).

Finally, it was expected that student engagement and classroom community would be significantly and positively associated with wellbeing. Research examining higher education supports the copious benefits of student engagement in relation to retention, social connectedness, academic achievement, and positive adjustment (Tinto, 2000; Van Ryzin, Gravely, & Roseth, 2009). Furthermore, connectedness in school can positively influence wellbeing (Dubow, Tisak, Causey, Hryshko, & Reid 1991), and classroom community is inversely related to feelings of alienation (Rovai & Wighting, 2005). The association between course satisfaction and wellbeing was examined on an exploratory basis.

With regards to *indirect* effects, it was expected that social anxiety would be negatively associated with academic experiences (i.e., student satisfaction, classroom

community, course satisfaction) through academic communication. Because student-student and student-instructor interactions are essential in the prediction of student outcomes (e.g., Dillenbourg et al., 1996; Doise & Mugney, 1984; Springer et al., 1999; Woo & Reeves, 2007), it was postulated that academic communication would be an underlying mechanism in this model.

It was also expected that academic experiences would mediate the link between social anxiety and wellbeing. Higher education places many demands on students, which may exacerbate negative feelings among socially anxious individuals (Topham, 2009). Therefore, it was expected that academic experiences would account for at least some variance in wellbeing.

Some gender differences were also tentatively hypothesized. In samples of university students, it has been found that females experience higher levels of social anxiety compared to males (e.g., Merikangas et al., 2002; Russell & Shaw, 2009). Therefore, it was expected that compared to males, females would demonstrate stronger effects on significant pathways including social anxiety as an exogenous variable. Moreover, it has been suggested that females (compared to males) place more importance on social interactions within the educational setting (Kirkup & von Prummer, 1990). Therefore, it was expected that compared to males, females would demonstrate stronger effects on pathways involving academic communication (e.g., communication with instructors → course satisfaction)

Statistical Analysis Plan

Following preliminary analyses (i.e., data cleaning, descriptive statistics), two structural equation models (SEM) were conducted to examine the direct and indirect links

among study variables. SEM is a data-analytic technique that specifies latent variable models (i.e., measurement models), which provide estimates of relations among latent constructs and their indicators, and associations among other constructs (i.e., structural component) (Kline, 2016; Tomarken & Waller, 2005). SEM carries with it many benefits, including the ability to assess psychometric properties of measures, and thereby estimating relations among constructs while reducing random error (Bollen 1989). An advantage over other techniques (e.g., multiple regression) includes the ability to test global fit, and to revise a conceptual model based on modification indices (in combination with theory) in both simple and complex models (Judd, McClelland, & Culhane, 1995). Therefore, a measurement model and structural model were specified prior to evaluating the conceptual model and group differences.

Study 3 – Method

Participants

Participants for the first conceptual model were $N = 1073$ undergraduate students (21.6% male; 77.9% female; 0.5% other) enrolled at a post-secondary institution in south-eastern Ontario, Canada ($M_{\text{age}} = 20.3$). The second conceptual model utilized a subset of participants who completed a follow Part 2 follow-up assessment ($n = 229$, representing 21% of the original sample; 18% male; 82% female). Refer to Study 2 for a detailed demographic overview of participants.

Procedure

As mentioned in Study 2, data collection occurred in two parts. Part 1 took place at the start of the term. Students who completed Part 1 were given the opportunity to complete Part 2, which took place halfway through the term. Data collected was used for

Study 2, 3, and 4, for different research purposes. The *Academic Communication Inventory* was the only measure used in multiple studies, with the exception of demographic variables, Social Connectedness, and Life Satisfaction. See Study 2 *procedure* for a detailed overview of recruitment method and ethical protocol.

Measures

All measures were completed online for course credit through Qualtrics. Qualtrics is a secure survey site, which uses multi-layer security to protect privacy of the data.

Demographic variables. Participants completed questionnaires about their demographic information (see Appendix R), including their gender, age, ethnicity, and parental education. Additionally, participants were asked about their living accommodations, year in university, major, GPA, and course context exposure (i.e., online, blended, face-to-face).

Communication. Participants completed the finalized version of the *Academic Communication Inventory* (ACI; see Appendix S), to assess their communication for the purposes of academic achievement (consisting of 12 questions) at two time points. Only the first time point was used in the current study. Participants were asked to complete the ACI for a specific course to assess their course specific communication style (i.e., for either a blended, online, or offline course). Results from Study 2 demonstrated measure invariance across educational contexts, therefore ACI scores in differing educational context were pooled together (i.e., not examined as between-subject variables). As a reminder, the ACI is comprised of two subscales, including *communication with instructors* and *communication with peers* and was rated on a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Items were used as latent variable

indicators to reduce measurement error. The Time 1 assessment of academic communication was used in the first and second conceptual model. See Study 2 for additional measure details.

Social Anxiety. To assess social anxiety, participants completed the *Liebowitz Social Anxiety Scale* (LSAS; Liebowitz, 1987; see Appendix T) at Time 1. The LSAS is a 24 item self-report designed to assess fear and avoidance of social (e.g., going to a party, meeting strangers) and performance situations (e.g., taking a test, giving a report to a group). When rating questions (e.g., telephoning in public) for *fear*, participants rated their response on a 4-point scale ranging from *1 = none* to *4 = severe*. Higher scores indicate more fear. When rating questions for *avoidance*, participants rated their response on a 4-point scale ranging from *1 = never* to *4 = usually*. Higher scores indicate more avoidance. A total score of social anxiety was created by summing all avoidance and fear questions and was treated as a continuous variable. Both scales on the LSAS have demonstrated excellent validity and internal consistency, $\alpha = .94$ to $.92$ (Heimberg et al., 1999) and have been previously used in studies of social anxiety in higher education (e.g., Topham et al., 2016). Both scales on the LSAS demonstrated excellent internal consistency with the current sample, $\alpha = .92$ to $\alpha = .95$.

Academic experiences. Participants' course specific learning experiences were assessed with three separate questionnaires examining their course engagement, feelings of classroom community, and course satisfaction. Participants were asked to think of the same course while completing these questionnaires at two different time points (either a blended, online, or offline course). Measures completed at the first time point were used

when examining the first conceptual model ($N = 1073$), and measures completed at the second time point were used when examining the second conceptual model ($n = 229$).

Participants completed the *Student Course Engagement Questionnaire* (SCEQ; Handelsman, Briggs, Sullivan, & Towler, 2005 – see Appendix U) to assess their course specific student engagement. Sample items include “listening carefully in class”, “applying course material to my life”, and “participating in small-group discussions”, ranging on a five-point scale from 1 = *not at all characteristic of me* to 5 = *very characteristic of me*. A summary score was computed by aggregating all items, with higher scores indicating higher levels of course engagement. This measure has been used in the past to assess student engagement among college students in particular courses (Handelsman et al., 2005) and contains questions relevant to each educational context examined herein. The SCEQ has demonstrated good internal consistency in previous studies ($\alpha = .76-.82$) and with the current sample ($\alpha = .92-.90$).

Next, participants responded to the *Classroom Community Scale* (CCS; Rovai, 2002a – see Appendix V). The CCS is a 20 item self-report designed to assess both feelings of *connectedness* (e.g., “I feel that students in this course care about each other”) and *learning* (e.g., “I feel that I am encouraged to ask questions) in a specific course. Questions were responded to on a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Items were averaged, with higher scores indicating increased feelings of *classroom community*. Although this measure was originally created to assess students in an online learning environment (Rovai, 2002a; Rovai, 2002b), items appear to be applicable to students across learning contexts. This measure demonstrated good internal consistency with the current sample ($\alpha = .82-.87$), which is consistent with past studies

(Rovai, 2002a; Rovai, 2002b; Rovai & Jordan, 2004; Rovai & Wighting, 2005; Shea, Li, & Pickett, 2006).

Finally, participants completed selected questions from the *Student Satisfaction Scale* (SSS; Bollinger & Halupa, 2012 – see Appendix W) to assess their perceived educational value of a selected course. Eight questions were selected from the original 24-item scale on the basis of generalizability across educational contexts (e.g., “I am satisfied with the level of effort this course requires”, “I will be satisfied with my final grade in this course”). Items were rated on a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Total scores were computed with higher scores indicating greater student course satisfaction. This measure originally demonstrated good internal consistency in previous studies, α ranging from .72 to .92 (Bollinger & Halupa, 2012; Kurucay & Inan, 2017), and presented good internal consistency in the current sample (α = .87-.83).

Indices of wellbeing. Participants also completed assessments of various indices of wellbeing. The *UCLA Loneliness Scale*, Version 3 (Russell, 1996), *Social Connectedness Scale* (Lee, 2001), and the *Perceived Stress Scale* (Cohen, 1994) were administered at Time 1 and were therefore used in the first conceptual model ($N = 1073$)⁵. The *Satisfaction with Life Scale* (Diener et al., 1985), *Loneliness in Context Questionnaire for College Students* (Asher, Weeks, & McDonalds, 2010), and the *Perceived Stress Scale* (Cohen, 1994) were administered at Time 2 and were therefore used in the second conceptual model ($n = 229$)⁶.

⁵ When summary scores were examined together, measures of wellbeing at Time 1 indicated good reliability ($\alpha = .756$)

⁶ When summary scores were examined together, measures of wellbeing at Time 2 indicated good reliability ($\alpha = .750$).

Participants completed the 20-item *UCLA Loneliness Scale* to measure their subjective feelings of loneliness and social isolation (Russell, 1996, see Appendix X). Participants were asked to indicate how often each statement presented described them (e.g., “I am unhappy doing so many things I love”, “I cannot tolerate being alone”, “I feel left out”), on a 4-point scale ranging from 1 = *I never feel this way* to 4 = *I often feel this way*. Aggregate scores were computed with higher scores indicating more feelings of loneliness and social isolation. In previous studies, the UCLA Loneliness Scale (Version 3) has demonstrated good internal consistency, α ranging from .89 to .94. Results from the present study were consistent ($\alpha = .96$). For the purpose of the first conceptual model, this measure was reverse scored (higher scores indicating less loneliness) and was used as an indicator of wellbeing⁷.

Social connectedness was also assessed using the 20-item *Social Connectedness Scale – Revised* (SCS-R; Lee et al., 2001, see Appendix F). Consistent with previous research, the reliability in the current sample was excellent ($\alpha = .93$). See Study 1 for additional measure details.

As an assessment of stress, participants completed the revised 10-item *Perceived Stress Scale* (PSS; Cohen, 1994, see Appendix Y), which measures the degree to which one appraises experiences as stressful (Cohen, Kamarck, & Mermelstein, 1983). Participants were asked about their feelings and thoughts during the last month and to rate *how often* they felt or thought a certain way (ranging from 1 = *never* to 5 = *very often*). Sample items include “In the last month, how often have you felt nervous or stressed?” and “In the last month, how often have you been able to control irritations in

⁷ The 4-point scale on the UCLA Loneliness Scale was recoded into to a 5-point scale, to be consistent with the weight of other indicators of wellbeing. Subsequent scales deviating from 5-point (i.e., *Satisfaction with Life*) were also adjusted accordingly.

your life?”. An aggregate score was computed with higher scores indicating more perceived stress. The PSS has been widely used in previous research and has demonstrated good psychometric properties, including good internal consistency, α ranging from .78 to .91 (e.g., Cohen & Williamson, 1988; Lesage, Berjot, & Deschamps, 2012; Leung, Lam, & Chan, 2010; Remor, 2006; Roberti, Chaaya, Osman, Naassan, & Mahfoud, 2010). In the current study, the 10-item PSS demonstrated good internal consistency at the first ($\alpha = .86$) and second time point ($\alpha = .88$). Stress was assessed at both time points. Accordingly, perceived stress at the first time point was used in the first conceptual model, and perceived stress at the second time point was used in the second conceptual model, both as indicators of wellbeing. Stress was reverse scored when included in the conceptual models, with higher scores indicating lower stress.

Participants completed the *Loneliness in Context Questionnaire for College Students* (Asher et al., 2010, see Appendix Z), a 10-item measure that asks about participants’ experiences of loneliness in different settings (e.g., “class is a lonely place for me” and “I am lonely with other people”). Participants rated their agreement with each statement on a scale ranging from 1 = *never* to 5 = *always*. Aggregate scores were computed with higher scores indicating greater feelings of loneliness at university. This measure has been used previously in samples of university students, demonstrating good internal consistency, $\alpha = .91$, and good test-retest reliability, average $r = .64$ (Asher et al., 2010). Internal consistency for the current sample was similarly high ($\alpha = .93$). Loneliness reversed scored when included as an indicator of wellbeing on the second conceptual model, with higher scores indicating less loneliness.

Finally, participants completed the *Satisfaction with Life Scale* (SLS; Diender, Emmons, Larsen, & Griffin, 1985, see Appendix G), a 5-item scale designed to measure global judgements of one's life satisfaction. Participants responded to each statement with their agreement, on a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. Sample items include "In most ways my life is ideal" and "The conditions of my life are excellent". Summary scores were computed with higher scores indicating greater satisfaction with life. The current sample demonstrated good internal consistency ($\alpha = .88$), which is in line with previous research (Diener, Sandvik, Seidlitz, & Diener, 1993; Pavot & Diener, 1993; Pavot, Diener, Colvin, & Sandvik, 1991).

Study 3 – Results

Missing data. Variables of interest (i.e., ACI subscales, social anxiety subscales, GPA, measures of course experiences, and indices of wellbeing) were examined for patterns of missing data. Little's MCAR test (Little, Jorgenson, Lang, & Moore, 2014) was examined and data were not found to be missing completely at random for the combination of variables in the first set of analyses, $p < .001$, but it was missing completely at random for the second set of main analyses, $p = .295$. However, missing data was lower than 5% for all study variables, and therefore randomness was not of concern. Therefore, full-information maximum likelihood (FIML) was used to handle missing data (Enders, 2010).

Outliers. Univariate outliers were investigated by examining both box plots and standardized scores. Several univariate outliers found when examining the upper and lower fences of the boxplot, but the majority were within the confines of ± 3.29 , with the exception of 4 (all associated with variable *Belonging*). The winsorization method was

used to treat univariate outliers by replacing values with the largest acceptable observation (Kwak & Kim, 2005). Multivariate outliers were investigated by examining groups of variables used in each subsequent analysis via diagnostic statistics examining mahalanobis' distance. Results indicated four participants with a mahalanobis' distance greater than the critical chi-square cut-off, and therefore these cases were removed from the dataset ($df_{critical} = 26.12$; $\alpha_{critical} = .001$).

Assumptions. Independence of observations was found via the Durbin-Watson statistic, which ranged from 1.95 to 2.095. Typically, values close to 2 indicate that there is no correlation between residuals. Next, Tolerance and VIF scores were examined to rule out multicollinearity. Tolerance values were all above the suggesting cut-off value of $> .10$, ranging from .35 to .99, and Variance Inflation Factor (VIF) ranged from 1.95 to 2.79, indicating no issue (Kutner, Nachtsheim, Neter, & Li, 2004).

The assumption of linearity was assessed by visual inspection of scatterplots of the studentized residuals against the predicted values. The scatterplots appeared to be relatively oval shaped and in the anticipated direction, and there appeared to be no systemic relation between the errors and predicted model (Tabachnik & Fidell, 2013), thus linearity was assumed. By further examining these plots, homoscedasticity was assumed, as the spread of residuals was relatively constant.

Normality was examined through visual inspection of P-P Plots, a Normal Q-Q Plot of the studentized residuals, and absolute values of skewness and kurtosis. All variables remained within the suggested confines of the absolute value ± 2 for skew and kurtosis (Field, 2009; Trochim & Donnelly, 2006), however some variables appeared to be slightly non-normal. Relevant transformations were made (Templeton, 2011),

resulting in distributions that approached normality. Similar to Study 2, pattern of results for subsequent analyses did not differ when comparing original versus transformed data, and therefore analyses are presented with non-transformed data to ease interpretation.

Preliminary Analyses

As in Study 2, participants were deleted from the dataset based on completion of study variables. Descriptive analyses were computed for study variables of interest to examine the means, standard deviations, and minimum and maximum values to ensure data were in the plausible variable range (see Table 10).

Bivariate correlations were then examined for all main study variables for the first (see Table 11) and second (see Table 12) set of main analyses (i.e., structural equation models). Among the results, communication with instructors was positively associated with most indices of academic experience (i.e., course engagement, classroom community, student satisfaction) at Time 1. Similar results were found for communication with peers, with significant correlations for both course engagement and classroom community, but not course satisfaction. Academic communication did not appear to be associated with most indices of wellbeing, with the exception of communication with peers and social connectedness at Time 1 and communication with peers and loneliness at Time 1.

Table 10

Summary of Descriptive Statistics for all Study Variables

Variable	N	Mean (SD)	Range
Instructors1	1072	2.72 (1.43)	1-5
Instructors2	1071	2.41 (1.35)	1-5
Instructors3	1072	2.12 (1.32)	1-5
Instructors4	1070	2.11 (1.32)	1-5
Instructors5	1072	2.17 (1.35)	1-5
Instructors6	1070	2.35 (1.37)	1-5
Instructors7	1072	2.08 (1.31)	1-5
Peers1	1071	3.28 (1.43)	1-5
Peers2	1067	3.26 (1.50)	1-5
Peers3	1073	3.15 (1.54)	1-5
Peers4	1073	2.89 (1.55)	1-5
Peers5	1071	2.87 (1.55)	1-5
Anxiety	992	2.63 (.719)	1.25-4
Course Engagement	1047	3.44 (.691)	1-5
Classroom Community	1043	3.19 (.512)	1-4.8
Student Satisfaction	1040	3.51 (.800)	1-5
Social Connectedness_T1	1058	3.39 (.892)	1.3-5
Loneliness_T1	1019	3.38 (.946)	1-5
Stress_T1	1017	2.99 (.581)	1-5
Belongingness_T2	229	3.58 (.558)	1-5
Stress_T2	229	2.97 (.734)	1-5
Loneliness_T2	229	3.65 (.906)	1-5
Life Satisfaction_T2	229	3.37 (.902)	1-5

Table 11

Bivariate Correlations among Main Study Variables for the first set of main analyses

	1	2	3	4	5	6	7	8	9
1. Instructors	-								
2. Peers	.496**	-							
3. Social Anxiety	-.143**	-.055	-						
4. Engagement	.501**	.304**	-.176**	-					
5. Community	.196**	.306**	-.216**	.466**	-				
6. Course Sat	.123*	.045	-.131**	.495**	.508**	-			
7. Connectedness	.039	.120*	-.462**	.120**	.327**	.130**	-		
8. Loneliness	-.018	-.069*	.374**	-.069**	-.207	-.081*	-.708**	-	
9. Stress	-.036	-.096	.406**	-.123**	-.149**	-.143**	-.408**	.440**	-

* = $p < .05$
 ** = $p < .01$

Table 12

Bivariate Correlations among Main Study Variables for second set of main analyses

	1	2	3	4	5	6	7	8	9
1. Instructors	-								
2. Peers	.496**	-							
3. Social Anxiety	-.143**	-.055	-						
4. Engagement	.498**	.305**	-.157**	-					
5. Community	.196**	.289**	-.183**	.466**	-				
6. Course Sat	.076*	.009	-.094**	.470**	.559**	-			
7. Life Sat	.090	.139*	-.200**	.318**	.204**	.222**	-		
8. Loneliness	-.026	-.045	.323**	-.199**	-.089	-.111	-.468**	-	
9. Stress	-.110	.006	.397**	-.259**	-.186**	-.212**	-.529**	.542**	-

* = $p < .05$ ** = $p < .01$

White cells = measures at Time 1; shaded cells = measures at Time 2

A similar pattern of associations was found with academic communication at Time 1 and indices of academic experience at Time 2. Communication with instructors was positively associated with course engagement, classroom community, and course satisfaction. Communication with peers was positively associated with both course engagement and classroom community, but not course satisfaction. Academic communication at Time 1 was not associated with most indices of wellbeing at Time 2, with the exception of communication with peers and life satisfaction.

Consistent with hypotheses, social anxiety was negatively associated with communication with instructors. Contrary to expectations, the same patterns of results were not found for communication with peers. As expected, indices of social anxiety at Time 1 were significantly and negatively correlated with indices of academic experience at Time 1 and Time 2. Moreover, social anxiety was positively associated with loneliness and stress at both Time 1 and Time 2 and negatively associated with social connectedness at Time 1, and life satisfaction at Time 2.

As expected, all indices of academic experiences were positively associated with one another at both Time 1 and Time 2. When examining indices of wellbeing, all were either positively or negatively associated with one another, in the anticipated direction at both time points.

Multiple Mediation Model 1: Concurrent Associations

The purpose of the present set of analyses was to test a hypothesized model depicting both direct and indirect effects between social anxiety, academic communication (both instructors and peers), academic experiences (engagement, community, satisfaction) and wellbeing (loneliness, stress, social connectedness), see

Figure 11. All variables in this analysis were collected at Time 1 and therefore utilize the full sample of participants ($N = 1073$).

Measurement model specification. To examine the measurement model, the original model was re-specified as a Confirmatory Factor Analysis. Two latent variables were included (communication with instructors, 7 indicators; communication with peers, 5 indicators), which were permitted to covary. Indicators for these latent variables were the finalized items from the Academic Communication Inventory pertaining to each subscale. A third latent variable (wellbeing) was included but was not permitted to covary based on the original model specification. Three observed variables served as the indicators for wellbeing, including (1) social connectedness; (2) loneliness; and (3) stress. Both loneliness and stress were reverse coded, so all variables were in the same direction, with higher scores indicating greater wellbeing. The initial model demonstrated good fit, $\chi^2(85) = 440.40, p < .001$, RMSEA = .062 [.057, .068], CFI = .956, TLI = .945, SRMR = .055, AIC = 45290.58, BIC = 45539.54, with the exception of the Chi-Square value. Of note, although important to report, the Chi-Square test is no longer relied upon as a basis to accept or reject model fit, due to its sensitivity to large sample size (Schermelleh-Engel, Moosbrugger, & Müller, 2003; Vandenberg, 2006).

Modification indices were examined to identify any justifiable changes that could be made to improve model fit. Suggestions pointed towards allowing measurement errors to correlate, which may not be ideal for model replication in future studies (Hermida, 2015), and were therefore ignored. Other suggested modifications were theoretically unjustifiable. Therefore, the original measurement model was retained moving forward.

Structural model specification. Following the specification of the measurement model, the model was re-specified with the addition of the structural components. Latent variables were retained, and measured variables were added to the model. Social anxiety was added as a single measured exogenous variable, and student engagement, classroom community, and course satisfaction were added as measured endogenous variables⁸. This model demonstrated good fit, $\chi^2(135) = 690.38$, $p < .001$, RMSEA = .062 [.057, .067], CFI = .942, TLI = .927, SRMR = .056, AIC = 52147.30, BIC = 52515.76. Next, the modifications indices were examined to determine which justifiable alterations could be made to the model. There were no theoretically justifiable changes to be made to the model, and therefore the original model was retained. According to the *t*-rule, the complete model was over-identified with 190 pieces of unique information (*t*) and 58 estimated parameters (*k*), resulting in 132 degree of freedom ($df = k - t$).

Conceptual Model. The conceptual model was evaluated in MPLUS 8.0 (results from estimated direct paths are displayed in Figure 12). As expected, social anxiety was directly and negatively associated with communication with instructors, student engagement, classroom community, course satisfaction, and wellbeing (all *p*'s < .001). Contrary to expectations, when communication with peers was regressed on social anxiety, the negative association only approached significance ($p = .078$). Moreover, communication with instructors was positively associated with student engagement ($p < .001$), but not classroom community ($p = .147$), and course satisfaction only approached significance ($p = .067$). Communication with peers was significantly and positively

⁸ Social anxiety, student engagement, classroom community and course satisfaction were not specified as latent variables due to model complexity and convergence issues. Therefore, because of the unidimensionality and high reliability of the aforementioned scales, composite scores were utilized in the SEM.

Figure 12. Structural Equation Model ($N = 1073$) depicting estimated direct associations between social anxiety, communication with instructors and peers, academic experiences and wellbeing. IT# = Item from the ACI; LON = reverse scored UCLA loneliness scale; STR = reverse scored perceived stress scale; CON = social connectedness scale. Solid lines indicate significant pathways; dotted lines indicate non-significant pathways. * $< .05$, ** $< .001$, ⁺ $< .08$.

associated with student engagement ($p < .001$) and classroom community ($p < .001$), but not course satisfaction ($p = .195$). Moreover, student engagement ($p = .040$) and classroom community ($p < .001$) was positively associated with wellbeing, but no significant association was found between course satisfaction and wellbeing ($p = .466$).

Finally, communication with instructors and peers was positively correlated ($p < .001$), as was student engagement and classroom community ($p < .001$), student engagement and course satisfaction ($p < .001$), and classroom community and course satisfaction ($p < .001$).

Indirect effects were also estimated to examine the potential mediating role of academic communication (i.e., with instructors and peers) in the links between social anxiety and academic experience, and the mediating role of academic experiences (i.e., engagement, community, satisfaction) in the links between social anxiety and wellbeing (see Table 13).

There was a significant and negative indirect effect of social anxiety on engagement via communication with instructors, but the mediating role of communication with peers only approached significance. Contrary to expectations, neither communication with instructors or communication with peers mediated the link between social anxiety and classroom community. However, the sum of both academic communications together (i.e., multiple mediation) accounted for significant variation in the negative association between social anxiety and classroom community. The same pattern was found with regards to course satisfaction. The sum of both communication with instructors and peers together accounted for significant variation in the links between social anxiety and course satisfaction.

Table 13

Indirect Effects of Social Anxiety on Academic Experiences through Academic Communication, and Academic Communication on Wellbeing through Academic Experiences.

Indirect Path	β	<i>SE</i>	<i>p</i>
Anxiety → Com → Engage	-.059	.016	.001
Anxiety → Instruct → Engage	-.049	.014	.001
Anxiety → Peers → Engage	-.010	.006	.091
Anxiety → Com → Community	-.022	.011	.050
Anxiety → Instruct → Community	-.004	.004	.349
Anxiety → Peers → Community	-.018	.011	.080
Anxiety → Com → Satisfaction	-.010	.005	.049
Anxiety → Instruct → Satisfaction	-.007	.005	.136
Anxiety → Peers → Satisfaction	-.003	.003	.296
Anxiety → AcadExper → Wellbeing	-.045	.010	.001
Anxiety → Engage → Wellbeing	-.009	.005	.072
Anxiety → Community → Wellbeing	-.058	.012	.001
Anxiety → Satisfaction → Wellbeing	.004	.005	.478

Significant effects are in bold.

Anxiety = Social Anxiety; Com = Communication; Engage = Student Engagement;

Instruct = Communication with Instructors; Peers = Communication with Peers;

Community = Classroom Communication; Satisfaction = Course Satisfaction; AcadExper = Academic Experiences.

Academic experience was found to play a mediating role between social anxiety and wellbeing. For example, although social anxiety was not associated with wellbeing via student engagement (approached significance) or course satisfaction, it was associated significantly and negatively via classroom community. Thus, a multiple mediation was also present, and academic experiences accounted for significant variance in the negative association between social anxiety and wellbeing.

Taken together, these results suggest that academic communication accounts for variance in the association between social anxiety and academic experiences, and academic experience accounts for at least some of the variance in the links between social anxiety and indices of wellbeing. Consistent with hypotheses, academic communication acts as a mechanism to help explain the negative association between social anxiety and a variety of course based outcomes in higher education. Furthermore, social anxiety is indeed associated with wellbeing through academic experience, particularly classroom community.

Gender differences. Multi-group analyses were conducted to determine if the current conceptual model can be tested across gender. A *configural* model was specified, in which parameters were freely estimated and demonstrated good fit, $\chi^2(164) = 483.051$, $p < .001$, RMSEA = .060 [.054, .066], CFI = .961, TLI = .950, SRMR = .058, AIC = 45166.89, BIC = 45694.68. As a result, a series of model constraints were added sequentially to examine the potential decline in model fit indices, which would suggest model invariance. Accordingly, a *Metric* model was specified, in which factor loadings were set to be equal between males and females. Results indicated good fit, $\chi^2(179) = 508.57$, $p < .001$, RMSEA = .059 [.053, .065], CFI = .959, TLI = .952, SRMR = .063,

AIC = 45162.31, BIC = 45615.41, with fit indices only minimally declining. Finally, *scalar* invariance was examined by constraining both factor loadings and item intercepts across groups, which resulted in adequate-to-good fit $\chi^2(194) = 592.747, p < .001$, RMSEA = .062 [.056, .068], CFI = .951, TLI = .947, SRMR = .069, AIC = 45216.58, BIC = 45595.01. Fit indices once again diminished slightly but remained within the acceptable range. Therefore, meaningful mean differences can be estimated between males and females for the current model.

Accordingly, a series of Wald χ^2 test of parameter equalities (using Holm's Sequential Bonferroni Procedure) were conducted to examine potential gender effects on pathways present in the current model. Therefore, one at a time, gender differences on individual paths were evaluated by being constrained to be equal across males and females, where as other paths were freely estimated. Significant results were then reevaluated based on the outcomes of the Holm's Sequential Bonferroni Procedure, which was implemented to reduce familywise error. All significant group differences fell below the critical cut-off score at the $p < .05$ level (p 's ranging from .005 to .05) and were thus interpreted.

Complete results are displayed in Table 14. Of note, the positive correlation between communication with instructors and peers was significantly stronger among males than females. As well, the path from social anxiety to communication with instructors and peers different significantly by gender, with females demonstrating a stronger negative association than males. The negative relations between social anxiety and both student engagement and course satisfaction were also significantly stronger among female than males. The path from communication with instructors to course

Table 14

Summary of Wald χ^2 Test Results using Holm's Sequential Bonferroni Procedure to Examine Gender Differences on Pathways from Figure 12.

Path	χ^2	<i>p</i>	Male β (SE)	<i>p</i>	Female β (SE)	<i>p</i>
Peers W Instruct	23.856	.001	.625(.046)	.001	.316(.035)	.001
Engage W Comm	.025	.873				
Engage W Sat	.248	.618				
Comm W Sat	.429	.507				
Peers ON Anxiety	289.05	.001	.511 (.030)	.001	-.069(.035)	.070
Instruct ON Anxiety	430.67	.001	.600 (.030)	.001	-.164 (.038)	.001
Engage ON Anxiety	4.60	.03	-.025 (.049)	.616	-.137(.029)	.001
Sat ON Anxiety	5.749	.01	.005(.063)	.933	-.144(.035)	.001
Comm ON Anxiety	1.640	.21				
Engage ON Peers	.005	.943				
Sat ON Peers	.354	.552				
Comm ON Peers	.127	.721				
Engage ON Instruct	2.655	.103				
Sat ON Instruct	6.317	.012	-.160 (.12)	.176	.097(.037)	.008
Comm ON Instruct	1.227	.268				
Wellbeing ON Anxiety	20.030	.001	-.082 (.055)	.137	-.475(.032)	.001
Wellbeing ON Engage	6.078	.013	.134 (.075)	.073	-.079(.041)	.05
Wellbeing ON Comm	10.712	.001	.284(.040)	.001	.485 (.063)	.001
Wellbeing ON Sat	1.747	.186				

Mean comparisons between males and females were not made for non-significant χ^2 test statistics.

W = Correlated With; ON = Regressed On; Peers = Communication with Peers; Instruct = Communication with Instructors; Comm = Classroom Community; Engage = Student Engagement; Sat = Course Satisfaction; Anxiety = Social Anxiety.

satisfaction was also significantly different (i.e., negative for males and positive for females).

Significant gender differences were also found when examining paths to wellbeing. For example, the negative association between social anxiety and wellbeing was stronger among females than males. Student engagement also demonstrated a gender effect, and was positively associated with wellbeing among males, and negatively associated with wellbeing among females. Finally, course satisfaction and wellbeing were more strongly positively associated for females compared to males (significantly different). Pathways not mentioned did not differ significantly by gender.

Multiple Mediation Model 2: Longitudinal Associations

The purpose of the next set of analyses was to assess a conceptual model similar to Model 1 (i.e., assessing direct and indirect links between social anxiety, academic communication, academic experiences, and wellbeing – see Figure 12), but with variables collected at two time points. Social anxiety and academic communication were assessed at Time 1, and academic experiences (i.e., student engagement, classroom community, and course satisfaction) and wellbeing were assessed at Time 2. It was of interest to see if Model 1 could be replicated with a smaller sample over time ($n = 229$).

Measurement model specification. The conceptual model was specified as a Confirmatory Factor Analysis to examine the isolated measurement model. The communication latent variables (communication with instructors, 7 indicators; communication with peers, 5 indicators) were specified and were permitted to covary. The wellbeing latent variable was included but was not permitted to covary with other variables. Measures collected at Time 2 served as the indicators for the latent variable

wellbeing, including (1) loneliness; (2) stress; and (3) satisfaction with life. Both loneliness and stress were reverse coded so all variables were in the same direction, with higher scores indicating greater wellbeing. The initial model demonstrated good fit, $\chi^2(85) = 373.088, p < .001$, RMSEA = .056 [.050, .062], CFI = .960, TLI = .950, SRMR = .057, AIC = 40648.95, BIC = 40912.51. Modification indices did not suggest any justifiable changes, and therefore the current measurement model was retained.

Structural model specification. Next, the model was re-specified with the addition of the structural components. Latent variables were retained, and measured variables were added to the model. Social anxiety was added as a single measured exogenous variable (Time 1), and student engagement (Time 2), classroom community (Time 2), and course satisfaction (Time 2) were added as measured endogenous variables. This model demonstrated adequate fit, $\chi^2(135) = 565.008, p < .001$, RMSEA = .054 [.050, .059], CFI = .949, TLI = .936, SRMR = .058, AIC = 47844.94, BIC = 48221.35. Modification indices suggested no theoretically justifiable changes, and therefore the original model was retained. According to the *t*-rule, the complete model was over-identified with 190 pieces of unique information (*t*) and 58 estimated parameters (*k*), resulting in 132 degree of freedom ($df = k - t$).

Conceptual Model. Results from estimated direct paths are displayed in Figure 13. Generally speaking, the pattern of effects was similar to those in Model 1. For example, social anxiety was significantly and negatively associated with communication with instructors ($p = .03$), whereas the negative association with communication with peers was not significant ($p = .75$). As expected, social anxiety was significantly and negatively associated with indices of academic experience (all p 's $< .05$) and wellbeing

Figure 13. Structural Equation Model ($N = 229$) depicting estimated direct associations between social anxiety (Time 1), communication with instructors and peers (Time 1), academic experiences (Time 2) and wellbeing (Time 2). IT# = item from the ACI; LON = reverse scored loneliness in context questionnaire; STR = reverse scored perceived stress scale; and SAT = satisfaction with life scale. Solid lines indicate significant pathways; dotted lines indicate non-significant pathways. * < .05, ** < .001, + < .08.

($p < .001$). Moreover, communication with instructors was significantly and positively associated with student engagement ($p < .001$), but not classroom community ($p = .35$) or course satisfaction ($p = .20$). Communication with peers was significantly and positively associated with student engagement ($p = .025$) and classroom community ($p < .001$), but not course satisfaction ($p = .54$). Student engagement ($p = .10$), classroom community ($p = .73$) and course satisfaction ($p = .46$) were not significantly associated with wellbeing.

Indirect effects were examined to investigate the mediating role of academic communication (i.e., with instructors and peers) in the links between social anxiety and academic experience, and the mediating role of academic experiences (i.e., engagement, community, satisfaction) in the links between social anxiety and wellbeing (see Table 15).

The indirect effects were consistent with those found in Model 1 in terms of the *pattern of effects*. Effects were similar in size and directionality. However, unlike Model 1, effects in Model 2 were not significant. Thus, academic communication did not mediate the links between anxiety and engagement, classroom community, or satisfaction. Furthermore, academic experiences did not account for significant variance between social anxiety and wellbeing. The non-significant findings are likely a result of a lack of power due to the use of a small sample in a model high in complexity. Future studies should attempt to replicate the results from Model 1 with a larger sample size across two time points for additional credibility.

Table 15

Indirect Effects of Model 2 - Social Anxiety on Academic Experiences through Academic Communication, and Academic Communication on Wellbeing through Academic Experiences.

Indirect Path	β	<i>SE</i>	<i>p</i>
Anxiety → Com → Engage	-.050	.036	.167
Anxiety → Instruc → Engage	-.047	.033	.152
Anxiety → Peers → Engage	-.003	.011	.755
Anxiety → Com → Community	-.017	.023	.464
Anxiety → Instruct → Community	-.011	.011	.314
Anxiety → Peers → Community	-.006	.019	.754
Anxiety → Com → Satisfaction	-.019	.015	.232
Anxiety → Instruct → Satisfaction	-.018	.015	.218
Anxiety → Peers → Satisfaction	-.001	.004	.782
Anxiety → AcadExper → Wellbeing	-.034	.019	.073
Anxiety → Engage → Wellbeing	-.025	.018	.15
Anxiety → Community → Wellbeing	-.004	.012	.735
Anxiety → Satisfaction → Wellbeing	.005	.008	.548

Significant effects are in bold.

Anxiety = Social Anxiety; Com = Communication; Engage = Student Engagement;

Instruct = Communication with Instructors; Peers = Communication with Peers;

Community = Classroom Communication; Satisfaction = Course Satisfaction; AcadExper = Academic Experiences.

Gender differences. Next, multi-group analyses were conducted to determine if Model 2 could be tested across gender. Therefore, a series of models were examined while sequentially implementing model constraints. A *Configural* model demonstrated good fit, $\chi^2(192) = 447.860$, $p < .001$, RMSEA = .050 [.044, .056], CFI = .965, TLI = .956, SRMR = .073, AIC = 40561.119, BIC = 41118.78. Next, a *metric* model was specified by constraining factor loadings, and also demonstrated good fit $\chi^2(208) = 477.325$, $p < .001$, RMSEA = .049 [.043, .055], CFI = .963, TLI = .957, SRMR = .083, AIC = 40558.58, BIC = 41036.58, with fit indices declining minimally. Finally, a *scalar* model was examined by constraining factor loadings and intercepts, and results indicated adequate-to-good fit $\chi^2(224) = 525.497$, $p < .001$, RMSEA = .050 [.045, .056], CFI = .958, TLI = .956, SRMR = .085, AIC = 40574.75, BIC = 40973.99, with once again only minimal deterioration of fit indices. Therefore, meaningful differences can be estimated between males and females for the current model.

Thus, a series of Wald χ^2 test of parameter equalities (using Holm's Sequential Bonferroni Procedure) were implemented to examine potential gender effects on model pathways. Gender differences were examined sequentially by adding equality constraints to one path at a time, while allowing the others to be freely estimated. All significant group differences that fell below the critical cut-off score at $p < .05$ were interpreted.

Results are displayed in Table 16. The positive association between communication with peers and instructors was significantly stronger for males compared to females. The negative relations between social anxiety and academic communication (both with peers and with instructors), student engagement, and satisfaction were also all

Table 16

Summary of Wald χ^2 Test Results for Model 2 using Holm's Sequential Bonferroni

Procedure to Examine Gender Differences on Pathways from Figure 13.

Path	χ^2	<i>p</i>	Male β (SE)	<i>p</i>	Female β (SE)	<i>p</i>
Peers W Instruct	23.49	.001	.624(.045)	.001	.321(.035)	.001
Engage W Comm	.037	.847				
Engage W Sat	.301	.583				
Comm W Sat	.446	.504				
Peers ON Anxiety	285.59	.001	.508 (.030)	.001	-.072(.039)	.064
Instruct ON Anxiety	427.98	.001	.598 (.030)	.001	-.172 (.039)	.001
Engage ON Anxiety	4.405	.036	-.022 (.049)	.654	-.132(.030)	.001
Sat ON Anxiety	5.672	.01	.007(.060)	.930	-.143(.04)	.001
Comm ON Anxiety	1.561	.211				
Engage ON Peers	.001	.991				
Sat ON Peers	.422	.516				
Comm ON Peers	.042	.838				
Engage ON Instruct	2.620	.105				
Sat ON Instruct	6.331	.011	-.167 (.11)	.158	.094(.037)	.011
Comm ON Instruct	1.418	.233				
Wellbeing ON Anxiety	2.117	.145				
Wellbeing ON Engage	0.052	.819				
Wellbeing ON Comm	1.845	.101				
Wellbeing ON Sat	.036	.850				

Mean comparisons between males and females were not made for non-significant χ^2 test statistics. W = Correlated With; ON = Regressed On; Peers = Communication with Peers; Instruct = Communication with Instructors; Comm = Classroom Community; Engage = Student Engagement; Sat = Course Satisfaction; Anxiety = Social Anxiety.

significantly stronger among females than males. Finally, the association between course satisfaction and communication with instructors was negative for males and a positive for females (which were significantly different).

Of note, this pattern of gender differences was predominantly consistent with the first conceptual model. However, unlike Model 1, there were no group differences present when examining the associations between study variables and wellbeing. This could be a function of either sample size, or variables used to create the latent variable wellbeing.

Study 3 – Discussion

The overarching goal of Study 3 was to examine the links between social anxiety, communication, academic experiences, and wellbeing in two similar models. Model 1 examined a large sample at one time point, whereas Model 2 examined a smaller sample across two time points (with different indices of wellbeing). Results from Model 1 demonstrated academic communication (joint effect of instructors and peers) accounted for significant variance in the links between social anxiety and academic experiences (i.e., student engagement, classroom community, course satisfaction). Moreover, social anxiety was negatively related to academic experiences, in both models and there was at least some evidence that academic experiences explained part of the association between social anxiety and wellbeing. Results from both models were consistent in terms of patterns of results. Effects and gender differences are discussed below.

Academic Communication with Instructors and Peers

Research finds that student-student and student-instructor interactions relate to a myriad of positive academic outcomes (e.g., Arbaugh & Benbunan-Fich, 2007;

Joksimovic et al., 2015; Marks et al., 2005; Mosser, 2010), including student engagement (Dixon, 2010). Therefore, it was anticipated and found that communication with both *instructors* and *peers* would be associated with student engagement. Measures of student engagement often include *behavioural engagement*, which encompasses students' actions (i.e., participation, attendance, learning involvement) (e.g., Boucheix et al., 2013; Peters et al., 2011; Thompson et al., 2012), which aligns with components of *academic communication*. For example, participating in both learning activities with classmates and in classroom discussions involves *talking* with others. Moreover, *emotional engagement* emphasizes student experiences of negative or positive emotions towards course content, and peers and teachers (e.g., Kay, 2011; Missette, Reed, Scot, Callahan, & Slade, 2010; Sun & Rueda, 2012), in which communication with others is inherent.

Because communication is an essential component to student engagement, it is important that higher education continues the shift from the instructional paradigm (i.e., delivering content via straight lecture) to a learning paradigm, involving high levels of active participation (Barr & Tagg, 1996). An active approach to learning can increase communication between students and instructors, leading to positive outcomes. For example, Marbach-Ad and Sokolove (2002) found that in a large lecture-based class where active learning was encouraged (i.e., participatory learning, question and answer sessions, group discussions, etc.), the frequency of student-instructor communication was increased (as compared to a traditional lecture-based control class). Furthermore, an active learning environment often includes collaborative learning opportunities, which ultimately fosters communication among students. Collaborations have been found to increase student engagement, as students can help their peers understand course material

through *relatable* explanations (e.g., Caldwell, 2007; Crouch & Mazur, 2001; Michaelson et al., 2004).

Results from Study 3 indicated that communication with peers but not instructors was associated with classroom community (i.e., feelings of connectedness with others in a specific course). Therefore, it appears that interactions among students may be the driving force in developing a sense of classroom community. Student-student communication may be associated with increased classroom community for a variety of reasons. First, increased interaction among students may open additional lines of communication (i.e., exchanging personal information), thus strengthening bonds. Second, students who communicate in class may be more likely to engage in study groups. Study groups have been found to enhance communication about course material, ultimately increasing academic achievement (Aamodt, 1982). Lastly, student-student interactions may lead to friendships, which could result in increased feelings of closeness, which may bolster positive academic outcomes. For example, Bronkema and Bowman (2017) found friendships in higher education were predictive of academic achievement and degree completion. It is important to foster student-student communications as classroom community is associated with knowledge sharing behaviours and student success (Garrison & Arbaugh, 2007; Ouzts, 2006; Yilmaz, 2016).

As previously mentioned, communication with instructors was not associated with classroom community. This is not to say that instructors do not play a critical role in the development of a strong classroom community, rather their influence may lie more in course design and facilitation of student-student interactions. For example, Dennen and colleagues (2007) found that too much instructor participation in course discussion

boards or group learning activity actually decreased student participation. Therefore, course instructors may wish to take a facilitator role by ensuring students are effectively connecting and collaborating with their classmates, allowing students themselves to be the active participants.

It was hypothesized that communication with instructor and course satisfaction would be positively associated. This was in part because student satisfaction is often linked to assessment and course content (Dong & Lucey, 2013), which is quite often under control of the instructor. Moreover, critical areas of student satisfaction often pertain to instructor responsiveness, communication, and access (Douglas, McClelland, & Davies, 2008). Direct effects from communication with instructors to course satisfaction from the first conceptual model approached significance, and results from the second conceptual model were null – which may be largely due to the specific measure of course satisfaction used.

Quite often, measures of student satisfaction are the summary evaluation of students' expectations versus perspectives (Gruber, Fub, Voss, & Glaser-Zikuda, 2010; Sarrico & Rosa, 2014), and reflect opinions on assessments, quality of teaching, and course communication. However, the measure of course satisfaction used in Study 3 (Bollinger & Halupa, 2012) assessed course satisfaction by utilizing items relating to students personal performance (i.e., "I am satisfied with my performance in this course", "I am satisfied with my final grade in this course", "I am satisfied with how I am able to apply what I have learned in this course"). Thus, *course satisfaction* may reflect student's satisfaction with their own academic performance instead of a global course satisfaction, which may explain the unexpected results. The association between academic

communication and student satisfaction should be further explored with a different measure in future studies.

Social Anxiety

Consistent with hypotheses, the results from Study 3 add to the limited research indicating that social anxiety is negatively associated with student engagement in higher education (Wittchen, 1999). In a qualitative study, Russell and Topham (2012) found that social anxiety impacts engagement in learning activities. For example, socially anxious students reported experiences of anticipatory anxiety when presented with a classroom learning activity, embarrassment, as well as disabling effects. Student experiences described in Russell and Topham's study correspond to dimensions of student engagement as outlined in Henrie et al. (2015). For example, *behaviourally engaging* tasks (i.e., participatory learning) may cause disabling effects such as thought blocking or drawing a blank, which may impact socially anxious students' ability to *cognitively engage* with material. This may subsequently lead to excessive blushing, resulting in self-consciousness (Russell & Topham, 2012), negatively impacting *emotional engagement*. Therefore, socially anxious students may experience a snowball effect of undesirable events related to student engagement.

Students who experience social anxiety report difficulty in face-to-face classrooms in the presence of active learning activities (Russell & Topham, 2012). In light of technological advancements, studies suggest that computer-mediated communication may be a more comfortable medium for socially anxious individuals (Caplan, 2007; Gross et al., 2002; Lee & Stapinski, 2012; Pierce, 2009; Shephard & Edelman, 2005). However, online learning activities (i.e., those mediated via computer)

were recently demonstrated to have little compensatory effects for university students who experience social discomfort (Grieve, Kemp, Norris, & Padgett, 2017). Because socially anxious students have difficulty engaging in both face-to-face and computer-mediated learning activities, it is critical for educators to develop novel ways to engage *all* students in the classroom. For example, mobile-based interactive teaching tools have been found to increase student engagement and performance (Lim, 2017), and may be beneficial for socially anxious students as they allow for *anonymous* polling, quizzes, and games.

Bruce and Seed (1999) suggest that higher education places social demands on students, which may trigger or exacerbate social anxiety. Furthermore, students are often expected to engage with unfamiliar peers during learning activities (Topham, 2009), which may increase socially anxious student's experiences of stress, potentially resulting in withdrawal from classmates. In line with this, results from the current study found that social anxiety was negatively associated with classroom community.

Previous studies demonstrate that classroom community (i.e., feelings of belongingness; social community of learning; students sharing knowledge, values, and goals – Rovai, 2002) is associated with greater perceived cognitive learning, increased interactions, collaborative learning, feelings of belongingness, greater satisfaction in both online and offline courses (e.g., Akyol & Garrison, 2008; Rovai, 2002; Rovai & Jordan, 2004; Tayebnik & Puteh, 2013; Top, 2012; Wang, 2010). On the other hand, low sense of community is associated with two key components linked to student dropout – student burnout and feelings of isolation (McCarthy, Pretty, & Catano, 1990; Morgan & Tam, 1990). Socially anxious students are already at risk for negative academic outcomes,

including higher rates of attrition (e.g., Ameringen et al., 2003; Stein & Kean, 2000; Wetterberg, 2004; Wittchen et al., 1999; Zukerman et al., 2019) – therefore it is necessary to find ways to mitigate their discomfort with others, in hopes to increase feelings of classroom community.

Although no previous studies have examined social anxiety and satisfaction in higher education, the current study hypothesized and demonstrated that social anxiety was negatively associated with course satisfaction. It has been documented that both clinical and subclinical levels of social anxiety is linked to poor satisfaction with life in a variety of domains, including achievement, family, employment, and social functioning (Eng, Coles, Heimberg, & Safren, 2005; Fehm, Beesdo, Jacobi, & Fiedler, 2008; Safren, Heimberg, Brown, & Holle, 1997). Results from Study 3 suggest that dissatisfaction extends to the educational setting. As previously mentioned, the measure of *course satisfaction* utilized in the current study may reflect more on the students perceived performance in a course than their satisfaction with course components (i.e., quality, instructor, assessments). Thus, due to socially anxious students' educational struggles, the negative link between social anxiety and satisfaction is expected. Finally, given the shift towards a *learning paradigm* (Barr & Tagg, 1996), the educational setting may be even more anxiety provoking due to high levels of participatory learning and active engagement, which in turn, may be lowering feelings of course satisfaction among socially anxious students.

A different pattern of results was found in the link between social anxiety and communication with instructors compared to peers. For example, social anxiety was negatively associated with communication with instructors, and contrary to hypotheses,

there was no significant association between social anxiety and communication with peers. As discussed previously, the multi-modal nature of the *Academic Communication Inventory* (ACI) measures both face-to-face and computer-mediated communication. The *peers* subscale in particular weighs heavier on online versus in-person interaction.

Socially anxious individuals often find communicating via technology more comfortable and less threatening as they have time to thoughtfully prepare a question or response, and physical appearance is not of concern (e.g., Bonetti et al., 2010; Caplan, 2007; Cuhadar, 2012; Lee & Stapinski, 2012; Suler, 2004; Walther et al., 2005). Therefore, it is possible that socially anxious students communicate more via technology, and therefore their *communication with peers* scores were somewhat higher than expected. This may in part explain the null association between social anxiety and communication with peers.

Additionally, the ACI primarily measures one-to-one communication (not group communication), which socially anxious students may be more comfortable with. It is possible that socially anxious students may be familiar with a few peers in their course (i.e., learning communities, previous courses, through other networks), resulting in more comfortable one-on-one communication. For example, *learning communities* are encouraged in higher education (referring to groups of students who are intentionally clustered together) (Smith, MacGregor, Matthews, & Gabelnick, 2004), which often result in increased student interaction and success (Kuh, Kinzie, Schuh, & Whitt, 2005; Love, 2012). Learning communities may be particularly beneficial for certain students in reducing social discomfort associated with communication.

Although student-instructor interaction contributes to academic success in higher education, not all students may feel comfortable engaging in communication with a

course professor. In the educational context, there is a power dynamic between student and teacher. Power in this regard refers to the ability of one individual to influence another to do something (Kearney, Plax, Richmond, & McCroskey, 1984). Moreover, some instructors may use *fear appeals* (otherwise known as anti-social compliance strategies) in their classroom teaching (i.e., you will fail the course if...), which may intimidate students. Power and fear appeals are inextricably linked to communication (Richmond & Roach, 1992), which may result in one-way statements opposed to conversations. Socially anxious students may be particularly susceptible to experiencing nervousness around instructors because of their authority, even if they are not capitalizing on power or using fear appeals. For example, common items on measures of social anxiety and social phobia assess fear and avoidance towards people of authority (Liebowitz, 1987; Ranta et al., 2007), which may in part explain the negative association between social anxiety and communication with instructors.

Results from Study 3 demonstrated that communication with instructors partially explains the negative association between social anxiety and student engagement. Therefore, to increase student engagement among socially anxious students, it is important to target non-threatening communication strategies which can facilitate student-instructor interaction. Moreover, it is important to encourage instructor immediacy, while discouraging intimidating behaviours that highlight power dynamics. Immediacy relates to approach and avoidance behaviours (Andersen, 1979; Mehrabian, 1971), including both nonverbal (gesturing, eye contact, positive affect, relaxed posture, and a lack of barriers between instructor and students) and verbal behaviours (knowing students by name, inclusive terminology, small talk, outside of class conversations,

approachability, interest in student perspective). Instructor immediacy is associated with teacher responsiveness, caring, and trustworthiness (Thomas, Richmond, & McCroskey, 1994; Thweatt, 1999) as well as student attendance and participation (Rocca, 2004).

Increasing instructor immediacy may help socially anxious students feel less intimidated and more comfortable in their interactions with instructors, which may increase communication and student engagement.

Finally, the results demonstrated that academic communication (summed across both instructors and peers) accounted for significant variance in the relation between social anxiety and both classroom community and student satisfaction. Therefore, academic communication is an important underlying mechanism explaining the links between social anxiety and academic experiences. It is important to provide opportunities to increase communication that will appeal to students who experience social discomfort. For instance, Wang (2010) found that incorporating both online communication via blogs and face-to-face learning activities in a course served to “break the ice” and helped to maintain interactions among students, fostering a sense of community in the classroom. Including less threatening and indirect forms of communication (i.e., blogs) may increase comfort and thus academic communication. Furthermore, providing students with their *preferred* communication modality (i.e., face-to-face; computer-mediated) or platform (i.e., discussion post, blog, small group-setting, one-on-one) may increase comfort and therefore interactions. Suggestions to promote communication among socially anxious students are presented in the General Discussion.

Social Anxiety, Academic Experiences, and Wellbeing

The current study found some inconsistent results with regards to the direct link between academic experiences and student wellbeing. Student engagement and classroom community were positively and directly associated with wellbeing in the first conceptual model, but not the second. This highlights a potential issue with *directionality*.

Specifically, both Model 1 and 2 examined academic experiences and wellbeing at the same time point (i.e., Model 1 at Time 1; Model 2 at Time 2). Therefore, it may be that student engagement and classroom community share variance with wellbeing, but academic experiences may not influence wellbeing. It was expected that academic experiences would be positively associated with wellbeing, as research demonstrates that both engagement and connectedness in school are associated with wellbeing (e.g., Creed, Muller, & Patton, 2003; Dubow et al., 1991; Rovai & Wighting, 2005; Tinto, 2000; Van Ryzin et al., 2009). However, the relation between student engagement and wellbeing may be more complex.

According to Field (2009), for successful learning to take place, students need to feel well both physically, socially, and emotionally. Therefore, it may be that student wellbeing influences academic experiences in higher education (instead of academic experiences influencing wellbeing, as conceptualized in the current study). Future studies may benefit from more explicitly examining the influence of student wellbeing on indices of academic experience in a longitudinal design to better understand the directionality of effects.

As mentioned, classroom community mediated the link between social anxiety and wellbeing (in the first conceptual model). Therefore, if socially anxious students

experience more classroom community, this may serve to improve their wellbeing. This indirectly underscores the importance of academic communication for socially anxious students (which mediated the link between social anxiety and classroom community). If communication is increased, sense of classroom community may increase, which may have a positive effect on wellbeing. Of note, since data was collected at one time point (Model 1), directionality cannot be inferred.

Model 2 did not replicate the mediating role of individual academic experiences (i.e., student engagement, classroom community, course satisfaction) in the links between social anxiety and wellbeing. However, the direction of effects was the same as Model 1, and results approached significance (i.e., $p = .073$). Therefore, enhancing the academic experiences of socially anxious students may help to increase their wellbeing.

Gender Effects

Measurement invariance across gender was examined for the structural components of both models, to ensure groups could be compared. Among the results, males and females were found to conceptualize the ACI in a similar way (i.e., scalar invariance was achieved). Therefore, the ACI can be used confidently in future studies to examine and compare communication with instructors and peers between males and females.

Consistent with hypotheses, there were gender differences found on direct pathways in both models. As compared to males, females were found to have significantly stronger negative associations between social anxiety and: (1) communication with instructors; (2) student engagement; (3) course satisfaction; and (4) wellbeing. Research demonstrates that compared to their male counterparts, females

experience higher levels of social anxiety (e.g., MacKenzie & Fowler, 2013; Merikangas et al., 2002; Russell & Shaw, 2009), which *may* help explain these stronger negative effects. Baptista and colleagues (2012) found that among socially anxious college women, fear of public speaking was the most common social fear. Public speaking is commonly incorporated into classroom activities meant to promote student engagement (Davidson, Hughes, George, & Blazer, 1994; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992), which may consequently strengthen the negative association between social anxiety and student engagement among women.

The positive association between communication with instructors and student satisfaction was also significantly stronger for females than males. Previous research demonstrates that males tend to communicate with their teacher more than females (Hillmann & Davenport, 1978; Hutchinson & Beadle, 1992; Jones & Dindia, 2004; Karp & Yoels, 1976; Sternglanz & Lyberger-Ficek, 1977). However, these communications are *both* positive and negative. It is possible that compared to males, females experience more positive student-instructor conversations, which may thereby increase their course satisfaction. Moreover, females place more importance on interactions with others in the educational setting (Kirkup & von Prummer, 1990), which may contribute to communications with a positive undertone, and therefore higher course satisfaction. In support of this, Kim and Sax (2009) found that females are more satisfied with their interaction with faculty than their male counterparts, which may contribute to overall course satisfaction.

The gender differences discussed thus far were found in both the single time point and short-term longitudinal models. One gender difference was evident Model 1 (i.e.,

large sample; one time point) but not replicated in Model 2 (i.e., smaller sample; two time points): student engagement and wellbeing were significantly and positively associated for males, and significantly and negatively associated for females. The little research that has been conducted on student engagement and wellbeing reports a positive correlation between the two (e.g., Creed et al., 2003; Dubow et al., 1991; Tinto, 2000; Van Ryzin et al., 2009), and does not report on gender differences. Moreover, there is no theory to support this finding. Since this finding was not replicated in Model 2, it needs to be explored in subsequent research meriting further discussion.

Conclusions and Caveats

Results from Study 3 provided additional support for the utility of the *Academic Communication Inventory* and is one of the few studies to examine the correlates and outcomes of social anxiety and academic experiences in higher education. In Model 1, communication with peers and instructors accounted for significant variance in the negative relation between social anxiety and academic experiences. Therefore, improving socially anxious students' interactions with others may enhance their educational outcomes. Direct effects from the first model discussed herein were found to be replicable with a smaller sample across two time points. Results from the current study suggests that social anxiety is negatively related to communication with instructors and academic experiences, and therefore educators should consider the needs and struggles of these students when designing their courses to create an inclusive learning environment.

Nevertheless, some caveats should be considered. For example, some of the direct and indirect effects found in the structural equation models were small (but still significant). It is important to note that both models were statistically well-fitting, and

many of the results were consistent across models. Moreover, the use of a more diverse sample would allow for greater generalizability of results. The current study collected data from only one institution – future studies may wish to examine data from multiple institutions. Furthermore, examining social anxiety in higher education in multiple countries may allow for greater generalizability. To date, social anxiety in higher education has only been examined in country-specific studies (e.g., Baptista et al., 2012; Bella & Omigbodun, 2012; Gultekin & Dereboy, 2011; Hakami et al., 2017; Russell & Shaw, 2009; Shah & Kataria, 2010; Tillfors & Furnmark, 2007).

Academic communication has proven to be an important construct, demonstrating unique relations with both social anxiety and academic experiences. Therefore, it is critical to explore ways in which educators can promote communication among socially anxious students. To do this, we must first identify potential *barriers* to student-student and student-instructor communication. Therefore, the final study of this dissertation examines academic communication from a quasi-qualitative perspective, by exploring with whom students communicate and why.

Study 4

Student's Communicative Preferences: A Quasi-Qualitative Investigation

Following the development and implementation of the *Academic Communication Inventory*, it was of interest to understand *why* students might choose to communicate with certain people over others. Accordingly, Study 4 was intended to supplement previous quantitative investigations by attempting to: (1) gain additional insight into the ACI (i.e., peers vs. instructors); (2) understand more about socially anxious students'

communicative preferences; and (3) further explore the role of gender differences in communication in higher education.

To investigate this, an open-ended query was presented to participants, and responses were analysed using thematic analyses, then subsequently coded and examined using quasi-qualitative methods. Results from Study 1 and Study 2 indicated a two-factor structure for the ACI, with identifiable subscales pertaining to “communications with instructors” and “communication with peers”. Accordingly, it was expected that in response to the open-ended question, students would indicate that they tend to speak to their peers, to their instructors, or to a combination of both. Of particular interest was the rationale(s) that they were expected to provide for such preferences. Following thematic analyses, mean differences in social anxiety and gender were examined between emerging themes, to deepen our understand of socially anxious individuals’ communicative preferences.

Approach to Coding

The current analytic approach followed the recommendations of Braun and Clark (2006). Although specific predictions grounded in theory and empirical evidence could be made, inductive analyses were used (i.e., without trying to fit data into a pre-existing coding framework). Therefore, coders did not consider hypotheses in hopes of reducing bias. Further, Braun and Clarke (2006) discuss the study of direct experience, known as phenomenology – in which there is no level of interpretation. As the current analyses were conducted on an exploratory basis, the phenomenological approach was applied.

Participants

Participants for this study were from the same sample described in Study 2 and Study 3 ($N = 1074$). Those who responded to the open-ended question (presented below) were included in the current analyses ($n = 894$, 19.2% male; 80.8%). See Study 2 for details regarding demographic information. Attrition analyses were conducted to explore possible biases in the portion of the sample that completed open-ended questions. There were no significant differences in sample characteristics between those who completed open-ended question and those who did not.

Thematic analyses continued until saturation of responses was obtained⁹. Therefore, approximately 25% of the participants ($n = 233$; 22.1% males, 77.9% females) were used to examine emerging themes qualitatively, whereas the full sample was used to compare responses to open-ended questions quantitatively (coding manual was developed following initial thematic analyses – as explained below).

Measures

As part of the online questionnaire (see *procedure* in Study 2 and study 3), participants were asked the open-ended question: “When you have a question about coursework, who do you ask and why?”. This question was developed for the second round of data collection, based on the results from Study 1 (i.e., initial factor structure of the *Academic Communication Inventory*). Participants *gender* and *social anxiety* scores were used in quantitative analyses. For example, social anxiety was measured using the *Liebowitz Social Anxiety Scale* (LSAS; Liebowitz, 1987) (see Study 2 for details) and an aggregate variable was created, which was then used to compare mean differences in social anxiety between emerging themes.

⁹ Due to the short nature of many open-ended responses, saturation took longer than had anticipated.

Results

Thematic Analyses

After reading through 25% ($n = 233$) of the responses to the open-ended question, initial ideas were recorded relating to emerging themes. As there was no pre-existing knowledge of the responses among the three coders, repeated reading of responses allowed for familiarity with data. Initial codes were generated in a systematic way, and data was collated accordingly to each code. Following this, the search for themes began, which required additional collation of codes, and data extraction relevant to potential themes. Themes were then reviewed to ensure consistency in relation to the coded extracts. Then, themes were specified and defined, which assisted in providing an overall story to participant responses. Selected excerpts from the data were then compiled for the themes to relate to the research questions and literature. Coders met several times to review codes and themes, and to identify any discrepancies. Discrepant themes that were not easily resolved via discussion were not included. Finally, a selection of excerpts from the data was compiled to relate the themes to the relevant research question and literature.

Qualitative themes. Four overarching themes emerged during the thematic analysis that captured students' general preference when asking a course related question, including: (1) peers; (2) instructors; (3) peers and instructors; and (4) no one. Each of these main themes was supported by subthemes, which appeared to be of similar nature.

Theme 1: Peers. Thirty-seven percent of students said that they would ask *peers* questions about coursework for a variety of reasons. Participants often cited with whom they would prefer to communicate with, and followed their answer with a supporting statement. Among their expansions, participants cited themes such as *fears of negative*

evaluations and discomfort, convenience, and knowledge translation. Detailed descriptions are found below.

Fears of negative evaluation and discomfort. This was the most common subtheme to emerge under the *theme of peers*. Twenty-five percent of students indicated that they would ask peers course-based questions because they fear they will sound unintelligent or experience feelings of discomfort when talking to an instructor or TA. This was epitomized by a participant's statements that:

"I would ask someone taking the class because sometimes I think my questions make me look less intelligent in front of the prof when all I am trying to do is understand better and sometimes for me that means to "dumb" down the material".

"I find the instructor intimidating and feel judged and looked down upon for not understanding material which does not make me feel very good... so I find it more comfortable to ask my classmates".

Moreover, participants directly cited feelings of nervousness and discomfort when speaking to an instructor. These statements and many like them highlight an underlying anxiety when approaching a class instructor with a question.

Convenience. Six percent of students said that they would ask peers questions because it was the most convenient. Among the reasons cited, ease of communication (i.e., several modes of connectivity), accessibility, and efficiency (i.e., instant response) were the most prevalent. For example, participants responses were similar to the following:

“I usually ask friends because I can send them a text message or call and they are always around. It is also a lot easier to get a hold of them for a quick answer to a question”.

“asking instructors requires a lot more effort so its easiest to ask people from class”.

Knowledge translation. The last subtheme to emerge focussed on the translation of knowledge. Six percent of students said they would ask peers because of their ability to communicate their knowledge clearly and effectively. For example:

“It is helpful for me to ask peers because they may have understood the concept and are able to explain it in a way that actually makes sense”.

“I talk to people in the class about questions because the professor often makes things seem much more difficult then it really is”.

This theme underscores the idea that certain students’ learning may benefit more from student-student communications than student-instructor communications.

Theme 2: Instructors. The next theme focussed on students who preferred to communicate with instructors when asking questions about coursework. Twenty-eight percent of students said that they would ask their instructor or TA questions. Only two subthemes emerged where students cited consistent reasons *why* they would ask their instructors/TAs questions (over others).

Convenience. Similar to the theme of *peers*, about 6% of students mentioned they would ask questions to their instructors out of convenience. Responses typically indicated that contacting the instructor with questions was the easiest way to receive an answer:

“I ask the teacher over email. I don’t have time to meet with anyone and it is the easiest way to get the info I need”.

“I prefer to ask the instructor because they get back to me quickly”.

However, some participants did not seem to have strong rationale for their decision to ask an instructor questions, which may suggest more habitual behaviour, for example:

“If I have a question I just send the prof an email, no real reason I guess it is just easier and more convenient”.

Knowledge and clarity. Nearly 23% of participants said they would ask the instructor questions because of their knowledge of both course content and assessments, and their ability to communicate effectively. One student’s response exemplifies this nicely:

“I prefer to ask instructors course related questions because they are teaching the course so they know best and can explain everything, they also know what they would consider the correct answer to questions and what they would want to see on an evaluation”.

Many students cited reasons including:

“They are right 100% of the time”.

“It is easier to learn and understand a prof compared to other students”.

“They are obviously more knowledgeable than students”.

“Profs are excellent at answering questions. They run the show so they are the ones to go to if you want to do well”.

These statements also hint at a rationale of authority. Students may be likely to go to instructors, as they are ultimately responsible for assessments and final grades.

Theme 3: Peers and Instructors. Twenty-seven percent of students said that they would ask peers and/or instructors questions about coursework. There were various reasons (as indicated in subthemes) why students might choose either peers *or* instructors first, and then follow up with the other, or why their choice may be context specific.

Feelings of comfort. About 6% of participants indicated they would ask a peer or an instructor a question, but it was dependent on how comfortable they felt in each situation. For example:

“I talk to my peers because I'm more comfortable around them, unless I feel comfortable enough to ask the prof, then I will go to them”.

Thus, students are likely to open lines of communication differently in various courses, depending on the level of comfort they experience with their peers and instructors.

Another consistent response was:

“I sometimes ask peers because they are not as intimidating and it is more comfortable, but if they don't have the answers I still go to the prof”.

This demonstrates a clear preference (peers over instructors due to preference), however, if need be, some students will ask questions to both.

Convenience. Next, only 3% of participant stated that they would ask peers and instructors out of convenience. When they did, it usually resembled one participants response:

“I ask peers first because instructors are usually busier and have less time to answer questions, but if they're free and it is convenient I would go ask the instructor”.

Question contingent. This subtheme refers to the type of question that the students have that seems to dictate who they communicate with. About 5% of student's responses fell within this theme. For example:

“Depends. When it comes to projects, essays and tests I will ask an instructor, but if it's deadlines or clarification of knowledge then I will ask a peer”.

“Depends on the situation. I will turn to peers for basic questions but instructors for important or bigger questions on assignments”.

Information gathering. Approximately 18% of students mentioned they would go to both peers and instructors because they can provide different information and help. Students often noted that it is important to get the most information and help possible, while others indicated they often asked peers first, followed by instructors if they needed clarification.

“If I am struggling with something I will go to the prof, TA, and people in the class to get as many answers as I can. Everyone can give me different information”.

“I always ask peers first, if they do not know the answer I will ask the professor”.

“I ask my peers first because they might know some answers that I need, but if they don't I go to the profs office”.

“I prefer to ask peers related questions to see if they are struggling with the same concept, but if they can't answer the question I will ask the instructor because they will clarify”.

Theme 4: No one. Eight percent of students said that they would not ask anyone questions about coursework. Many responses were similar to:

“No one because I will figure it out”.

“I don’t ask questions I just Google it”.

“I don’t need to ask the information is on the course website”.

However, one subtheme did emerge and seemed to highlight students feelings of anxiety.

Feelings of anxiety. Five percent of participants (over half of the responses in this overarching theme) indicated that they experience some type of anxiety or discomfort when asking questions. For example:

“No one, talking with people triggers my anxiety”.

“I don’t ask questions because I feel insecure”.

“Nobody. I am socially anxious and therefore, I find it very intimidating”.

“Instructors intimidate me so I try to figure things out on my own. I do not want to look stupid in front of people in the class either so I avoid asking them course related questions if possible”.

These responses, and others like it, suggest that there is a subgroup of students who avoid communicating for the purpose of academic advancement all together (even when they require help).

Individual Differences in Thematic Responses: Gender and Social Anxiety

Results from the thematic analyses were used to create a coding manual for the present question (see Appendix AA). Once the coding manual was finalized, coders began examining all responses independently and assigning numeric codes to participant responses. Inter-coder reliability (using Cohen’s Kappa) was established on 25% of the sample, ranging from $\alpha = .80$ to $.85$. Quantitative results were used to statistically

compare gender and themes, frequency of themes and subthemes, and to examine mean levels of social anxiety within each main theme.

Differences in frequencies. Marascuillo Procedure was conducted to determine statistically significant differences among main themes and subthemes (see Table 17 for ratios). For significant differences to occur at $p < .05$, the statistical value presented must be higher than the critical cut-off (Marascuillo, 1966). With regards to main themes, students indicated the theme of *peers* was present significantly more than *instructors* (.09 > Critical = .06), *peers and instructors* (.10 > Critical = .06), and *no one* (.29 > Critical = .051). The theme of *instructors* (.20 > Critical = .048) and *peers and instructors* (.19 > Critical = .048) were significantly more prevalent than the theme of *no one*. There was no significant difference between the theme of *instructors* and the theme of *peers and instructors* (.001 < Critical = .058).

Within the theme of *peers*, the subtheme of *Fears of negative evaluation and discomfort* appeared significantly more often than *convenience* (.19 > Critical = .04) and *knowledge translation* (.19 > Critical = .04). The themes of *convenience* and *knowledge translation* were not significantly different (.001 < Critical = .027). Within the theme of *instructors*, the theme of *knowledge and clarity* was significantly more prevalent than the subtheme of *convenience* (.17 > Critical = .031).

Table 17

Frequencies for themes and subthemes from full sample

Peers	36.9¹⁰
Fears of Neg Evaluation	27.1
Convenience	6.7
Knowledge Translation	6.8
Instructors	28.4
Convenience	1.04
Knowledge and Clarity	24.2
Peers and Instructors	26.9
Convenience	4.07
Question Contingent	5.36
Information Gathering	8.62
Comfort	6.5
No one	7.5
Anxiety	4.1

¹⁰ Theme totals are not cumulative, as responses may be coded into multiple subthemes

There were several subthemes within the main theme of *peers and instructors*. The theme of *information gathering* appeared significantly more than *convenience* (.15 > Critical = .038), *comfort* (.12 > Critical = .041), and *question contingent* (.09 > Critical = .06). The subtheme of *comfort* was not significantly more frequent than *convenience* (.03 = Critical = .03) or *question contingent* (.001 < Critical = .025), and *question contingent* was not cited significantly more than *convenience* (.02 < Critical = .025).

Gender. A series of chi-square analyses were conducted to compare the ratio of males and females among each theme and subtheme. Results indicated that the distribution of males and females within each observed main theme did not differ significantly from expected values (see Table 18). Results comparing gender distributions within each theme are presented below.

In the theme of *peers*, the distribution of males and females were as expected for both subthemes *fear of negative evaluation and comfort* and *convenience*, but not *knowledge translation*. Responses from males included the subtheme of *knowledge translation* more often than expected, whereas responses from females included the subtheme of *knowledge translation* less than expected. Therefore, more males and less females than expected indicated they understand answers best when it is presented by their peers.

In the theme of *instructors*, the distribution of males and females were as expected for both the subtheme of *convenience* and the subtheme of *knowledge and clarity*. With regards to the theme of *peers and instructors*, the observed distribution of males and females did not differ from the expected count for the subtheme *convenience*, *question contingent*, or *information gathering*. However, distributions of observations

Table 18

Summary of observed and expected chi-square ratios of males and females in themes and subthemes

	χ^2	<i>df</i>	<i>p</i>	Male Observed	Male Expected	Female Observed	Female expected
Main theme	12.12	8	.145				
Peers				54	61.5	280	269.9
Fears of Neg	2.26	2	.323	33	37.2	197	193.1
Evaluation							
Convenience	2.91	2	.233	13	8.9	42	46.0
Knowledge	7.51	2	.023	15	8.4	37	43.5
Translation							
Instructors				46	49.3	208	204.1
Convenience	.288	2	.886	1	1.1	5	4.9
Knowledge and	2.17	2	.703	36	37.1	169	169.7
Clarity							
Peers and				53	46.8	187	193.7
Instructors							
Convenience	.265	2	.269	4	7.5	30	26.4
Question	.447	2	.800	9	10.1	37	35.7
Contingent							
Information	4.17	2	.124	10	15.6	61	55.1
Gathering							
Comfort	7.51	2	.023	6	12.3	49	43.5
No one				11	5.8	19	24.1
Anxiety	.032	2	.885	6	4.8	12	10.9

differed from expected for males with regards to the subtheme of *feelings of comfort*, with a higher than expected count of males indicating they would ask either peers or instructors questions depending on their comfort level with each.

Finally, in the theme of *no one*, the observed and expected differences between males and females did not differ in the subtheme of *anxiety*.

Social anxiety. A one-way ANOVA was conducted on the entire sample to examine the mean level differences in social anxiety scores between communication preferences. Main themes were used as between group variables (i.e., peers, instructors, peers and instructors, no one). Results indicated a significant effect, $F(3, 891) = 9.153, p = .001$. Results from post-hoc analyses demonstrated that social anxiety scores were significantly higher in the group *communicate with no one* ($M = 2.50; SD = .70$) compared to *communicate with instructor* ($M = 2.08; SD = .61$) and *communicate with peers and instructor* ($M = 1.98; SD = .56$). Social anxiety scores were also significantly higher in *communicate with peers* ($M = 2.31; SD = .55$) theme compared to both *communicate with instructor* theme and *communicate with peers and instructors* theme (see Figure 14). There was no significant difference in social anxiety scores between *communicate with no one* and *communicate with peers*, or *communicate with instructor* theme and *communicate with peers and instructors* theme.

Figure 14. *Significant differences in social anxiety between main qualitative themes.*

Study 4 – Discussion

Study 4 explored the communicative preferences of students in higher education, specifically with whom they choose to communicate with and why. Thematic analyses indicated that students ask questions to their peers the most, followed by instructors, then both peers and instructors, and lastly no one. Among the results, the most prevalent subtheme within the communication with peer theme was *fears of negative evaluation and discomfort* surrounding communication with instructors, accounting for one quarter of the sample. Some gender differences also emerged. For instance, more males than expected ask questions to either peers or instructors, depending on their level of comfort with each. Finally, mean levels of social anxiety differed across each main theme, suggesting that social anxiety contributes to student communicative preferences.

Emerging Themes

The emerging themes and subthemes provided insight into reasons why students may score high and/or low on the *Academic Communication Inventory* (ACI) subscales. For example, upon examining *Theme 3: Peers and Instructors*, a highly cited subtheme was *information gathering*, in which students reported they would go to both *peers* and *instructors* for help (or whomever can provide them the information required). These are likely the students who would score high on both subscales of the ACI. Additionally, student responses that fell under *Theme 4: No one*, often citing *feelings of anxiety* would likely score low on both subscales of the ACI. Emerging subthemes are helpful in identifying ways to decrease communication barriers.

Interestingly, two of the main themes (*peers* and *instructors*) were inextricably connected in terms of the rationale. A large number of students indicated they would ask

peers questions (i.e., one quarter of the sample) because they felt uncomfortable or too anxious to talk to their instructor, and/or they felt they would be negatively evaluated. Therefore, the reason that many students communicate with their classmates actually has nothing to do with the helpfulness of their peers, but rather the avoidance of their instructor. Although student-student communications are beneficial for academic experiences (Bippus et al., 2001; Martin et al., 2000; Myers et al., 2002), a large number of students may be missing out on the unique benefits of student-instructor relationships. This raises an important issue in higher education – fear of authority. As previously mentioned, increasing instructor immediacy behaviours (Thomas et al., 1994; Thweatt, 1999) may serve to reduce student discomfort in the presence of an instructor and subsequently increase student-instructor communication. To do this, it may be necessary to engage instructors in professional development workshops to increase awareness of the concept of immediacy, as many teachers may not be cognizant of intimidating behaviours.

Importantly, nearly one-quarter of the sample indicated they would choose to communicate with their instructor when they had question. The most frequently reported reason was the instructor's *knowledge* and ability to *clearly* explain a concept. Many student responses within this theme suggested they see their instructor as approachable and responsive. Therefore, fear, discomfort, and anxiety in the presence of instructors is not ubiquitous among students in higher education. Thus, individual differences among students is an important factor to consider when examining communicative preferences (e.g., Elffers et al., 2012; Sanchez et al., 2006) when trying to unravel the barriers that underlie student-instructor communication.

Technology played a role in communicative preferences among students. For example, after students indicated who they would ask a question to (i.e., *peers*, *instructors*, or *peers and/or instructors*), students commonly cited rationale such as *convenience*. Unlike other subthemes, *convenience* often included different types of computer-mediated communications. Such statements as “I can just easily send a message or email” were common, regardless of the message recipient. This lends itself to the notion that computer-mediated communication may increase overall communication, which has been documented in many studies (e.g., Brooks & Young, 2016; Hooper et al., 2006; Li & Pitts, 2009; McGee & Carmean, 2006; Vu & Fadde, 2013). Many responses in the *convenience* subtheme also supported previous findings that messaging classmates is advantageous because of the convenience, immediacy, and impact on time management (e.g., Allen, Witt, and Wheelless, 2006; Martinez-Torres, Toral, Barrero, & Gallardo, 2007; Yao, 2011). Research also demonstrates that messaging with peers may increase feelings of rapport and social connectedness (e.g., Holley & Dobson, 2008; Lauricella & Kay, 2013; Rau, Goa, & Wu, 2008), which may bode well for students’ academic experiences.

A handful of students indicated they would turn to their peers when they had a question because they learned best from classmates (i.e., subtheme: *knowledge translation*). This finding supports the importance of collaborations both inside and outside of the classroom, as students help one another understand and comprehend academic concepts through relatable examples (e.g., Caldwell, 2007; Crouch & Mazur, 2001; Michaelson et al., 2004). As a portion of students learn best from their peers, integrating cooperative learning activities such as *jigsaw* may improve student outcomes.

Such activities assign tasks to all group members to increase student-interaction, encourage participation, and enhance cooperative learning (Huang, Liao, Huang, & Chen, 2014).

A minority of students reported that they would not ask anyone course related questions, with a commonly cited reason being *feelings of anxiety*. This subgroup indicated they would abstain from all communications, often to avoid discomfort that may accompany social interactions. It is possible that incorporating anonymous message boards into a course learning management system may increase levels of comfort among certain students, therefore opening lines of communication. For example, in a study by Roberts and Rajah-Kanagasabai (2013), students report being significantly more likely to post to discussion boards when anonymous posting was enabled, compared to when identified posting was required. Providing students with a similar outlet may facilitate communication and could ultimately improve their academic performance.

Social Anxiety

Mean differences in self-rated social anxiety were examined between emerging themes. Social anxiety scores in the theme of *no one* and *peers* were significantly higher than *instructors* and *peers and instructors*, which fits conceptually. For example, the defining characteristics of social anxiety include fear of social or performance situations and scrutiny by others (Schneier, 2006). Moreover, socially anxious individuals may be worried about sounding inarticulate, stupid, not knowing what to say, or being ignored (Mattick & Clarke, 1998). These characteristics were often noted in students' responses in *Theme 1: Peers* (i.e. "I would feel more hesitant to ask an instructor as it gives me anxiety to talk to a person in authority, as I may look stupid if I don't know something. So

I would ask a friend”) as well as *Theme 4: No one* (i.e., “People intimidate me so I try to figure things out on my own. I do not want to look stupid in front of anyone”). Socially anxious individuals often rate high on *fear of authority* (Liebowitz, 1987; Ranta et al., 2007), which may account for the lower social anxiety scores in the *Theme 2: Instructors* and *Theme 3: Peers and Instructors*.

Socially anxious students report their anxiety tends to be overlooked in the educational setting, which exacerbates stress (Topham, 2009). Therefore, it is important that considerations be made for socially anxious students when designing courses and assessments. To assist students who feel uncomfortable with communication, it may be helpful to incorporate either anonymous polling in class or online discussion boards. Research has found that participation rates increase, and students experience a sense of psychological safety when anonymity is enabled in courses (Roberts and Rajah-Kanagasabai, 2013; Van Soest, Canon, & Grant, 2000; Yu & Liu, 2009). Moreover, socially anxious students may benefit from small group activities (i.e., *think, pair, share*), to develop relationships with classmates. For example, student-student interactions have been found to increase during small cooperative learning activities (Cavalier, Klein, & Cavalier, 1995; Huang et al., 2014). Then, when questions arise, students who typically experience social discomfort may feel comfortable contacting their peers for assistance.

Finally, because students with higher social anxiety tended to either *not* ask questions to anyone, or to query peers instead of instructors, it is important to reflect on instruction style. Research suggests that instructor approachability, responsiveness, caring, and trustworthiness positively impact academic outcomes (Andersen, 1979; Mehrabian, 1971; Rocca, 2004; Thomas et al., 1994; Thweatt, 1999). Additional

suggestions regarding ways to mitigate socially anxious student's communication struggles are forwarded in the General Discussion section.

Gender

Open-ended responses were analyzed in terms of gender differences and expected counts. Within the main theme of *peers*, males indicated they ask course-related questions to their peers *because* they learn best from them (more often than expected), and females less than expected. These results suggest that some males may perceive greater learning from their peers, and some females less so. Moreover, more males than expected reported that they would ask *peers and/or instructors* questions based on *feelings of comfort* with each. Previous research indicates that females report greater use of collaborative learning strategies than their male peers (Stump, Hilpert, Husman, Chung, & Kim, 2011), and it has been theorized that males tend to work independently, whereas females work more collectively (Belenky et al., 1986; MacKeracher, 1994). Moreover, males have been found to place less importance on communication with others (Kirkup & von Prummer, 1990). Therefore, in this regard, previous theory and research does not align with findings from Study 4. However, it is important to consider that the results presented are main effects, and there are other variables that may help to explain these findings. Future studies may wish to further explore gender differences in course-related question-asking among students in higher education, while considering related variables.

Conclusions and Caveats

The goal of Study 4 was to explore *who* students ask course-related questions to and *why*. The main themes which emerged aligned with the subscales of the ACI (i.e.,

communication with *peers*, *instructors*, *peers and instructors*, and *no one*), with subthemes providing rationale for communicative preferences. Among the results, a large portion of students reported communicating with peers because they were uncomfortable asking instructors questions, whereas a subgroup indicated they would not ask questions due to feelings of anxiety. The role of technology was highlighted in communication with instructors and peers with regards to *convenience*, and ratings of social anxiety were found to be significantly higher in communication with *no one* and *peers*, compared to both *instructors*, and *peers and instructors*. The current study provides insight into student rationale for help-seeking communication.

Notwithstanding, there are considerations to be made. First, students reported on their communication with others with regards to *asking a question about coursework*. Therefore, communicative preferences cannot be generalized. Future studies may wish to ask more detailed open-ended questions to understand students' communicative preferences in different contexts. Second, students responded to an online survey, resulting in relatively brief statements. In-person interviews would likely result in more detailed and thought-provoking responses. Third, social anxiety was examined in terms of mean differences in emerging themes. Future studies would benefit from examining a specific sample of socially anxious students to gain more specific insight regarding their struggles with communication in education. For example, Topham (2016) used a sample of self-identified socially anxious students in a qualitative study examining social anxiety in learning. Finally, gender differences were not in line with previous research. Therefore, it is possible that results were spurious and should therefore be interpreted with caution. Nevertheless, the current study provides preliminary findings about the

rationale for asking course-related questions to peers and/or instructors, provides additional insight into the ACI, and extends findings on social anxiety and academic communication. We now understand some of the reasons *why* students ask peers versus instructors questions, and can work to reduce some of the barriers that exist.

General Discussion

There were two overarching goals of this dissertation research. The first goal was to conceptualize the novel phenomenon of *academic communication* and to develop an assessment of this construct in the context of higher education, encompassing multiple forms of communication (i.e., mixed modalities and formalities) – which may be applied across different educational contexts. The second goal was to examine a complex conceptual model linking social anxiety, academic communication, academic experiences, and wellbeing in higher education.

Study 1 examined the psychometric properties, reliability, and validity of the newly developed *Academic Communication Inventory* (ACI). Results demonstrated that the ACI consists of two subscales: (1) communication with instructors; and (2) communication with peers. Both subscales include face-to-face and computer-mediated communication, suggesting that the divide between modalities may not be as pronounced as it once was. Rigorous testing confirmed that the ACI is a reliable and valid measure of general academic communication (i.e., across all courses). By examining *academic communication*, we can further our understanding of how communication with instructors and/or peers contributes to a diverse range of academic successes among students.

Next, the primary goal of Study 2 was to examine the psychometric properties and factor structure of the ACI in offline, online, and blended learning courses. Study 2 also

investigated mean differences in communication with peers and instructors across course contexts, between genders, and over time. First, measurement invariance across course context was established – ensuring meaningful group differences could be examined. Next, students were found to communicate more with peers than instructors, and communication with peers increased over time. Moreover, the results demonstrated higher levels of overall communication in offline and blended courses compared to online courses, and mean differences were found in communication with peers versus instructors as a function of course context. Gender differences were also evident, with females and males reporting different levels of communication with peers and instructors. Generally speaking, results suggest that the ACI is a multi-faceted measure of communication that can be implemented similarly in several course contexts.

Study 3 demonstrated the utility of the ACI by examining the links between social anxiety, communication, academic experience, and wellbeing in two similar models. Model 1 examined a large sample at one time point, whereas Model 2 examined a smaller sample across two time points. Model 1 suggests that academic communication may be critical in helping to explain why socially anxious students have more negative academic experiences (i.e., engagement, classroom community, and student satisfaction). Contemporaneously, AC was found to partially mediate the association between social anxiety and academic experiences. Moreover, there was at least some evidence to support the notion that academic experiences play a role in socially anxious students' low wellbeing. Results from Study 3 suggest that improving and/or increasing socially anxious students' interactions with others may enhance their educational outcomes. This

study is one of the few to examine the correlates and outcomes of social anxiety and academic experiences in higher education.

Finally, Study 4 explored the communicative preferences of students in higher education, specifically with whom they choose to communicate with and why. Thematic analyses indicated that students ask questions to their peers the most, followed by instructors, then both peers and instructors, and lastly no one. Among the results, the most prevalent subtheme within the communication with peer theme was *fear of negative evaluation and discomfort* surrounding communication with instructors, accounting for one quarter of the sample. It was inferred that a large portion of students experience discomfort and fear of negative evaluation in the presence of their instructor. Mean levels of social anxiety differed across each main theme, suggesting that social anxiety contributes to student communicative preferences. Social anxiety was significantly higher in *Theme 4: No one* and *Theme 1: Peers*, compared to the other two themes (i.e., *Theme 2: Instructors*; *Theme 3: Peers and Instructors*). Study 4 provided additional support and insight for the emerging factor structure of the ACI (Study 1), and for the associations between social anxiety and the subscales of the ACI (Study 3).

When taken together, results from the four studies herein suggest that *academic communication* is a novel and unique construct and merits further exploration in the context of the university experience. In the following sections, results from the four studies are discussed with an integrative approach within the context of current research. Implications for educational practice, conclusions, and future directions are presented.

Implications for Educational Practice

The association between the ACI and positive academic experiences suggest that academic communication is a relevant construct in higher education. Moreover, individual differences such as social anxiety predicted academic communication, which in turn may impact upon student engagement, classroom community, and student satisfaction. Therefore, it is important to briefly re-examine literature examining communicative modalities in higher education with an eye towards educational implications.

Academic communication. The educational environment can foster student's interpersonal interactions, which is believed to promote deep understanding of content and enhance psychological connection to a course (Gunawardena & Zittle, 1997; Moore, 2013; Shearer, 2013; Shorts et al., 1976; Young, 2006). In line with this, this doctoral dissertation research demonstrated that academic communication is positively associated with student engagement, classroom community, and student satisfaction. Previously, research has linked these academic experiences to university success (Garrison & Arbaugh, 2007; Ouzts, 2006; Yilmaz, 2016). Therefore, educators may wish to provide numerous channels of communication within the physical and virtual classroom to enhance student's communication with both peers and instructors.

Higher education institutions have been scrutinized for their teaching-focussed content delivery and urged to improve student learning (O'Flaherty & Phillips, 2015). This is in line with the shift from a teaching to learning paradigm, which has been encouraged for two decades (Barr & Tagg, 1996) and supports an interactive learning environment high in communication. Although lecture-style teaching is not disappearing

any time soon (Barrett, Mangan, Neshyba, Talbert, & Young, 2014; Ferrari & O'Connor, 2013; O'Flaherty & Phillips, 2015), researchers have been examining the effectiveness of educational tools and activities on student-student and student-instructor interaction, many of which can be applied across educational contexts.

For example, research has repeatedly demonstrated that direct messaging and/or sending peer to peer text messages leads to higher levels of communication (e.g., Brooks & Young, 2016; Hooper et al., 2006; Johnson, 2007; Kennedy et al., 2008; Lauricella & Kay, 2013; McGee & Carmean, 2006; Vu & Fadde, 2013; Yao, 2011). This was also indirectly supported in Study 4 when examining the subtheme of *convenience* in the overarching theme of *peers*. Therefore, encouraging students to exchange contact information early in a course may benefit student-student interaction, increasing *communication with peers*. This may also serve as an icebreaker for socially anxious students. Moreover, office hours facilitate student-instructor relationships (Bippus et al., 2003; Hooper et al., 2006; Jaasma & Koper, 1999; Meyers, 2003), and likely contribute to higher levels of communication. Although office hours are typically institutionally mandated (Acitelli et al., 2003), it is important for instructors to *encourage* students to attend to maximize effectiveness. Finally, interactivity on discussion boards provides an outlet for various forms of student communication and had been found to improve course outcomes (e.g., Balaji & Chakrabarti, 2010; Baran & Correia, 2009; Jaggars & Xu, 2016; Lee et al., 2011; Schallert et al., 2003-2004; Volger et al., 2013). However, students have presented mixed feelings about the benefits of such interactive tools (Holmes & Prieto-Rodriguez, 2018). Therefore, it is important to emphasize to students the importance of discussion boards as a communicative tool and encourage student use to increase

communication. Additionally, it may be beneficial to solicit feedback from students to determine if there are communication platforms they prefer to use.

Cooperative learning tasks and informal study groups are inherently high in interactivity and beneficial to learning (e.g., Aamodt, 1982; Gunawardena & Zittle, 1997; Hong et al., 2015; Moore, 2013; Shearer, 2013; Young, 2006; Zhao & Kuh, 2004). Therefore, planning lessons that involve a high level of group-work and encouraging students to create *outside of class* study groups may support the growth of student-student relationships, which may lead to higher levels of academic communication. However, it is important to highlight that putting students into a group *does not* automatically turn students into a team (Opdecam & Everaert, 2018). For example, there are students who prefer to work alone, which may negatively impact group work (Seow & Shankar, 2018). With the help of an instructor, students need to be taught how to communicate with each other, how group work truly works, how to build a consensus, and how to make progress (Woodman & Sherwood, 1980), all of which may positively impact academic communication. It is important for educators to bare this in mind when incorporating group-work and while facilitating activities.

University students are reporting more use of cloud services (Gonzalez-Martinez et al., 2015), which are often intended to increase productivity and connectivity (Arpaci et al., 2015; Huang et al., 2013). Previous findings suggest that cloud services facilitate collaborations among students (Al-Zoube, 2009), and increases social presence (Huang, 2016). Therefore, although it is not a direct form of communication, these platforms may still foster a sense of closeness among classroom participants. Anecdotally, some professors report keeping a living document of course-related questions and answers,

accessible to students throughout a term. Students are permitted to ask questions via the shared document and to comment on any answer provided (i.e., requesting elaboration, adding sub-questions, etc.). Students informally report increased perceived instructor presence and approachability. Incorporating a medium such as an accessible cloud service may increase instructor immediacy, which may help to increase rates of productive academic communication – and hopefully decrease student discomfort and anxiety. This is an area of research that warrants empirical investigation, as findings may have important implications on educational practice and student outcomes. All of the above channels of communication are likely to increase academic communication and therefore positively contribute to student's academic experiences and overall success.

Social anxiety in education. Although social anxiety is highly prevalent in the higher education context (Russell & Topham, 2012), it has received surprisingly little direct empirical attention in the extant literature. Accordingly, this dissertation research adds to the limited previous research in this area (Ameringen et al., 2003; Bernstein et al., 2007; Kessler, 2003; Topham, 2009; Topham et al., 2016; Wetterberg, 2004; Wittchen et al., 1999; Zukerman et al., 2019) by further demonstrating the potential negative effects of social anxiety in the university setting. For example, social anxiety was found to be a potential detriment to communication with instructors and a range of academic experiences (i.e., student engagement, classroom community, student satisfaction). There was also some evidence to suggest that if we enhance socially anxious students' academic experiences, this *may* serve to improve wellbeing. Therefore, several suggestions to assist socially anxious students in higher education are forwarded below.

Results from the current studies suggest that students may benefit from establishing a stronger relationship with their instructor, as communication with instructors is positively associated with academic experiences and academic performance (Jaasma & Koper, 1999). This may be particularly pertinent to students who experience heightened levels of social anxiety, as social anxiety was found to be negatively associated with communication with instructors. To begin with, establishing a high level of instructor immediacy may result in students perceiving an instructor to be more approachable and less threatening (Andersen, 1979; Mehrabian, 1971; Thomas et al., 1994; Thweatt, 1999). Similarly, establishing a classroom that is high in emotional warmth and support may result in positive teacher-student relationships. Although no research has explored this at the university level, studies examining children and adolescents find that emotionally warm teachers and positive student-teacher relationships provide students with a feeling of security, support, and comfort, which promotes positive academic outcomes and behavioural engagement (e.g., Birch & Ladd, 1997; Engels et al., 2016; Jellesma, Zee, & Kooman, 2015; O'Connor, Dearing, & Collins, 2011; Pianta, 1999; Roorda, Koomen, Spilt, & Oort, 2011; Rudasill, Reio, Stipanovic, & Taylor, 2010). As mental health is a common issue in higher education classrooms (Prince, 2015), it may also be beneficial for instructors to openly discuss student mental health and provide students with physical and/or virtual resources. Instructors may wish to link resources to the courses learning management system, to ensure they are viewed. This may communicate to students that the instructor is knowledgeable and compassionate about mental health struggles, in turn creating a more comfortable and emotionally safe environment.

Although students receive all required course information via syllabus, socially anxious students may benefit from receiving more details about social expectations in advance (i.e., participation, group-work, in-class activities), to help mentally prepare for their classroom experiences. Also, including activities that involve anonymous participation (i.e., mobile learning activities; discussion boards) (Lim, 2017; Roberts & Rajah-Kanagasabai, 2013) may increase socially anxious students comfort in participation and increase overall inclusiveness. Moreover, by focussing on the *learning* paradigm instead of the *teaching* paradigm (Barr & Tagg, 1996), all students are provided with more opportunities for conversations with their instructors, which may foster a sense of classroom community. It has been suggested that providing a few different activity choices may shape student's enthusiasm for learning and may enhance performance (Brooks & Young, 2011; Iyengar & Lepper, 2000). Socially anxious students may benefit from choosing the activity that best suits their comfort level. For example, they may not be comfortable public speaking, but may prefer a written assignment.

Conversely, researchers suggest that socially anxious individuals should engage in public speaking and group interaction, which may in turn build self-confidence and may help manage anxiety (e.g., Chartier, Hazen, & Stein, 1998; Russell & Topham, 2012). This is reminiscent of exposure therapy, which has been found to reduce levels of public speaking fears and social anxiety in only a few sessions (Hindo & Gonzalez-Prendes, 2011). There is at least some evidence that repeated verbal participation and social interaction in higher education may reduce social discomfort. In a study conducted by Topham and colleagues (2016), participants reported experiencing negative physiological responses, fearful self-consciousness, and distress early in a course. However, over time

the familiarity with peers and the classroom environment reduced anxiety for some individuals. Therefore, although socially anxious students may prefer to avoid certain activities, exposure to verbal participation may result in positive longer-term outcomes.

It is important to note that individuals who experience social anxiety may feel uncomfortable even after social success, as if waiting for a negative event to follow (Alden, Taylor, Mellings, & Laposa, 2008). Moreover, socially anxious individuals tend to recall social feedback as less positive than it actually was (Glazier & Alden, 2017; Glazier & Alden, 2019). Therefore, even if students with heightened social anxiety engage in a successful oral presentation in front of their classmates, they may still be more likely to dismiss, be skeptical of, or diminish any positive feedback received.

This highlights the need for tangible, direct, and constructive feedback following student activities and presentations, particularly those involving a social-evaluative component. For example, applause combined with a letter grade can easily be brushed off, leaving little impact on students. On the other hand, applause and letter grade, coupled with high-quality written feedback may be more effective, as students can re-read written feedback in the future. Studies find that effective feedback enhances learning for all students (Ferguson, 2011; James, Krause, and Jennings, 2010), but it may be especially important for those who experience social discomfort, and may serve to boost confidence in future oral tasks.

A series of meta-analyses demonstrate cognitive-behavioural therapy (CBT) is an effective treatment for social anxiety (Acarturk, Cuijpers, van Straten, & de Graaf, 2009; Olatunji, Cisler, & Deacon, 2010; Powers, Sigmarsson, & Emmelkamp, 2008). CBT focuses on challenging and changing maladaptive cognitive processes and behaviours to

ultimately improve emotional regulation and coping strategies (e.g., Beck, 2011; Field, Beeson, & Jones, 2015; Taylor & Alden, 2008). An alternative approach to CBT (available to everyone) is an internet-based treatment following CBT principles, which is also cost effective. Tillfors and colleagues (2008) suggest that this may be suitable for socially anxious students, as they may feel less embarrassed and scrutinized when treatment is remotely conducted. Furthermore, these researchers found that internet-based self-help was effective for university students with social anxiety. It may be advantageous to publicize similar interventions in higher education institutions to increase awareness about treatment options.

There are many strategies that can be implemented in the classroom and higher education community to foster the academic success and wellbeing of socially anxious students. It may be necessary for instructors to learn about these techniques in professional development workshops. Therefore, teaching and learning centres at higher education institutions are encouraged to develop sessions specific to assisting students with social anxiety.

Gender

There were several gender effects found in the studies presented, including differences in communication and correlates of social anxiety. For example, females reported higher levels of overall communication compared to males, and communication levels among females were found to increase over the duration of a semester, whereas males' communication remained static. Therefore, it is possible that females may thrive even more in environments rich in interaction and collaborative learning. Despite this, male students were still found to communicate more with their instructor than females.

Sadker and Sadker (1985) suggest that teachers may be more accepting of males asserting their dominance, which may subsequently encourage males to interact more frequently with their instructors.

Similar to the aforementioned findings, compared to males, females were found to have significantly stronger negative associations between social anxiety and communication with instructors. There has been some support that social anxiety manifests differently among males and females, which may help shed light on these findings. For example, Habke, Hewitt, Norton, and Asmundson (1997) administered items from several measures of social anxiety to university students to determine factors predicting pathology. Overall, the factor structure supported a two-dimensional nature of social fears (i.e., social interaction anxiety; social scrutiny), but a third factor emerged based on gender. For males, the third factor consisted of items suggesting general social discomfort. For females, the third dimension that appeared reflected responses to social power (i.e., difficulty talking to authority, disagreeing with others, making eye-contact).

Considering this, it is also possible that females (particularly those with heightened levels of social anxiety) are more apprehensive when interacting with authority figures. This apprehension may also contribute to the stronger negative association between social anxiety and student engagement and course satisfaction found in females compared to males. Indeed, the classroom instructor plays a large role in students' engagement and satisfaction. This again ties back to the importance of instructor immediacy (Andersen, 1979; Mehrabian, 1971; Thomas et al., 1994; Thweatt, 1999), particularly for the benefit of female students.

Generally speaking, females report higher levels of social anxiety than males (e.g., MacKenzie & Fowler, 2013; Merikangas et al., 2002; Russell & Shaw, 2009). Because of this, prevalence of social anxiety may be disproportionately higher in the university context compared to outside of academia, due to the notably higher ratio of females to males. This adds further reason for educators to consider the struggles of socially anxious students in the higher education context.

Suggestions to enhance learning and communication among students must be considered within the contemporary view of gender. Early conceptions of gender placed masculinity and femininity at opposite ends of a single spectrum (Kail & Barnfield, 2018). However, modern views include two dimensions – instrumental roles (i.e., independent, competitive, aggressive, confident, dominant) and expressive roles (i.e., emotional, kind, creative, gentle, aware of other's feelings), which may correspond to females (low instrumental, high expressive), males (high instrumental, low expressive), or androgynous individuals (high instrumental, high expressive) (Kail & Barnfield, 2018). It is important to be cognizant of modern conceptions of gender by avoiding gender segregation in the classroom. For example, when considering Belenky and colleagues (1986) *learning styles model*, it would be incorrect to assume a class dominated by males would learn best independently, and thus forgo collaborative learning opportunities. Instead, include strategies that have been proven to enhance learning for all genders.

General Limitations and Future Directions

The current program of research addresses a series of gaps in the literature including the development and implementation of the ACI, examining academic

communication across educational context, expanding on the limited research investigating social anxiety in higher education, and understanding reasons *why* students ask course-related questions to certain individuals. These studies connect the concept of communication in education to academic experiences among socially anxious students, and provide evidence that a substantial portion of students actively avoid asking their instructors questions, and thus turn to peers. Nevertheless, there are some general limitations to acknowledge.

To begin with, although the *academic communication inventory* is a valid and reliable measure of communication in higher education, there may be important channels not included. Thus, it is possible that levels of communication are underestimated for some students. For example, Li and Pitts (2009) found that over half of their students used email to ask course-related questions. Communication modalities have evolved over the past ten years, but email is still frequently used among students. This may be particularly important for students with social anxiety, as they are found to prefer computer-mediated communication (Caplan, 2007; Gross et al., 2002; Lee & Stapinski, 2012; Shephard & Edelman, 2005). Therefore, revised versions of the ACI may wish to include such avenues of communication.

Additionally, *communication with teaching assistants* was not considered independent from instructors in the development and final scales of the ACI. Rather, there were two items relating to communication with TAs, which were on the *communication with instructors* scale. Research finds that students in large classes tend to perceive poor quality communication with faculty, and often choose to communicate with teaching assistants (Cotton & Wilson, 2006). Furthermore, it is possible that socially

anxious students may find TAs less threatening than an instructor. Interestingly, there was little evidence of student preference for communication with TAs when examining the open-ended questions in Study 4. The order of the questionnaires on the online survey may have contributed to this. For example, the ACI (focussing mostly on communication with peers and instructors) was presented prior to the open-ended questions, which may have inadvertently primed students to think of either their peers or instructors (and not TAs). Therefore, future research may wish to examine communication with TAs more closely.

Although Study 2 demonstrated that academic communication differed across educational context, Study 3 did not consider educational context when examining the links between social anxiety, communication, academic experiences, and wellbeing. Because blended learning provides students with diverse communicative options (e.g., Park & Bonk, 2007; Rogers et al., 2003), it is possible that socially anxious students may find it easier to reach out to peers and/or instructors. It may be beneficial to explore the role of learning context in the links between social anxiety and academic communication.

As previously mentioned, results from the current research were based on data collected at one Canadian university. To allow for greater generalizability, future studies may wish to solicit participation from several institutions. Further, it would also be of interest to examine AC in other academic contexts – both more advanced (i.e., graduate programs) and less advanced (i.e., high schools). Additionally, all gender differences found should be interpreted with caution due to the prominent gender imbalance, as well as the possibility that the sample of males may not be generalizable (i.e., all males were from psychology courses). Finally, future studies should consider oversampling to ensure

all gender identities are adequately captured and therefore included in analyses (i.e., “male”, “female”, “other”).

Contributions and Concluding Remarks

Despite the limitations presented in the general and study-specific sections, the current research presented a number of strengths and contributions to research. For example, both data collections had large sample sizes. This allowed for data in Study 1 to be split into two samples to perform both an EFA and CFA (Noar, 2003; Van Prooijen & Ven der Kloot, 2001), providing more evidence for the ACIs two-factor structure. Moreover, a large sample allowed for a statistically complex model to be examined in Study 3.

The present thesis presented a literature review of three overlapping constructs in higher education - engagement, participation, and collaboration. When examining these constructs, communication was found to be a connecting theme. This led to the development of a unique construct coined *academic communication*, referring to communication with others for the purpose of academic advancement. This thesis not only developed a new construct, but a multi-faceted measure of academic communication (Study 1), which was then found to be invariant across academic construct (Study 2). Moreover, Study 3 demonstrated the utility of the ACI in a complex model linking social anxiety, academic communication, academic experiences, and student wellbeing.

The current research also adds to the limited research examining social anxiety in higher education (Ameringen et al., 2003; Bernstein et al., 2007; Kessler, 2003; Topham, 2009; Topham et al., 2016; Wetterberg, 2004; Wittchen et al., 1999; Zukerman et al., 2019), particularly in Canada. Specifically, Study 3 was the first to explore the role of

communication in explaining the links between social anxiety and academic experiences, and to investigate the mediating role of academic experiences in the association between social anxiety and wellbeing. This is an area of research that is grossly lacking empirical attention, considering the high prevalence of clinical and sub-clinical levels of social anxiety (e.g., Furmark, 2002; MacKenzie & Fowler, 2013; Russell & Shaw, 2009). Moreover, the final study provides insights into students (including those who are socially anxious) communicative preferences. This study nicely supplemented studies 1-3. Nevertheless, it is evident that the ACI warrants continued work, and that we have only scraped the surface empirically investigating social anxiety in the university context. The current research provides a foundation for future studies to continue examining academic communication and social anxiety in the higher education landscape.

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Appendix A
Information Letter and Informed Consent

Principal Investigator:

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Invitation:

You are invited to participate in a study examining the different ways that students communicate with each other, and how this might impact their feelings of social connectedness, wellbeing, and academic achievement. We are interested in obtaining responses from first- and second-year university students.

What's Involved?

As a participant, you will be asked to complete an online survey containing questions about the different ways that you communicate with others, your feelings of social connectedness, and general wellbeing. Moreover, you will be asked for information about you as an individual (e.g., age, sex, personality). Participation will take approximately an hour.

Potential Benefits and Risks:

There are no risks associated with participating in this study. The results will not benefit you directly but will help researchers understand more about the relationship between computer-mediated and face-to-face communication in relation to feelings of social connectedness, wellbeing, and academic achievement. You may prefer not to answer some questions if they make you uncomfortable. If you would like to talk to a qualified counsellor about your personal situation, you can contact Student Health and Counselling Services at (613) 520 – 6674.

Confidentiality:

We collect data through Qualtrics, which uses servers with multiple layers of security to protect the privacy of the data (e.g., encrypted websites and password protected storage). Qualtrics servers are located in the US, and therefore data is subject to US laws on privacy and confidentiality. However, we ensure that your Internet IP address will not be collected in Qualtrics. Any identifying information (i.e., name provided to ensure you receive course credit for completion) will be deleted from the data set, and participants

will be rendered anonymous. Furthermore, data that is rendered anonymous will be deleted after 5 years. Any publications using the data from this study will use the data of the group together, ensuring that no information about a single individual is given.

Participation Compensation:

You will receive 0.5% towards a psychology course for your time and participation.

Publication of results:

Results of this study may be published in professional journals and presented at conferences. Any publications using the data from this study will use the data of the group together; ensuring no information about single individuals will be given.

Contact information and ethics clearance:

If you have any questions about this study or require further information, please contact Kristen Archbell or Dr. Robert Coplan using the contact information provided. This study has been reviewed and received ethics approval from the Carleton University Research Ethics Board-B (CUREB-B Clearance #106838). Should you have any ethical concerns about this study, please contact Dr. Andy Adler (613-520-2600 ext. 4085 or ethics@carleton.ca). Thank you for your assistance in this project. Please print and keep a copy of this for your records.

Consent:

I agree to be part of the study described above based on the information I have read. I have had the chance to ask questions about the study and I know that I may ask questions in the future. I understand that I may change my mind and stop being in the study at any time. If I choose to do this, I understand that there is the option to exit the survey at the bottom of each webpage, and I can withdraw without penalty. I acknowledge that in the case that I do withdraw, my data will be deleted directly from the server.

Click on “Next” if you agree to participate and you will be redirected to the survey. Click on “Exit the Survey” if you have read the above information and DO NOT agree to participate.

Appendix B Debriefing

Thank you for participating in the **Online versus Offline Communication and Social Connectedness Study!**

What are we trying to learn in this research?

The purpose of this research is to examine the different ways in which people prefer to communicate (i.e., offline versus online communication), and the impact this may have on their social and academic achievement. For example, some people may choose to engage primarily in computer-mediated communication (i.e., sending text messages, emails, posting to social media), because they may feel more comfortable. These different forms of communication may be associated with feelings of social connectedness, wellbeing, and academic achievement. Previous research has suggested that individuals who are socially anxious feel more comfortable communicating in the online environment. However, researchers have not yet established different outcomes related to academic achievement. Moreover, it was of interest to assess online versus offline feelings of social connectedness in terms of general wellbeing.

Why is this important to scientists or the general public?

As we move further into the digital age, more and more of our social interactions are taking place online, or via other computer-mediated means (i.e., Facebook, text messaging). Scientists are trying to understand how this shift might affect our psychological and emotional well-being, as well as the implications it may have on academic outcomes. This research will provide an important first step in determining the connection between different forms of communication, socio-emotional wellbeing, and academic outcomes. Moreover, providing information on the ways in which communication (online versus offline) can impact academic achievement can inform “best practices” for educators.

Where can I learn more?

If you are interested in learning more about this topic, here are a few academic articles that might be of interest:

- Davenport, S. W., Bergman, S. M., Bergman, J. Z., & Farrington, M. E. (2014). Twitter versus Facebook: Exploring the role of narcissism in the motives and usage of different social media platforms. *Computers in Human Behavior*, 32, 212-220.
- Ross, C., Orr, E. S., Sisic, M., Arseneault, J. M., Simmering, M. G., & Orr, R. R. (2009). Personality and motivations associated with Facebook use. *Computers in Human Behavior*, 25(2), 578-586.
- Stopa, L., & Clark, D.M. (2000). Social phobia and interpretation of social events. *Behavior Research and Therapy*, 38, 273-283.

What if I have questions?

For more information, or if you have any questions about this study, please contact Kristen Archbell (kristen_archbell@carleton.ca) or Dr. Robert Coplan in the Department of Psychology at Carleton University (613-520-2600 ext. 8691, robert_coplan@carleton.ca). If you have any ethical concerns, contact Dr. Andy Adler (613-520-2600 ext. 4085 or ethics@carleton.ca). This study has been reviewed and received ethics approval from the Carleton University Research Ethics Board-B (CUREB-B Clearance #106838)

If after participating in this research, you feel distressed, uncomfortable, or unhappy for any reason, please contact your family physician or the Carleton University's Health and Counselling Services (613-520-6674).

Appendix C
Academic Communication Inventory

INSTRUCTIONS: Think about the courses you have taken during university, and the ways in which you generally communicate with your peers, instructors, and TAs. On the scale provided, rate how much you agree or disagree with the following statements:

- 1 = Strongly Disagree**
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I participate in class discussions
2. I answer questions posed by the instructor during class
3. I contribute to conversations with peers during group-work
4. I ask questions during lecture or seminar
5. I attend TA office hours to ask questions
6. I attend instructor office hours to ask questions
7. I attend question and answer sessions for class (e.g., before an exam)
8. I make appointments to meet with the instructor/TA
9. I talk to peers before/after class about course work
10. I talk to professor before/after class about course work
11. I meet peers to discuss coursework outside of class
12. I meet peers to study outside of class
13. I talk with peers outside of class to discuss the course
14. I talk with instructor/TA outside of class to discuss the course
15. I stop my TAs outside of class to discuss/ask questions about the course
16. I drop by my instructor or TAs office without appointment to ask questions
17. I post questions on a course discussion board that are monitored by an instructor
18. I post questions on a course discussion board that are not monitored by an instructor
19. I attend TA virtual office hours to ask questions
20. I attend my instructors' virtual office hours to ask questions
21. I send peers emails to ask questions about coursework
22. I send TAs emails to ask questions/clarification about coursework
23. I send instructor emails to ask questions/clarification about coursework
24. I answer questions posed by instructor on online polling systems
25. I send peers text messages about coursework
26. I send peers instant messages on social networks about coursework
27. I send TAs instant messages on social networks about coursework
28. I use "online groups" to discuss coursework with peers (e.g., FB group)
29. I create/use "shared online documents" for communication for coursework/studying (e.g., Google Docs)

Appendix D
(Kuh et al., 2008)

National Survey of Student Engagement – Scale of Educationally Purposeful Activities

- 1 = Very Often**
2 = Often
3 = Occasionally
4 = Never

INSTRUCTIONS: On the scale provided, rate how often you do the following:

1. Asked questions in class or contributed to class discussion
2. Made a class presentation
3. Prepared two or more drafts of a paper or assignment before turning it in
4. Come to class without completing reading or assignment*
5. Worked with other students on project during class
6. Worked with classmates outside to class to prepare class assignments
7. Tutored or taught other students (paid or voluntary)
8. Participated in a community-based project as part of a regular course
9. Used an electronic medium (listserv, chat group, Internet, etc.) to discuss or complete an assignment
10. Used email to communicate with an instructor
11. Discussed grade or assignments with an instructor
12. Talked about career plans with faculty member or advisor
13. Discussed ideas from your readings or classes with faculty members outside of class
14. Received prompt feedback from faculty on your academic performance (written or oral)
15. Worked harder than you thought you could to meet an instructor's standards or expectations
16. Worked with faculty members on activities other than coursework (committee, orientation, student life activities, etc.)
17. Discussed ideas from your readings or classes with others outside of class (students, family members, coworkers, etc.).
18. Had serious conversations with students of a different race or ethnicity than your own
19. Had serious conversations with students who differ from you in terms of religious beliefs, political opinions, or personal values

Appendix E
 Impression Management Scale (BIDR, Version 6)
 (Paulhus, 1991)

Using the scale below as a guide, fill in the letter for each statement to indicate how much you agree with it.

1	2	3	4	5	6	7
NOT TRUE			SOMEWHAT TRUE			VERY
TRUE						TRUE

-
- 1. I sometimes tell lies if I have to*
- 2. I never cover up my mistakes
- 3. There have been occasions when I have taken advantage of someone*
- 4. I never swear
- 5. I sometimes try to get even rather than forgive and forget*
- 6. I always obey laws, even if I'm unlikely to get caught
- 7. I have said something bad about a friend behind his or her back*
- 8. When I hear people talking privately, I avoid listening
- 9. I have received too much change from a salesperson without tell him or her*
- 10. I always declare everything to customs
- 11. When I was young I sometimes stole things*
- 12. I have never dropped litter on the street
- 13. I sometimes drive faster than the speed limit*
- 14. I never read sexy books or magazines
- 15. I have done things that don't tell other people about*
- 16. I never take things that don't belong to me
- 17. I have taken sick-leave from work or school even though I wasn't really sick*
- 18. I have never damaged a library book or store merchandise without reporting it
- 19. I have some pretty awful habits*
- 20. I don't gossip about other people's busines

Appendix F
Social Connectedness Scale - Revised
(Lee et al., 2001)

1. I feel distant from people.
2. I don't feel related to most people.
3. I feel like an outsider.
4. I see myself as a loner.
5. I feel disconnected from the world around me.
6. I don't feel I participate with anyone or any group.
7. I feel close to people.
8. Even around people I know, I don't feel that I really belong.
9. I am able to relate to my peers.
10. I catch myself losing a sense of connectedness with society.
11. I am able to connect with other people.
12. I feel understood by the people I know.
13. I see people as friendly and approachable.
14. I fit in well in new situations.
15. I have little sense of togetherness with my peers.
16. My friends feel like family.
17. I find myself actively involved in people's lives.
18. Even among my friends, there is no sense of brother/sisterhood.
19. I am in tune with the world.
20. I feel comfortable in the presence of strangers.

Appendix G
Satisfaction with Life
(Diener et al., 1985)

Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- 7 - Strongly agree
- 6 - Agree
- 5 - Slightly agree
- 4 - Neither agree nor disagree
- 3 - Slightly disagree
- 2 - Disagree
- 1 - Strongly disagree

_____ In most ways my life is close to my ideal.
_____ The conditions of my life are excellent.
_____ I am satisfied with my life.
_____ So far I have gotten the important things I want in life.
_____ If I could live my life over, I would change almost nothing

Appendix H
Squared Multiple Correlations of ACI Items

	<i>Tolerance</i>	<i>Squared Multiple Correlations</i>
ACI 1*	.532	.468
ACI 2*	.552	.448
ACI 3*	.726	.274
ACI 4*	.563	.437
ACI 5*	.302	.698
ACI 6*	.316	.684
ACI 7	.648	.352
ACI 8*	.412	.588
ACI 9*	.399	.601
ACI 10	.437	.563
ACI 11*	.179	.821
ACI 12	.217	.783
ACI 13*	.246	.754
ACI 14*	.370	.630
ACI 15	.450	.550
ACI 16	.436	.564
ACI 17*	.430	.570
ACI 18	.380	.620
ACI 19*	.193	.807
ACI 20*	.213	.787

	<i>Tolerance</i>	<i>Squared Multiple Correlations</i>
ACI 21	.608	.392
ACI 22	.399	.601
ACI 23	.383	.617
ACI 24	.734	.226
ACI 25*	.387	.613
ACI 26*	.251	.749
ACI 27	.222	.778
ACI 28*	.407	.593
ACI 29*	.409	.591

“*” Denotes items that were retained in the *Academic Communication Inventory*

Appendix I
Factor loadings for fixed three-factor solution

	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>
ACI 1	-	-	.898
ACI 2	-	-	.797
ACI 3	-	-	.409
ACI 4	-	-	.603
ACI 5	.816	-	-
ACI 6	.813	-	-
ACI 8	.728	-	-
ACI 9	-	.726	-
ACI 11	-	.758	-
ACI 13	-	.826	-
ACI 14	.585	-	-
ACI 17	.340	-	-
ACI 19	.831	-	-
ACI 20	.792	-	-
ACI 25	-	.739	-
ACI 26	-	.676	-
ACI 28	-	.536	-
ACI 29		.456	-

Appendix J
Factor loadings for fixed two-factor solution

	<i>Factor 1</i>	<i>Factor 2</i>
ACI 1	.396	-
ACI 2	.462	-
ACI 3	-	.300
ACI 4	.484	-
ACI 5	.793	-
ACI 6	.773	-
ACI 8	.720	-
ACI 9	-	.760
ACI 11	-	.787
ACI 13	-	.804
ACI 14	.647	-
ACI 17	.506	-
ACI 19	.758	-
ACI 20	.749	-
ACI 25	-	.789
ACI 26	-	.717
ACI 28	-	.555
ACI 29	-	.447

Appendix K
Factor loadings for fixed one-factor solution

	<i>Factor 1</i>
ACI 1	.480
ACI 2	.495
ACI 3	.351
ACI 4	.466
ACI 5	.668
ACI 6	.667
ACI 8	.655
ACI 9	.582
ACI 11	.635
ACI 13	.598
ACI 14	.662
ACI 17	.423
ACI 19	.597
ACI 20	.591
ACI 25	.539
ACI 26	.498
ACI 28	.499
ACI 29	.433

Appendix L
Factor loadings for one-factor confirmatory factor analysis

	<i>Factor 1</i>
ACI 1	.479
I participate in class discussions	
ACI 2	.455
I answer questions posed by the instructor during class	
ACI 3	.356
I contribute to conversations with peers during group-work	
ACI 4	.389
I ask questions during lecture or seminar	
ACI 5	.471
I attend TA office hours to ask questions	
ACI 6	.503
I attend instructor office hours to ask questions	
ACI 8	.506
I make appointments to meet with the instructor/TA	
ACI 9	.926
I talk to peers before/after class about course work	
ACI 11	1.041
I meet peers to discuss coursework outside of class	
ACI 13	.996
I talk with peers outside of class to discuss the course	
ACI 14	.562
I talk with instructor/TA outside of class to discuss the course	
ACI 17	.365
I post questions on a course discussion board that are monitored by an instructor	
ACI 19	.313
I attend TA virtual office hours to ask questions	
ACI 20	.353
I attend my instructors' virtual office hours to ask questions	
ACI 25	1.047
I send peers text messages about coursework	
ACI 26	.909
I send peers instant messages on social networks about coursework	
ACI 28	.728
I use "online groups" to discuss coursework with peers (e.g., FB group)	
ACI 29	.570
I create/use "shared online documents" for communication for coursework/studying	

Appendix M
Factor loadings for two-factor confirmatory factor analysis

	<i>Factor 1</i>	<i>Factor 2</i>
ACI 1	.561	
I participate in class discussions		
ACI 2	.659	
I answer questions posed by the instructor during class		
ACI 3	.716	
I contribute to conversations with peers during group-work		
ACI 4	.890	
I ask questions during lecture or seminar		
ACI 5	.929	
I attend TA office hours to ask questions		
ACI 6	.886	
I attend instructor office hours to ask questions		
ACI 8	.869	
I make appointments to meet with the instructor/TA		
ACI 9	.607	
I talk to peers before/after class about course work		
ACI 11	.616	
I meet peers to discuss coursework outside of class		
ACI 13	.648	
I talk with peers outside of class to discuss the course		
ACI 14		.499
I talk with instructor/TA outside of class to discuss the course		
ACI 17		.936
I post questions on a course discussion board that are monitored by an instructor		
ACI 19		1.088
I attend TA virtual office hours to ask questions		
ACI 20		1.042
I attend my instructors' virtual office hours to ask questions		
ACI 25		1.035
I send peers text messages about coursework		
ACI 26		.855
I send peers instant messages on social networks about coursework		
ACI 28		.680
I use "online groups" to discuss coursework with peers (e.g., FB group)		
ACI 29		.543
I create/use "shared online documents" for communication for coursework/studying		

Appendix N
Factor loadings for three-factor confirmatory factor analysis

	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>
ACI 1			.909
I participate in class discussions			
ACI 2			1.007
I answer questions posed by the instructor during class			
ACI 3			.425
I contribute to conversations with peers during group-work			
ACI 4			.923
I ask questions during lecture or seminar			
ACI 5	.910		
I attend TA office hours to ask questions			
ACI 6	.956		
I attend instructor office hours to ask questions			
ACI 8	.891		
I make appointments to meet with the instructor/TA			
ACI 9		.922	
I talk to peers before/after class about course work			
ACI 11		1.026	
I meet peers to discuss coursework outside of class			
ACI 13		1.023	
I talk with peers outside of class to discuss the course			
ACI 14	.847		
I talk with instructor/TA outside of class to discuss the course			
ACI 17	.599		
I post questions on a course discussion board that are monitored by an instructor			
ACI 19	.612		
I attend TA virtual office hours to ask questions			
ACI 20	.609		
I attend my instructors' virtual office hours to ask questions			
ACI 25		1.087	
I send peers text messages about coursework			
ACI 26		.941	
I send peers instant messages on social networks about coursework			
ACI 28		.767	
I use "online groups" to discuss coursework with peers (e.g., FB group)			
ACI 29		.567	
I create/use "shared online documents" for communication for coursework/studying			

Appendix O
Information Page and Consent (Study 2, 3, 4)

Exploring the links between communication, education, and wellbeing – Part 1 & 2

Invitation:

You are invited to participate in a study examining the different ways that students communicate with each other, and how this might impact their feelings of wellbeing, and academic achievement. We are interested in obtaining responses from first- and second-year university students.

What's Involved?

As a participant, you will be asked to complete an online survey containing questions about the different ways that you communicate with others, your feelings of social connectedness, and general wellbeing. Moreover, you will be asked for information about you as an individual (e.g., age, sex, personality). Participation will take approximately an hour.

Potential Benefits and Risks:

There are no risks associated with participating in this study. The results will not benefit you directly but will help researchers understand more about the relationship between computer-mediated and face-to-face communication in relation to feelings of social connectedness, wellbeing, and academic achievement. You may choose to not answer any questions if it makes you uncomfortable. However, participants are provided with the opportunity to withdraw at any point (by simply exiting the survey on any page with no penalty), or skip any question they prefer not to answer and are informed of this prior to beginning the study. If you would like to talk to a qualified counsellor about your personal situation, you can contact Student Health and Counselling Services at (613) 520 – 6674.

Confidentiality:

We collect data through Qualtrics, which uses servers with multiple layers of security to protect the privacy of the data (e.g., encrypted websites and password protected storage). We ensure that your Internet IP address will not be collected in Qualtrics. Any identifying information (i.e., your name provided to ensure you receive 0.5% course credit, your email addresses provided to be contacted for the Part 2 follow up – if applicable, and your name provided to link Part 1 and Part 2 of this study – if applicable) will be deleted from the data set, and participants will be rendered anonymous at the end of the term. Identifying information will not be associated with survey answers. Furthermore, data that is rendered anonymous will be deleted after 5 years. However, until the study data are completely anonymized, your data may be disclosed via a court order or data breach. Any publications using the data from this study will use the data of the group together, ensuring that no information about a single individual is given.

Participation Compensation:

You will receive 0.5% towards a psychology course for your time and participation.

Publication of results:

Results of this study may be published in professional journals and presented at conferences. Any publications using the data from this study will use the data of the group together; ensuring no information about single individuals will be given.

Contact information and ethics clearance:

If you have any questions about this study or require further information, please contact Kristen Archbell or Dr. Robert Coplan using the contact information provided. This study has been reviewed and received ethics approval from the Carleton University Research Ethics Board-B (CUREB-B Clearance 108238). Should you have any ethical concerns about this study, please contact Dr. Andy Adler (613-520-2600 ext. 4085 or ethics@carleton.ca). Thank you for your assistance in this project. Please print and keep a copy of this for your records.

Consent:

I agree to be part of the study described above based on the information I have read. I have had the chance to ask questions about the study and I know that I may ask questions in the future. I understand that I may change my mind and stop being in the study at any time. If I choose to do this, I understand that there is the option to exit the survey at the bottom of each webpage, and I can withdraw without penalty. I acknowledge that in the case that I do withdraw, my data will be deleted directly from the server.

Click on “Next” if you agree to participate and you will be redirected to the survey. Click on “Exit the Survey” if you have read the above information and DO NOT agree to participate.

Appendix P
Debriefing - Part 1 (Study 2, 3, 4)

Thank you for participating in the **“PART 1: Communication, education, and wellbeing”**

What are we trying to learn in this research?

The purpose of this research is to examine the different ways in which people prefer to communicate (i.e., offline versus online communication), and the impact this may have on their social and academic achievement. For example, some people may choose to engage primarily in computer-mediated communication (i.e., sending text messages, emails, posting to social media), because they may feel more comfortable. These different forms of communication may be associated with feelings of social connectedness, wellbeing, and academic achievement. Previous research has suggested that individuals who are socially anxious feel more comfortable communicating in the online environment. However, researchers have not yet established different outcomes related to academic achievement. Moreover, it was of interest to assess online versus offline feelings of social connectedness in terms of general wellbeing.

Why is this important to scientists or the general public?

As we move further into the digital age, more and more of our social interactions are taking place online, or via other computer-mediated means (i.e., Facebook, text messaging). Scientists are trying to understand how this shift might affect our psychological and emotional well-being, as well as the implications it may have on academic outcomes. This research will provide an important first step in determining the connection between different forms of communication, socio-emotional wellbeing, and academic outcomes. Moreover, providing information on the ways in which communication (online versus offline) can impact academic achievement can inform “best practices” for educators.

Where can I learn more?

If you are interested in learning more about this topic, here are a few academic articles that might be of interest:

- Davenport, S. W., Bergman, S. M., Bergman, J. Z., & Fearington, M. E. (2014). Twitter versus Facebook: Exploring the role of narcissism in the motives and usage of different social media platforms. *Computers in Human Behavior*, 32, 212-220.
- Ross, C., Orr, E. S., Sisic, M., Arseneault, J. M., Simmering, M. G., & Orr, R. R. (2009). Personality and motivations associated with Facebook use. *Computers in Human Behavior*, 25(2), 578-586.
- Stopa, L., & Clark, D.M. (2000). Social phobia and interpretation of social events. *Behavior Research and Therapy*, 38, 273-283.

What if I have questions?

For more information, or if you have any questions about this study, please contact Kristen Archbell (kristen_archbell@carleton.ca) or Dr. Robert Coplan in the Department of Psychology at Carleton University (613-520-2600 ext. 8691, robert_coplan@carleton.ca). If you have any ethical concerns, contact Dr. Andy Adler (613-520-2600 ext. 4085 or ethics@carleton.ca). This study has been approved by the Carleton University Research Ethics Board-B (CUREB-B Clearance 108238)

If after participating in this research, you feel distressed, uncomfortable, or unhappy for any reason, please contact your family physician or the Carleton University's Health and Counselling Services (613-520-6674).

Receiving Credit:

Please allow up to a week for your SONA credit to appear. We enter the credits manually after participants complete the survey ☺. If you are interested in Part 2 of this study, keep your eyes open for an email containing details about participating in Part 2 near the end of February!

Appendix Q
Debriefing - Part 1 (Study 2, 3, 4)

Thank you for participating in the **“PART 2: Communication, education, and wellbeing”**

What are we trying to learn in this research?

The purpose of this research is to examine the different ways in which people prefer to communicate (i.e., offline versus online communication), and the impact this may have on their social and academic achievement. As this portion of the study was conducted at a second time point in the semester, we were interested in whether your communication style remains stable across different courses and time. We also were investigating whether the course context (i.e., online, blended, offline) impacted how you communicate with peers and instructors. For example, some people may choose to engage primarily in computer-mediated communication (i.e., sending text messages, emails, posting to social media), because they may feel more comfortable. However, this might differ depending on the course context. Further, these different forms of communication may be associated different social and academic outcomes.

Why is this important to scientists or the general public?

As we move further into the digital age, more and more of our social interactions are taking place online, or via other computer-mediated means (i.e., Facebook, text messaging). Scientists are trying to understand how this shift might affect our psychological and emotional wellbeing, as well as the implications it may have on academic outcomes. It is becoming more common for students to enrol in blended and online learning for a variety of reasons (i.e., convenience, comfort). However, what is currently unknown is how communication styles in these different contexts may differ, and subsequently impact social and academic outcomes. This research will provide an important first step in determining the connection between different forms of communication, socio-emotional wellbeing, and academic outcomes. This second portion of the study will help determine the stability of the measure of academic communication, as well as other assessments of socio-emotional functioning and academic outcomes. Finally, providing information on the ways in which communication (online versus offline) can impact academic achievement can inform “best practices” for educators.

Where can I learn more?

If you are interested in learning more about this topic, here are a few academic articles that might be of interest:

Davenport, S. W., Bergman, S. M., Bergman, J. Z., & Fearington, M. E. (2014). Twitter versus Facebook: Exploring the role of narcissism in the motives and usage of different social media platforms. *Computers in Human Behavior*, 32, 212-220.

- Ross, C., Orr, E. S., Sisic, M., Arseneault, J. M., Simmering, M. G., & Orr, R. R. (2009). Personality and motivations associated with Facebook use. *Computers in Human Behavior*, 25(2), 578-586.
- Stopa, L., & Clark, D.M. (2000). Social phobia and interpretation of social events. *Behavior Research and Therapy*, 38, 273-283.

What if I have questions?

For more information, or if you have any questions about this study, please contact Kristen Archbell (kristen_archbell@carleton.ca) or Dr. Robert Coplan in the Department of Psychology at Carleton University (613-520-2600 ext. 8691, robert_coplan@carleton.ca). If you have any ethical concerns, contact Dr. Andy Adler (613-520-2600 ext. 4085 or ethics@carleton.ca). This study has been approved by the Carleton University Research Ethics Board-B (CUREB-B Clearance 108238)

If after participating in this research, you feel distressed, uncomfortable, or unhappy for any reason, please contact your family physician or the Carleton University's Health and Counselling Services (613-520-6674).

Appendix R
Demographic Information (Study 2, 3, 4)

Name: _____

Carleton email: _____

Age: _____

Sex: Male _____ Female _____ Other _____

Ethnic group: Caucasian _____ Asian _____ African-Canadian _____
Hispanic _____ Aboriginal _____ Other (*Specify*) _____

Is English your first language? Yes _____ No _____

Do you own a phone with texting capabilities? Yes _____ No _____

Did you move away from your hometown for university? Yes _____ No _____

Do you live on or off campus? On _____ Off _____

What year of study are you in?

What is your current GPA (%)?

What is your current GPA (12-point scale)?

What is your major?

Please fill out this Parent/guardian information about your primary caregivers. Either parent can be designated as Parent One or Parent Two.

Parent One's highest level of education completed (check one):

elementary school _____ high school diploma or equivalent _____
community college or equivalent _____ university degree _____
graduate school degree _____

Parent Two's highest level of education completed (check one):

elementary school _____ high school diploma or equivalent _____
community college or equivalent _____ university degree _____
graduate school degree _____

Are you interested in completing PART 2 of this study? You will receive another 0.5% credit towards a psychology grade. If yes, you will receive an email when PART 2 is available on SONA. Yes _____ No _____

Appendix S
Academic Communication Inventory
Finalized Version

INSTRUCTIONS: Think about a course you are currently taking, and the ways in which you communicated with your peers, instructors, and TAs during that course. On the scale provided, rate how much you agree or disagree with the following statements:

- 1 = Strongly Disagree**
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I answer questions posed by the instructor during class
2. I ask questions during lecture or seminar
3. I attend TA office hours to ask questions
4. I attend instructor office hours to ask questions
5. I make appointments to meet with the instructor/TA
6. I talk with peers outside of class to discuss the course
7. I talk with instructor/TA outside of class to discuss the course
8. I post on discussion boards that are monitored by an instructor
9. I send peers text messages about coursework
10. I send peers instant messages on social networks about coursework
11. I use “online groups” to discuss coursework with peers (e.g., FB group)
12. I create/use “shared online documents” for communication for coursework/studying (e.g., Google Docs)

Appendix T
Liebowitz Social Anxiety Scale
(Liebowitz, 1987)

INSTRUCTIONS: Read each situation carefully and answer the two questions about that situation. The first question asks how anxious or fearful you are in the situation. The second question asks how often you avoid the situation. If you come across a situation that you ordinarily do not experience, imagine “what if you were faced with that situation”, and then, rate the degree to which you would fear this hypothetical situation and how often you would intend to avoid it. Please base your ratings on the way the situations have affected you in the last week. Fill out the following scale with the most suitable answer provided below.

	Fear				Avoidance			
	No ne	Mil d	Mode rate	Seve re	No ne	Occasio nally	Ofte n	Usu ally
1. Telephoning in public								
2. Participating in small groups								
3. Eating in public places								
4. Drinking with others in public places								
5. Talking to people in authority								
6. Acting, Performing or giving a talk in front of an audience								
7. Going to a party								
8. Working while being observed								
9. Writing while being observed.								
10. Calling someone you don't know very well								
11. Talking with people you don't know very well								
12. Meeting strangers								
13. Urinating in a public bathroom								
14. Entering a room where others are already seated								
15. Being the centre of attention								
16. Speaking up at a meeting								
17. Taking a test								
18. Expressing a disagreement or disapproval to people you don't know very well								
19. Looking at people you don't know very well in the eye								
20. Giving a report to a group								

21. Trying to pick up someone								
22. Returning goods to a store								
23. Giving a party								
24. Resisting a high pressure salesperson								

Appendix U
Student Course Engagement Questionnaire
(Handelsman et al., 2005)

To what extent do the following behaviors, thoughts, and feelings describe you in this course. Please rate each of them on the following scale:

- 1 = Not at all characteristic of me**
2 = Not really characteristic of me
3 = Moderately characteristic of me
4 = Characteristic of me
5 = Very characteristic of me

1. Staying up on the readings
2. Making sure to study on a regular basis
3. Putting forth effort
4. Doing all the homework problems
5. Looking over class notes between classes to make sure I understand the material
6. Being organized
7. Taking good notes in class
8. Listening carefully in class
9. Coming to class every day
10. Finding ways to make the course material relevant to my life
11. Applying course material to my life
12. Finding ways to make the course interesting to me
13. Thinking about the course between class meetings
14. Really desiring to learn the material
15. Raising my hand in class
16. Asking questions when I don't understand the instructor
17. Having fun in class
18. Participating actively in small-group discussions
19. Going to the professor's office hours to review assignments or tests or to ask questions
20. Helping fellow students
21. Getting a good grade
22. Doing well on the tests
23. Being confident that I can learn and do well in the class

Appendix V
Classroom Community Scale
(Rovai, 2002)

Instructions: Below, you will see a series of statements concerning a specific course or program you are presently taking or have recently completed. Read each statement carefully, and indicate from 1 to 5 how much you agree with the statement. There are no correct or incorrect responses. Do not spend too much time on any one statement, but give the response that seems to describe how you feel.

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neither Disagree or Agree
- 4 = Agree
- 5 = Strongly Agree

- 1. I feel that students in this course care about each other.
- 2. I feel that I am encouraged to ask questions
- 3. I feel connected to others in this course
- 4. I feel that it is hard to get help when I have a question
- 5. I do not feel a spirit of community
- 6. I feel that I receive timely feedback
- 7. I feel that this course is like a family
- 8. I feel uneasy exposing gaps in my understanding
- 9. I feel isolated in this course
- 10. I feel reluctant to speak openly
- 11. I trust others in this course
- 12. I feel that this course results in only modest learning
- 13. I feel that I can rely on others in this course
- 14. I feel that other students do not help me learn
- 15. I feel that members of this course depend on me
- 16. I feel that I am given ample opportunities to learn
- 17. I feel uncertain about others in this course
- 18. I feel that my educational needs are not being met
- 19. I feel confident that others will support me
- 20. I feel that this course does not promote a desire to learn

Appendix W
Student Satisfaction Scale
(Bollinger & Halupa, 2012)

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neither Disagree or Agree
- 4 = Agree
- 5 = Strongly Agree

INSTRUCTIONS: Please read the following statements and respond on the scale provided for the course specified.

1. I am satisfied with the level of effort this course required
2. I am dissatisfied with my performance in this course
3. I am satisfied with my final grade in the course
4. I am satisfied with how I am able to apply what I have learned in this course
5. I was satisfied enough with this course to recommend it to others
6. Compared to other course settings, I am less satisfied with this learning experience
7. My level of satisfaction in this course would encourage me to enrol in another course in this setting
8. Overall, I am satisfied with this course

Appendix X
UCLA Loneliness Scale – Version 3
(Russell, 1996)

INSTRUCTIONS: Indicate how often each of the statements below is descriptive of you.

C indicates “I often feel this way”

S indicates “I sometimes feel this way”

R indicates “I rarely feel this way”

N indicates “I never feel this way”

1. I am unhappy doing so many things alone
2. I have nobody to talk to
3. I cannot tolerate being so alone
4. I lack companionship
5. I feel as if nobody really understands me
6. I find myself waiting for people to call or write
7. There is no one I can turn to
8. I am no longer close to anyone
9. My interests and ideas are not shared by those around me
10. I feel left out
11. I feel completely alone
12. I am unable to reach out and communicate with those around me
13. My social relationships are superficial
14. I feel starved for company
15. No one really knows me well
16. I feel isolated from others
17. I am unhappy being so withdrawn
18. It is difficult for me to make friends
19. I feel shut out and excluded by others
20. People are around me but not with me

Appendix Y
Perceived Stress Scale
(Cohen et al., 1994)

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

- 0 = never
- 1 = almost never
- 2 = sometimes
- 3 = fairly often
- 4 = very often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and stressed?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside of your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Appendix Z
Loneliness in Context Questionnaire for College Students
Asher et al., 2010

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither disagree nor agree
- 4 = Agree
- 5 = Strongly Agree

- 1. Class is a lonely place for me
- 2. I am lonely in the evening
- 3. My place of residence is lonely for me
- 4. My free time is lonely for me
- 5. I feel sad and alone on weekends
- 6. I am lonely with other people
- 7. I feel sad and alone at social events
- 8. I am lonely during meal times
- 9. I feel sad and alone when I am studying
- 10. Bedtime is a lonely time for me

Appendix AA
Study 4 – Coding Manual

“When you have a question about coursework who do you ask and why?”

Code	Characteristics	Examples
Anxiety or Comfort	Peers – “<i>Fears of negative evaluation and discomfort</i>” <i>feeling more comfortable around peers, not feeling intimidated or evaluated, less shy, judgement free; not wasting profs time; more approachable</i>	“People I know in the class because if i know the person well i feel less intimidated.” (1091) “Peers mostly because I feel more comfortable around them and comfortable asking them. A little shy from instructors” (1044) “I like to ask friends because they are always more approachable.” (1550) “people form class because I'm more comfortable around them” (1095)
	Both – “<i>Feelings of comfort</i>” <i>depends on comfort level (one or the other); they are comfortable with both peers and instructors</i>	“both are comfortable with me so I would choose either” (1370) “Both, peers are sometimes more approachable however instructors give more detailed answers so I would ask either if I felt comfortable.” (1443)
Convenience	Peers – <i>available most of the time, easier to get a hold of, more efficient</i>	“I prefer to ask peers because they are available most of the time, and i usually avoid the situation where i need to send an email to the instructors” (1015)
	Instructor – <i>easily accessible, email, get in touch quickly</i>	“The prof is the easiest to get a hold of. Easily accessible (email)” (1045)
	Both – <i>one first then the other, depending on who is busier, more convenient, location</i>	“I prefer to ask my peers first because I know my instructors are busy, if my peers cannot help me I will not hesitate to contact my instructor.” (1155) “I usually go to who ever is the easiest to get a hold of. Like if I am in class and I see the instructor there I will ask them. But if I am at home and it is easiest to shoot my friend a text I will also do that.” (1019)

Knowledge	<p>Peers – “Knowledge Translation” <i>peers help teach; give better examples, help explain</i></p> <p>Instructor – “Knowledge and Clarity” <i>more information, more reliable, know material better, trust answers</i></p> <p>Both – “Information Gathering” <i>Going to either peers followed by instructors, or both, to collect the most information possible</i></p>	<p>“People in the class, It feels like they understand better” (1039) “classmates, explain better examples” (1099)</p> <p>“Instructors, they have more information” (1014) “I prefer asking instructors since their answers are more reliable.” (1048) “Instructors. Because they know more about the material than my peers. I wouldn't trust them.” (1050)</p> <p>“I prefer to ask friends first and see if I missed something and then I still do not understand I will ask the professor” (1110) “I ask everyone to get the most information possible.” (1126)</p>
Question Contingent	<p>Both – depends on the question; who can give accurate information; who knows the answer best</p>	<p>“I depends on the question; if its about an exam or test, I go to the professor but if it's a simple concept i would just ask my peers” (1197)</p> <p>“classmate for basic stuff and prof for specific information.” (1148)</p>
Uncodeable	<p><i>Response that are ambiguous/nonsensical</i></p>	<p>“You can never be too sure.” (1096) “Instructors are expected not peers” (1009)</p>