ACADEMIC HELP SEEKING OF UNDERGRADUATE STEM STUDENTS: A BASIC PSYCHOLOGICAL NEEDS THEORY PERSPECTIVE

by
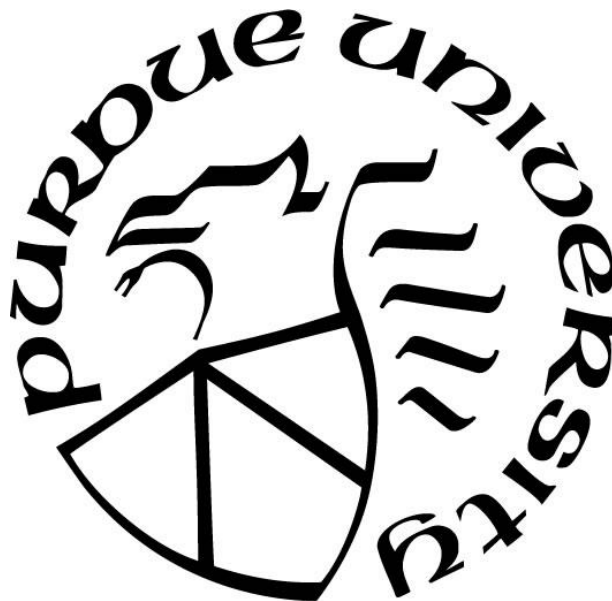
Hyejeong Oh

A Dissertation

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Doctor of Philosophy

Department of Educational Studies

West Lafayette, Indiana

August 2020

THE PURDUE UNIVERSITY GRADUATE SCHOOL
STATEMENT OF COMMITTEE APPROVAL

Dr. Helen Patrick, Co-Chair

Department of Educational Studies

Dr. John Froiland, Co-Chair

Department of Educational Studies

Dr. Anne Traynor

Department of Educational Studies

Dr. Eric Deemer

Department of Educational Studies

Approved by:

Dr. Janet Alsup

Head of the Graduate Program

I dedicate this dissertation to my beloved family and friends.

ACKNOWLEDGMENTS

I would like to thank my advisors, Dr. Helen Patrick and Dr. John Froiland, for their immense support and patience in guiding me through this dissertation. Dr. Patrick has always challenged me to think more thoroughly than I ever had and to consider things from diverse perspectives. Thanks to her constant guidance and unwavering patience over the course of six years, I have learnt and grown a lot in my field. Dr. Froiland has encouraged and instilled in me a passion and persistence in my research. Working and learning as an assistant in his class has been fun and meaningful. Through both advisors' guidance, I have learnt much about research and how I should approach, develop and complete this dissertation.

I would also like to thank Dr. Anne Traynor for her thorough comments and feedback on statistics. Her expertise has been invaluable in the methodical development of this dissertation. Dr. Eric Deemer's insightful and thought-provoking comments pushed me for a better dissertation. Through the course of this dissertation, I have come to appreciate the hard work they have put in to help me succeed. They have my utmost respect and appreciation.

This acknowledgement would not be complete without me expressing how much I appreciate my family, who has always been caring and supportive. I would not have completed this dissertation without this great pillar of support. I am also thankful for the love and encouragement from my friends, Ki Young, Seong Woo, and Ellen. Ki Young has always lent a listening ear and kept me in her prayers. I derived much strength from her love and support. Seong Woo kept me sane and positive regardless of obstacles and discouragements. Ellen and I shared many fun times. As a STEM major, she gave me a lot of constructive comments and advice on this dissertation. I would also like to thank Hyeree, Hyeseong, and Sunyoung for helping to create many happy and pleasant memories during my time in Purdue. They have made life and time away from my family and friends back home in South Korea more bearable. We spent much time sharing our life experiences and helping each other. Last but not least, I would like to express my gratitude to Ji Young and Sun Young, my old friends, my personal cheerleaders, in South Korea. I gained much strength from their humor, positivity and subtle encouragement during the many times I felt like giving up. I am forever indebted.

TABLE OF CONTENTS

LIST OF TABLES

7

LIST OF FIGURES

ABSTRACT

This study aimed to investigate how the satisfaction and frustration of 776 undergraduate STEM majors' basic psychological needs were related to their help seeking in a difficult course. It also identified the factor structures of adapted measures of academic help seeking and basic psychological needs. Factor analyses indicated that academic help seeking showed a 4-factor structure (adaptive, expedient, avoidant), with adaptive help seeking further distinguished based on the two sources (from the instructor/TA and from peers). Basic psychological needs exhibited an 8-factor structure, differentiated by whether each need (autonomy, competence, and relatedness) was satisfied or frustrated; relatedness satisfaction and frustration were also each differentiated by source (instructor/TA and peers). Psychological need satisfaction explained the data better than need frustration did in terms of both main effects and interaction effects. Interaction effects demonstrated that one psychological need was associated with academic help seeking through being moderated by another need or moderating a relation between another need and academic help seeking. Particularly, psychological need satisfaction showed some synergistic effects in that associations between one need satisfaction and academic help seeking were stronger when another need satisfaction was met. Implications for university educators, limitations, and directions for the future study were discussed.

Keywords: Academic help seeking; Basic psychological needs; Self-determination theory; undergraduate students; STEM

INTRODUCTION

When students encounter difficulty or are uncertain about how to proceed with assignments, one common response is to ask for help. Ideally, their help-seeking is adaptive, or involves asking for clues or explanations so that they can accomplish the assignment themselves and ultimately learn. However, students sometimes engage in expedient help-seeking, where they are concerned only with getting the solution or answer, without learning or understanding how the answer is worked out. Yet another response is to avoid seeking help, so that despite recognizing they do not know how to successfully complete an assignment, students do not ask for help.

The type of help that students seek when they have difficulty with academic tasks is related to their learning and achievement; achievement is highest when students use adaptive help seeking and lowest when they avoid seeking help (Karabenick, 2003; Ryan et al., 2005). Help seeking is also associated with students' motivation. Most of this research has considered the reasons that students engage in academic tasks (i.e., goal orientations; Ames, 1992). Studies found that students' focus on increasing their understanding (i.e., mastery orientation) is associated with adaptive help seeking, whereas a focus on outperforming others (i.e., performance-approach orientation) or avoiding appearing unable (i.e. performance-avoid orientation) is associated with maladaptive (i.e., expedient or avoidant) help seeking (Gonida et al., 2014; Roussel et al., 2011). There is much less research, however, on how help seeking is related to other aspects of motivation, such as the extent to which students' psychological needs for autonomy, competence, and relatedness are met. Students' need satisfaction plays an important role in a wide range of adaptive learning outcomes, including achievement (Wang et al., 2019), therefore research is needed to examine its association with help seeking. Moreover, it is also important to consider whether students' basic psychological needs are undermined or frustrated, because need frustration is associated with maladaptive outcomes (Bartholomew et al., 2011). Although psychological need frustration has been examined primarily in sports contexts, there is some evidence it is associated with classroom disengagement (Earl et al., 2017; Jang et al., 2016). Because expedient and avoidant help seeking may be considered forms of disengagement, research is also needed to examine whether they are associated with help seeking. Therefore, in this study I examine associations of college students' need satisfaction and frustration with their academic help-seeking.

Research on help seeking has predominantly investigated whether students seek help from someone in the classroom (e.g., asking "peer" for help when doing work at desk; Ryan & Shim, 2012). With a range of technologies widely available, however, students usually have more options than just asking for help in person; many students now use web-based tools as a primary source for help with academic tasks (Karabenick & Puustinen, 2013). Despite the increasing use of web-based tools as a source of academic help seeking, however, few studies that examine help seeking have considered technology-mediated sources. In the current study I consider both in-person and technology-mediated help seeking.

In addition, when examining help-seeking types, researchers do not usually ask about the source of the help sought. Typically, the source for help is not specified (e.g., "someone"). However, students may ask different people for different kinds of help, and those patterns may also be associated differentially with need satisfaction or frustration. In order to address these questions, I consider undergraduate students' help-seeking from the course instructor or teaching assistant (TA) and from classmates or peers separately.

LITERATURE REVIEW

Academic Help Seeking

Students unavoidably experience difficulties and confusion in their assignment and need academic help. From having academic difficulties to actual help seeking, this process functions as a goal-directed activity (Nelson-Le Gall, 1981). According to help seeking process models (Aleven et al., 2006; Nelson-Le Gall, 1981; Newman, 1998a, 1998b), seeking help generally consists of six phases: 1) awareness of the need for help, 2) a decision to seek help, 3) a decision about a target person to seek help from (i.e., source), 4) a decision about the type of help to seek, 5) implementation of help-seeking strategies, and 6) a reaction to help-seeking episode. Researchers have focused most attention on the types and sources of academic help.

Types of Academic Help Seeking

Researchers have identified three different types of academic help seeking: adaptive, expedient, and avoidant. Adaptive help seeking is defined as students' seeking help that is needed to solve the problem on their own, such as hints; on the contrary, expedient help seeking refers to request for direct answers or of having someone else solve the problem for them, so they can finish the work quickly (Nelson-Le Gall, 1981; Pajares et al., 2004). In addition, some students do not ask for help even if they know that they need help (i.e., help-seeking avoidance; Ryan et al., 1997). Each of these help seeking types is associated with different patterns of motivation and levels of achievement (e.g., Karabenick, 2003; Ryan et al., 1997; Ryan & Pintrich, 1997; Schenke et al., 2015).

Adaptive Help Seeking. When students engage in adaptive help seeking, or ask for hints or clues to complete the task by themselves, they are likely to have higher achievement than students with expedient or avoidant help seeking; the same pattern is found for students in elementary schools (Ryan et al., 2005), high schools (Schenke et al., 2015), and colleges (Karabenick, 2003). According to studies in college (Karabenick, 2003; Karabenick & Knapp, 1991), this is because adaptive help-seekers tend to use adaptive learning strategies, such as outlining the material (i.e., organization), relating new ideas to previous knowledge (i.e., elaboration), and monitoring their learning (i.e., metacognition). Students from the

middle grades through college also tend to experience more positive affect and less anxiety than avoidant help-seekers do (Karabenick, 2003; Pajares et al., 2004; Ryan et al., 2005).

Studies found, across the grade levels, that students who are adaptive help-seekers tend to be invested in learning and understanding the content and want to improve (i.e., be mastery goal orientated) (Butler & Neuman, 1995; Gonida et al., 2014; Karabenick, 2003; Newman, 1998b; Pajares et al., 2004; Roussel et al., 2011). Furthermore, across the grade levels these students generally express little concern about how their competence is viewed by others (i.e., be performance goal oriented), including not focusing on out-performing others (i.e., performance-approach oriented) or trying not to do worse than others (i.e., be performance-avoid oriented) (Gonida et al., 2014; Karabenick, 2004; Roussel et al., 2011; Ryan et al., 2005). When they perceive their teacher as emphasizing mastery goals in the classroom, middle school (Ryan et al., 1998), high school (Schenke et al., 2015), as well as college (Karabenick, 2004) students are also likely to use adaptive help seeking.

From elementary school through college, adaptive help-seekers tend to have their psychological needs for competence and relatedness met. Specifically, they feel efficacious for learning the content (Karabenick, 2003; Marchand & Skinner, 2007; Ryan et al., 2005; Ryan & Shin, 2011). Adaptive help-seeking is also more likely when students view their teacher as supporting them academically and socioemotionally or feel connected with them across the grade levels (Karabenick & Sharma, 1994; Marchand & Skinner, 2007; Newman & Schwager, 1993; Ryan et al., 2005; Schenke et al., 2015). According to Marchand and Skinner (2007), teacher support is associated with elementary and middle students' use of adaptive help seeking, mediated by satisfaction of students' three psychological needs. However, there is no research examining how autonomy is related to adaptive help seeking beyond middle schools, such as in higher education. Autonomy is likely to be important for college students' help seeking, however, given that autonomy is related to adaptive motivational beliefs (e.g., mastery goal orientations; Ciani et al., 2011), and that adaptive help seeking involves considerably more effort than just asking for the answer.

Expedient Help Seeking. When early adolescents (Ryan et al., 2005) and college students (Karabenick, 2003) who need help focus only on getting the answer, without concern about understanding the content, and finishing the task quickly they are likely to have lower achievement than students with adaptive help seeking do. In college, they generally use some learning strategies, such as organization and metacognition, but do not tend to use rehearsal and elaboration, contrary to adaptive help seekers who use all kinds of learning strategies (Karabenick, 2003; Karabenick & Knapp, 1991). Moreover, fifth-grade

13

expedient help-seeking students tend to feel moderate levels of positive affect (i.e., mid-way between that of adaptive and avoidant help-seekers) and high levels of anxiety (Ryan et al., 2005).

Students who are expedient help-seekers are likely to be concerned with demonstrating their competence and not looking incompetent rather than being engaged in the learning process (i.e., being low mastery and high performance-avoidance orientated); this result was found for both students in elementary school (Ryan et al., 2005) as well as in college (Karabenick, 2003, 2004). Expedient help seeking is also more likely when students view their teacher as emphasizing performance goals and as not supporting them emotionally; these results were found for students in the transition from elementary to middle school (Ryan & Shim, 2012), in middle school (Schenke et al., 2015), and in college (Karabenick, 2004).

Expedient help seekers also differ from adaptive and avoidant help seekers in the extent to which their competence and relatedness needs are satisfied. Elementary students tend to feel more competent about learning the content compared to avoidant help seekers, but less competent than adaptive help seekers do (Ryan et al., 2005). They also perceive a lower level of teacher support than adaptive help seekers and similar levels of that with avoidant help seekers (Ryan et al., 2005). In addition, in a study by Shim and colleagues (2013), middle schoolers who feel low peer support tend to seek expedient help. However, research examining how competence and relatedness needs are associated with expedient help seeking in college students is insufficient. Moreover, how student autonomy is related to expedient help seeking has not been investigated at any grade level.

Help-Seeking Avoidance. Students who avoid seeking help for difficult academic tasks tend to have achievement that is lower than those who engage in adaptive help-seeking, but similar to expedient help seekers, at least in elementary school (Ryan et al., 2005) and in college (Karabenick, 2003). Avoidant help-seeking early adolescents tend to report low self-regulated strategy use (Middleton & Midgley, 1997), and low positive affect and high anxiety (Ryan et al., 2005). They also show lower use of learning strategies compared to adaptive help seekers in college; although they are likely to use rehearsal and organization, elaboration and metacognition use is low (Karabenick, 2003).

Students from elementary school through college who avoid seeking academic help generally have a low mastery goal-orientation and high performance-approach or performance-avoidance orientation (Butler & Neuman, 1995; Gonida et al., 2014; Karabenick, 2003, 2004; Ryan et al., 2005). Furthermore, avoiding seek help is more likely

when view their teacher as placing a low emphasis on mastery goals and a high emphasis on performance goals in the classroom; this was found for students in elementary education (Ryan et al., 1998; Turner et al., 2002), secondary education (Shim et al., 2013), and higher education settings (Karabenick, 2004).

Satisfaction of each of the three basic psychological needs uniquely and negatively predicts help-seeking avoidance of elementary and middle school students; the association is greatest for perceived competence and least for perceived relatedness (Marchand & Skinner, 2007). Moreover, students' autonomy and competence satisfaction significantly and negatively predict increased avoidance within a year (Marchand & Skinner, 2007). Perceived competence for learning the content negatively predicts early adolescents' help-seeking avoidance directly, as well as indirectly via help-seeking threat (i.e., feeling that seeking help threatens self-esteem; Ryan & Pintrich, 1997). Teachers of help-seeking avoidant students tend to report low levels of support for students' needs for autonomy, competence, and relatedness in Grades 3-6 (Marchand & Skinner, 2007).

Summary. Although academic help seeking has been well explained with achievement goals that students demonstrate, a picture based on three basic psychological needs is incomplete. Although some studies have examined relations of competence and relatedness with different types of academic help seeking, students' autonomy has not been investigated. In particular, there are few studies that examine how basic psychological needs are associated with expedient help seeking in college. As mentioned before, expedient help seekers report greater competence for learning the content than help-seeking avoidant students but lower than adaptive help seekers; their confidence in relationships with others is similar to that of adaptive help seekers. How autonomy need is associated with help seeking patterns can help us better understand a whole picture of academic help seeking.

Moreover, most research (Marchand & Skinner, 2007; Middleton & Midgley, 1997; Ryan et al., 1998; Ryan et al., 2005; Ryan & Pintrich, 1997; Ryan & Shim, 2012) about academic help seeking has examined K-12 students, especially students in elementary and middle schools. In particular, there has not been a study investigating associations of college students' academic help seeking with basic psychological needs (i.e., autonomy, competence, and relatedness). Although associations between college students' perceived competence and academic help seeking have been examined (Karabenick, 2003), their autonomy has not been investigated as mentioned before. Autonomy is also important for college students, because it is related to motivation and engagement in higher education (Black & Deci, 2000). In terms of relatedness, studies on undergraduates' academic help seeking focus on whether and how

15

students ask for help in the context of instructor support (Karabenick, 1994; Karabenick & Sharma, 1994) or classroom goal structures (i.e., students' perception of the purposes for engaging in academic work that are emphasized in classroom; Karabenick, 2004, Schenke et al., 2015). More studies including other people in class (i.e., peers and teaching assistants) as help-seeking sources are needed, in addition to studies that focus on emotional connectedness.

Sources of Academic Help Seeking

When students have trouble with assignments, teachers and peers are two primary sources they can seek help from in class. Many factors, such as personal characteristics of helpers (e.g., nice, helpful), relationships with helpers, and their role or duty (e.g., the teacher's job is to help; Ryan & Pintrich, 1998), influence students' decision about who to ask for help. For instance, undergraduates' positive peer relationships are associated with a preference for asking peers, whereas valuing school is related to a preference for asking instructors (Makara & Karabenick, 2013b).

As web-based tools, such as a computer or a cell phone, have become widely available, students may also ask teachers or peers for help electronically, as well as in person. Makara and Karabenick (2013a) provide a framework to distinguish academic help seeking sources by four dimensions: a) role (i.e., whether the source's role is to help; formal vs. informal), b) relationship (i.e., whether the student perceives the relationship with the source as personal/close or not; personal vs. impersonal), c) channel (i.e., whether academic help seeking occurs in person or via technological tools; face to face vs. mediated), and d) adaptability (i.e., whether the help of the source can be adapted based on students' needs or not; dynamic vs. static). For example, the instructor in person can be considered a formal, personal, face-to-face, and dynamic source, whereas the instructor via email is a formal, personal/impersonal, mediated, and dynamic source.

The emergence of web-based tools has elaborated the characteristics of academic help seeking from teachers and peers. However, previous studies on academic help seeking in class have not explicitly reflected such changes in mediums of help-seeking sources. This differentiation is important, because undergraduate students' academic help seeking preferences and behaviors from the same source vary based on whether the source is face-to-face or technology-mediated. Specifically, college students tend to prefer asking for academic help in person to online when the source is an instructor or peer (Makara and Karabenick,

2013a). They prefer asking peers to instructors in person, whereas in using web-based tools, instructors are preferred sources to peers. Therefore, such differences in mediums need to be specified in academic help seeking measures, so that help-seeking behaviors may be understood more fully.

In addition, help-seeking sources are associated with the type(s) of academic help that students tend to seek. Although undergraduates generally prefer asking peers for help over instructors (Knapp & Karabenick, 1988), those seeking adaptive help to understand the content better tend to ask instructors rather than peers (Karabenick, 2003). High school students, however, appear to not differentiate between the teacher or peers in terms of the type of help sought. Specifically, when high school students in a computer science class were asked about the type of help seeking they engaged in with teachers and peers, they identified a three-factor structure (Pajares et al., 2004). That is, for example, expedient help seeking from teachers loaded on the same factor as expedient help seeking from peers did; the pattern was the same for adaptive and avoidant help-seeking. However, only an exploratory factor analysis was conducted in their study, thus more advanced analyses, such as a confirmatory factor analysis, are needed to address the question about whether the difference between Karabenick's (2003) and Pajares et al's (2004) findings may be due to grade level differences (college vs. high school) or methodological issues (correlation vs. EFA). In the present study I use CFA to examine the factor structure of the three types of help seeking from both peers and the instructor or TA, in addition to distinguishing between in-person and technology-mediated help.

Associations of Academic Help Seeking with Gender and Grade Level

According to previous studies, there are gender differences in the types of academic help seeking students engage in. Female, compared to male, students are more likely to seek adaptive help but less likely to use expedient and avoidant help seeking across the grade levels, including elementary (Marchand & Skinner, 2007; Middleton & Midgley, 1997), middle (Ryan & Shim, 2012) and high schools (Roussel et al., 2011; Schenke et al., 2015). For college students, studies have not examined whether gender is associated with academic help seeking (e.g., Karabenick, 2003, 2004).

In addition to gender, recent studies have shown that academic help seeking behaviors developmentally change as students advance from the late elementary to high school years. Adaptive help seeking tend to decrease, whereas expedient help seeking increases in

adolescent students (Lee et al., 2017; Marchand & Skinner, 2007; Ryan & Shim, 2012). Thus, undergraduates' grade level was included in the academic help seeking model in a recent study (Won et al., 2019). In their study, grade levels were positively associated with adaptive help seeking via the mediating role of self-efficacy for self-regulated learning, in contrast to studies in K-12 schools showing that adaptive help seeking decreases developmentally.

Self-Determination Theory

Basic psychological needs theory, one of the six mini-theories of self-determination theory (SDT; Deci & Ryan, 1985, 2000), emphasizes that students' three basic psychological needs (i.e., competence, autonomy, and relatedness) should be satisfied first to motivate them intrinsically (Ryan & Deci, 2017). Basic psychological need of competence means "understanding how to attain various external and internal outcomes and being efficacious in performing the requisite actions" (Deci et al., 1991, p. 327); autonomy is defined as "being self-initiating and self-regulating of one's own actions" (Deci et al., 1991, p. 327); and relatedness refers to "developing secure and satisfying connections with others in one's social milieu" (Deci et al., 1991, p. 327). Contrary to drive theory (Hull, 1943), which argues that people behave to satisfy their needs (e.g., hunger), basic psychological needs theory posits that people do not necessarily strive to satisfy their basic psychological needs. Instead, when these three psychological needs are fulfilled, people are likely to find interest and pleasure in their activity or task and be intrinsically motivated (Deci & Ryan, 2000). Furthermore, intrinsically and autonomously motivated students show higher achievement than students with controlled motivation from the early grades to college years (Froiland & Oros, 2014; Froiland & Worrell, 2016; Komarraju et al., 2009).

BPN Frustration. In addition to basic psychological needs satisfaction, recent studies have examined psychological needs frustration or thwarting (Vansteenkiste et al., 2020). Beyond low need satisfaction (i.e., need dissatisfaction), need frustration is active and intensive in its nature in that a psychological need is actively obstructed or undermined by contexts (Bartholomew et al., 2011; Costa et al., 2015).

Bartholomew and colleagues (2011) developed the need thwarting scale, consisting of thwarting of autonomy, competence, and relatedness needs, arguing that low levels of need satisfaction are not enough to reflect frustrated or thwarted needs. According to subsequent studies (Chen et al., 2015; Rocchi et al., 2017a; Rocchi et al., 2017b), measures of three psychological needs frustration loaded on different factors than did measures of three

psychological needs satisfaction. A six-factor structure (i.e., separate satisfaction and frustration scales for each psychological need) explained the data better than did a three-factor structure (e.g., autonomy need satisfaction and frustration loading on the same factor). There is also evidence for the distinctiveness of satisfaction and frustration in a sports context (Bartholomew et al., 2011). Specifically, exhaustion and negative emotion were moderately and positively associated with needs frustration, but either not related to or weakly and negatively correlated with need satisfaction. Such results were replicated in the context of one's general life (Chen et al., 2015; Costa et al., 2015) and a police officer training program (Gillet et al., 2014) in subsequent studies.

However, how needs frustration is associated with motivation and learning in academic contexts has been underexamined. Recent studies showed that needs frustration was positively associated with disengagement and negatively with engagement in class for elementary (Earl et al., 2017) and high school students (Jang et al., 2016). Whether such results can be generalized to college students needs to be examined.

Whether basic psychological needs frustration is a distinct construct from low levels of basic psychological needs satisfaction has not been examined with college undergraduates. Neither has their associations with the three types of academic help seeking been examined. Investigating the role that psychological needs frustration plays in terms of academic help seeking may increase understanding of the processes involved. I address this question in the present study by examining associations between undergraduates' need frustration and help seeking.

Interaction Effects Between Basic Psychological Needs. Most research on motivation from the basic psychological needs theory perspective has focused on how each need is uniquely associated with student motivation or engagement (Karimi & Sotoodeh, 2019; Tian et al., 2014). However, sometimes effects of one variable depend on levels of another variable(s) (i.e., interaction effects), thus they are not shown in analyses examining only unique and independent associations between two variables (i.e., main effects). For example, Dysvik and colleagues (2013) showed that each basic psychological need is independently related to employees' feelings of pleasure and interest in their jobs (i.e., intrinsic motivation). In addition, there are some interaction effects between basic psychological needs. Dysvik et al. (2013) found that employees' competence satisfaction and relatedness satisfaction are positively associated with intrinsic motivation only when they have high autonomy satisfaction. Furthermore, intrinsic motivation is high irrespective of the level of competence satisfaction when their relatedness satisfaction is high, but competence

satisfaction is positively related to intrinsic motivation when the level of relatedness satisfaction is low. However, because there is very little research on whether and how basic psychological needs interact with each other in academic settings, there is a need to examine possible interaction effects of basic psychological needs on academic help seeking.

Sources of Relatedness Satisfaction or Frustration. The need for relatedness may be satisfied or frustrated by different people. In class, teachers and peers are the two sources that students perceive connectedness with. Different relational sources are associated with different types or qualities of motivation and school outcomes. For instance, relatedness to teachers and relatedness with peers each uniquely predicts elementary students' engagement in class (Furrer & Skinner, 2003). In addition, support from teachers and from peers promote middle school students' learning and achievement in different ways. Specifically, support from teachers was related to adolescent students' focus on understanding and mastering the content (i.e., mastery goal orientations), whereas support from peers was associated with reduced test anxiety (Song et al., 2015). However, except for a few studies (e.g., Furrer & Skinner, 2003), most research framed by the SDT does not distinguish relational sources, merging them together and ignoring unique roles of each relational source in student motivation.

Relatedness to instructors and with peers each positively predicts student motivation and achievement in higher education settings. In terms of relationships with instructors or teachers, patterns and forms differ compared to those experienced in K-12 contexts, especially for younger students. In elementary grades one homeroom teacher typically teaches most subjects in one classroom for an academic year, which provides many chances for students to interact with their teachers. There tend to be fewer opportunities in high school, where students usually have different teachers for each subject, often for a semester at a time. Opportunities to form close and personal relationships with teachers or instructors may be even less for undergraduates, especially those at large universities and studying popular subjects. In addition to having many instructors and subjects, as in high school, undergraduates may experience large class sizes, lecture formats, less weekly contact time, and shorter semesters, all which may render relationships with instructors more depersonalized and task specific. Despite such challenges, studies demonstrate that relatedness with instructors is still important for undergraduates' motivation. The more undergraduates perceive instructors as approachable and respectful, the more students demonstrate adaptive motivation and achievement (Freeman et al., 2007; Komorraju et al., 2010; Micari & Pazos, 2012). Relationships with peers during the college years also are

positively associated with student motivation and achievement. For example, undergraduates who feel close to peers are more likely to study together for effective learning, compared to those who feel less close (Won et al., 2018), and a lack of peer support is related negatively to achievement and adjustment (Dennis et al., 2005). Therefore, more studies elaborating each relatedness source in class are needed, especially for examining student motivation and engagement that is relational in nature, such as academic help seeking.

Motivation and Engagement of STEM Undergraduates in Math Contexts

Mathematics, one of the core subjects in STEM disciplines, has been traditionally perceived as challenging and difficult for students. Math curricula are generally perceived as structured and presented in abstract and hierarchical ways (Cockcroft, 1982). The extra work of interpreting abstract representations and the perception that success or failure at one phase has a sequential influence on success or failure at the next phase may make students feel math is more difficult. According to Eccles and Wigfield (1995), such perceived task difficulty is negatively associated with math motivation for early to late adolescents. Fifth graders also report that although they could learn social studies by themselves, they could not learn mathematics by themselves (Stodolsky et al., 1991).

Low motivation and engagement can often be seen for undergraduate students who choose STEM as their major. Furthermore, the retention rate in STEM disciplines is low; 40-60% of STEM students change their major or fail to earn a degree (Daempfle, 2003; Drew, 2011; Holdren & Lander, 2012). It could be assumed that generally in challenging contexts, math students need more academic help and their help-seeking behaviors look different compared to those of students in other disciplines (e.g., literature or philosophy). Therefore, this study examines undergraduate STEM students' academic help seeking when they need help doing difficult mathematical assignments in their challenging major courses.

Research Questions

In this study I investigate the following two research questions:

1. What are the factor structures of academic help seeking and basic psychological need satisfaction and frustration?

    1.a. What is the structure of in-class and web-based help-seeking (i.e., adaptive, expedient, and avoidant) scores?

Because studies on academic help seeking have not measured both in-class and web-based forms of the three types of help-seeking, there is a need to examine the factor structure of scores. Results may indicate (a) a three-factor structure based on the three different types of academic help seeking (i.e., adaptive, expedient, avoidant), (b) a six-factor structure based on sources (i.e., classroom or online) and types of academic help seeking will be established, or (c) a structure whereby some types of help seeking are differentiated by source and some not. In addition, because the same phrases are used in the adaptive help seeking (e.g., get hints or clues) and in the expedient help seeking (e.g., get the answers) items, there may be some residual correlations between similar items. Therefore, the fit of the model with some correlated errors will be examined.

1.b. What is the structure of basic psychological need satisfaction and frustration scores?

Researchers have included need frustration in recent studies, however the factor structure of need frustration scores has not been established well in academic context. Therefore, there is a need to identify the factor structure of students' scores for need satisfaction and frustration. I will compare five measurement models to identify which model fits the data best. These models are as follows: a) 1-factor structure model with all items loading on one latent variable (i.e., basic psychological need); b) 2-factor structure model with two latent variables of basic psychological need satisfaction and need frustration; c) 3-factor structure model with latent variables of three needs (e.g., autonomy need satisfaction and frustration loading on one factor; i.e., autonomy need, competence need, and relatedness need); d) 6-factor structure model with each psychological need satisfaction and frustration loading on separate factors (i.e., autonomy satisfaction, competence satisfaction, relatedness satisfaction, autonomy frustration, competence frustration, and relatedness frustration); and e) 8-factor structure model whereby relatedness with the instructor/TA with peers are distinct. The factors would be: autonomy satisfaction, competence satisfaction, relatedness satisfaction from instructor/TA, relatedness satisfaction from peer, autonomy frustration, competence frustration, relatedness frustration from instructor/TA, and relatedness frustration from peers. The five hypothesized models are shown in Figure 1.

2. How are psychological need satisfaction and need frustration related to help-seeking? Based on factor structure results from the preliminary analyses, models of how basic psychological need satisfaction and frustration are associated with academic help seeking will be examined, using structural equation modeling (SEM).

22

2.a. How are psychological need satisfaction and frustration independently associated with help seeking? The proportion of variance in academic help seeking explained (i.e., R^2) by basic psychological need satisfaction and frustration, and the models' fits (e.g., CFI, TLI, RMSEA, and SRMR), are also investigated.

2.b. Are there interaction effects between basic psychological need satisfaction? If so, how do basic psychological need satisfaction interact each other to be related to academic help seeing?

2.c. Are there interaction effects between basic psychological need frustration? If so, how do basic psychological need frustration interact each other to be associated with academic help seeking?
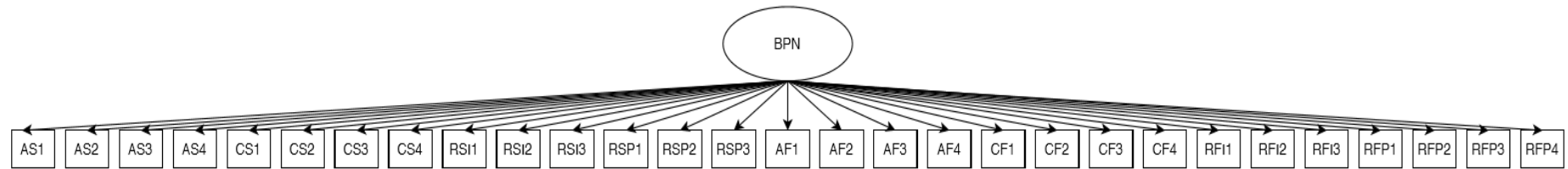
Model 1
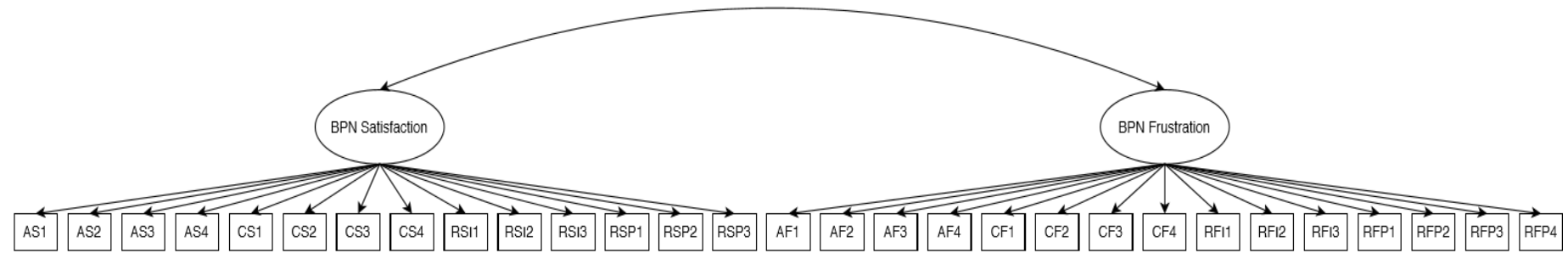
Model 2

Figure 1. The Five Hypothesized BPN CFA Models. *AS* Autonomy Satisfaction, *CS* Competence Satisfaction, *RSI* Relatedness Satisfaction (instructor/TA), *RSP* Relatedness Satisfaction (peer), *AT* Autonomy Frustration, *CF* Competence Frustration, *RFI* Relatedness Frustration (instructor/TA), *RFP* Relatedness Frustration (peer)

Figure 1 continued

Model 3

Model 4

25

Figure 1 continued

26
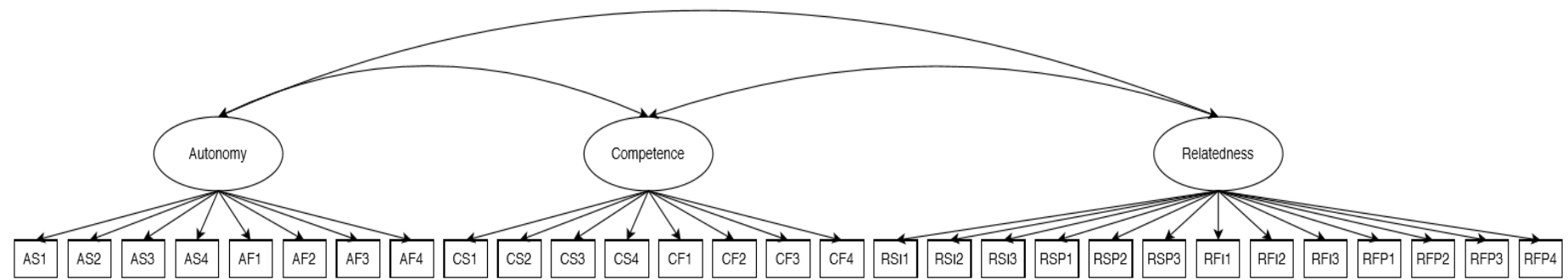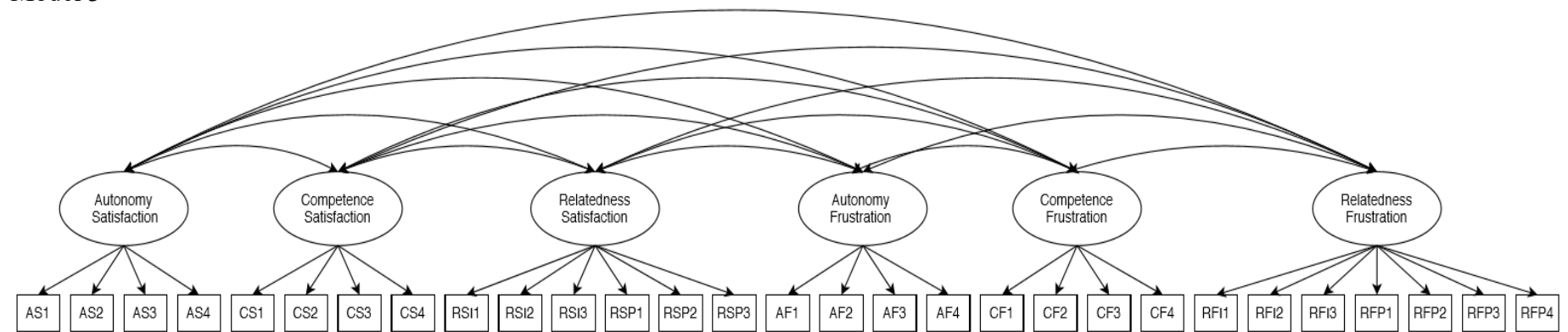
Model 5
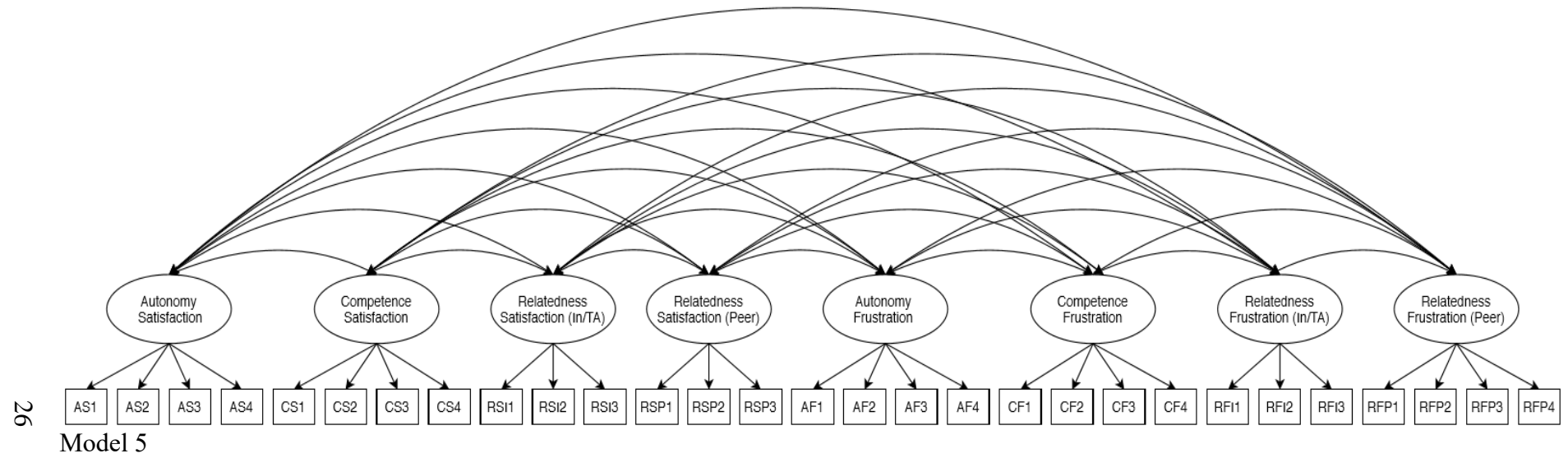
METHOD

Participants

The sample in this study was 776 undergraduate students majoring in a STEM discipline (i.e., science, technology, engineering, and math) in a large Midwestern university in the United States. There were 310 female (40%) and 465 male (60%) participants. The majority of participants were European American (486; 62.63%); other ethnicities were as follows: 210 Asian/Pacific Islander (27.06%), 35 Hispanic or Latino/a (4.51%), 35 Other (4.51%), and 10 African American or Black (1.29%). In terms of grade level, there were 282 freshmen (36.34%), 178 sophomores (22.94%), 180 juniors (23.20%) and 136 seniors (17.53%) participants. Most participants majored in Engineering (590, 76.03%); other majors were Science (155, 19.97%), Mathematics (36, 0.05%), and Statistics (19, 0.02%). The percentages do not equal 100 because 18 students had two or three majors. The average previous semester self-reported GPA for sophomores through seniors was 3.42/4.00 (median 3.5).

Procedure

The office of the Registrar in a large Midwestern university distributed an email from the researcher to undergraduate students majoring in engineering, statistics, mathematics, or computer science, inviting them to participate in the study. The email (shown in Appendix A) also contained a link to the Qualtrics survey. The invitation was sent in November and invited students to participate if they were currently taking a course in their major that required at least three mathematical assignments.

Participation involved clicking on the survey link within the email, which directed students to an informed consent form. After reading the form and confirming consent, students were directed to the survey. The first part of the survey asked about students' demographic information, including gender, class standing, ethnicity, major, and incoming GPA. Then students were asked to write the name and number of a specific course they were taking that semester for their STEM major that included at least three assignments involving mathematics. If they were taking more than one such class, they were asked to choose the most difficult one. Students were next asked to complete the survey, which took approximately 10 minutes. At the end of the survey participants were given the opportunity to

be entered into a drawing for a $20 Amazon gift card by submitting their email address. The odds of winning were at least 1 in 200, and four participants were randomly selected for the reward.

Measures

Students rated each survey item on a 7-point Likert scale ranging from 1 (*Completely false*) to 7 (*Completely true*). The items were preceded by the following instruction: "When you read the questions below, think about how you generally feel about this course [i.e., the course identified as having at least three assignments involving mathematics]." All scales and items are presented in Appendix B.

Academic Help Seeking (HS). Three types of academic help seeking were measured: adaptive, expedient, and avoidant, each with 10 items. Each subscale included 5 items referring to in-person help seeking and 5 referring to seeking help electronically. Items involving in-person help seeking came from Pajares et al. (2004), with minor adaptations (e.g., not referring specifically to computer class), and were preceded with the following instruction, "In this course, think about times when you need help doing difficult mathematical assignments and ask someone (e.g., instructor, teaching assistant, or student) in that course in person (i.e., not electronically)." Items referring to seeking help from electronic sources were adapted from Cheng and Tsai (2011), Makara and Karabenick (2013b) and Pajares et al. (2004). They were preceded with the direction "In this course, think about times when you need help doing difficult mathematical assignments and use web-based tools (e.g., computer or a cell phone) for help."

In Pajares et al.'s (2004) study psychometric analyses showed that Cronbach's alpha coefficients of the adaptive, expedient, and avoidant help seeking subscales were 0.89, 0.92, and 0.86, respectively. Construct validity of each subscale was also demonstrated; adaptive help seeking was positively correlated with perceived benefits of help seeking; expedient help seeking was negatively related to self-regulation and achievement; and help seeking avoidance was positively associated with anxiety.

Results from exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (presented in the Results section) indicated that responses about in-person and electronic methods of help-seeking did not form distinct factors within each help-seeking type. However, students differentiated between asking the instructor or TA and asking a peer for adaptive help. Guided by the factor analysis results I created four subscales: *Adaptive*

28

Help Seeking from the Instructor/TA (4 items, $\alpha = .77$), *Adaptive Help Seeking from a Peer* (4 items, $\alpha = .74$), *Expedient Help Seeking* (6 items, $\alpha = .80$), and *Avoidant Help Seeking* (2 items, $\alpha = .70$).

Basic Psychological Need (BPN) Satisfaction. The extent to which students perceived that their basic psychological needs were met in the challenging STEM course was assessed with four subscales, adapted from previous instruments (Chen et al., 2015; Froiland et al., 2019; Gunnell et al., 2013). Four subscales were adapted from Chen et al. (2015) and Gunnell et al. (2013); and one subscale of relatedness satisfaction from instructor/TA was based on Froiland et al. (2019). Specifically, because Chen et al. (2013) examined BPN satisfaction in general life and Gunnell et al. (2013) in physical activity, I revised some phrases (e.g., "my physical activity program") to reflect the academic course that students chose. In addition, in measuring Relatedness I distinguished between relatedness with an instructor or TA and relatedness with peers, given the different nature of these relationships. This is in contrast to some studies where the relational sources are vague (e.g., "people who I interact with while we do physical activity together"), and consistent with referring to perceived relationships with a teacher specifically (Froiland et al., 2019). In previous studies the instruments' scores exhibited acceptable-to-excellent internal consistency reliability; .65 - .88 in Chen et al. (2015) and .95 - .97 in Gunnell et al. (2013). The studies also identified that scores had good construct validity; for example, BPN satisfaction was positively correlated with life satisfaction and vitality (Chen et al., 2013).

Autonomy Satisfaction was measured with four items ($\alpha = .78$), *Competence Satisfaction* was measured with four items ($\alpha = .89$), *Relatedness Satisfaction with the Instructor/TA* was measured with three items ($\alpha = .91$), and *Relatedness Satisfaction with Peers* was measured with three items ($\alpha = .81$). CFA indicated support for the subscales, as presented in the Results section.

Basic Psychological Need (BPN) Frustration. To assess the extent to which basic psychological needs were frustrated in the course identified, I also adapted instruments by Chen et al., (2015) and Gunnell et al. (2013). Previous studies demonstrated validity and internal consistency reliability; Cronbach's alpha coefficients ranged from .64 - .86 in Chen et al. (2015) and an ordinal composite reliability ranged from .89 - .93 across two occasions in Gunnell et al. (2013). In addition, BPN frustration was associated positively with depressive symptoms (Chen et al., 2015) and negatively with subjective vitality and positive affect (Gunnell et al., 2013).

Autonomy Frustration was measured with four items (α = .64), *Competence Frustration* was measured with four items (α = .72), *Relatedness Frustration with the Instructor/TA* was measured with three items (α = .84), and *Relatedness Frustration with Peers* was measured with four items (α = .83). CFA indicated support for the subscales, as outlined in the Results section.

Demographic Information and Covariates. Participants' demographic information, including their gender, grade level, ethnicity, major, and incoming GPA (i.e., previous semester GPA or high school GPA), were collected. Since gender and grade level are associated with academic help seeking, and grade level is negatively related to basic psychological need satisfaction in late adolescents (Froiland et al., 2019), they were included as covariates in the hypothesized models.

Choosing the Most Difficult Major Course This Semester. Before starting the questionnaires, participants were asked to identify the most challenging course they were currently taking that had at least three assignments involving mathematics. To identify the content validity of how difficult they perceived regarding their chosen courses, they were also asked to rate on a 7-point Likert scale how difficult the course was (from 1 = *Very easy* to 7 = *Very difficult*) and how often they needed academic help for doing difficult mathematical assignments in the course (from 1 = *Never* to 7 = *Every Time*).

Data Analyses

Preliminary analyses were conducted to establish the validity and reliability of scores from both academic HS and BPN satisfaction and frustration measures before primary analyses. The construct validity for academic HS was investigated by: a) having two professors in the Educational Psychology Department review the items and b) by conducting both EFA and CFA after the sample was split into two.

For the construct validity of both BPN satisfaction and frustration scores, I compared five hypothesized CFA models (Figure 1). These were: a) 1-factor structure model (i.e., basic psychological need), b) 2-factor structure model (i.e., basic psychological need satisfaction and need frustration), c) 3-factor structure model (i.e., autonomy need, competence need, and relatedness need), d) 6-factor structure model (i.e., autonomy satisfaction, competence satisfaction, relatedness satisfaction, autonomy frustration, competence frustration, and relatedness frustration), and e) 8-factor structure model (i.e., autonomy satisfaction, competence satisfaction, relatedness satisfaction from the instructor/TA, relatedness

satisfaction from peers, autonomy frustration, competence frustration, relatedness frustration from the instructor/TA, and relatedness frustration from peers. Three of these models were used in previous studies. For example, the 2-factor structure model was used by Jang et al. (2016), the 3-factor structure model was used by Jang et al. (2009), and the 6-factor structure model was used by Chen et al. (2015). However, there have been insufficient studies of various models to identify which model is the best at explaining basic psychological needs. In particular, as mentioned in the previous section, perceived relatedness is associated with motivation and engagement in differential ways, depending on the type or source of relationship involved (e.g., Song et al., 2015). However, since models that include general relatedness have not been compared with a model in which relatedness is differentiated by source (i.e., 8-factor structure model), this is one of the objectives of the present study. After examining the scores for the HS and BPN satisfaction and frustration constructs, I examined the subscales' means, standard deviations, ranges, and correlations.

For primary analyses, the BPN satisfaction and frustration models were compared, using structural equation modeling. For model comparisons, various model fit indices, such as chi-square test statistic (x^2), a comparative fit index (CFI), a Tucker-Lewis Index (TLI), a root mean square error of approximation (RMSEA), a standardized root mean square residual (SRMR), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and variances explained by each model (R^2), were used. For CFI and TLI, $\geq$ .90 indicates an acceptable fit and $\geq$ .95 a good fit. RMSEA $\leq$ .06 (Hu & Bentler, 1999) and SRMR $\leq$ .05 indicate a good fit, and RMSEA and SRMR $\leq$ .08 an acceptable fit. The AIC and BIC are not absolute measures but used to compare two or more models estimated from the same data. The model with a smaller AIC or BIC indicates a better model fit.

To examine whether there were interaction effects between basic psychological needs on academic help seeking in each of the BPN Satisfaction and BPN Frustration Models, I conducted structural equation models of latent interactions. Contrary to multiple regressions, structural equation models of latent interactions considered measurement errors and showed more accurate estimates. I followed the strategy to create product indicators that Wu and colleagues (2013) recommended to obtain robust estimates under non-normal distribution. First, I created product indicators by matching indicators from each latent variable. To be specific, for the latent variables with the same number of indicators (e.g., Autonomy Satisfaction and Competence Satisfaction each including four indicators), indicators from each latent variable were matched in order of their reliabilities, as Marsh et al. (2004) and Coenders et al. (2008) argued. For instance, indicators with the lowest reliability from

31

Autonomy Satisfaction and Competence Satisfaction were matched to create a product indicator. For the latent variable with a different number of indicators (e.g., Autonomy Satisfaction with four indicators and Relatedness Satisfaction with the Instructor/TA with three indicators), three indicators that showed the highest factor loadings in Autonomy Satisfaction were chosen and matched with three indicators in Relatedness Satisfaction with the instructor/TA. To reduce collinearity, I mean-centered the two indicators, created an interaction term, and mean-centered the interaction term again (i.e., double mean-centering; Lin et al., 2010). Next, I fixed one loading for each latent variable to 1 to scale the latent-interaction variable.

There were six possible latent-interaction variables in each of the BPN Models (i.e., BPN Satisfaction and Frustration). These variables were: 1) Autonomy Satisfaction × Competence Satisfaction, 2) Autonomy Satisfaction × Relatedness Satisfaction with the Instructor/TA, 3) Autonomy Satisfaction × Relatedness Satisfaction with Peers, 4) Competence Satisfaction × Relatedness Satisfaction with the Instructor/TA, 5) Competence Satisfaction × Relatedness Satisfaction with Peers, and 6) Relatedness Satisfaction with the Instructor/TA × Relatedness Satisfaction with Peers in the BPN Satisfaction Model. If all these latent-interaction variables were included in one model, the model became too complicated, thus I included one latent-interaction variable at a time in the BPN Satisfaction Model, and followed the same procedure for the BPN Frustration model. If there was a significant interaction effect, I conducted simple-slopes analyses to further examine how variables interacted with each other in their association with academic help seeking. All variables were mean-centered before simple-slopes analyses.

The overview of the models for main effects and interaction effects is presented in Table 1. In addition, examples of latent-interaction models in the BPN Satisfaction and BPN Frustration Models are shown in Figure 2 and Figure 3, respectively.

Table 1. The Overview of Examined Models for Main Effects and Interaction Effects

	Model Name	Latent-Interaction Variable	Model Name	Latent-Interaction Variable
Main effects	BPN Satisfaction Model		BPN Frustration Model	
Interaction effects (Each latent-interaction variable is added at a time in BPN Satisfaction/Frustration Model.)	BPN Satisfaction-Interaction (AC) Model	Autonomy Satisfaction × Competence Satisfaction	BPN Frustration - Interaction (AC) Model	Autonomy Frustration × Competence Frustration
	BPN Satisfaction-Interaction (ARI) Model	Autonomy Satisfaction × Relatedness Satisfaction (In/TA)	BPN Frustration - Interaction (ARI) Model	Autonomy Frustration × Relatedness Frustration (In/TA)
	BPN Satisfaction-Interaction (ARP) Model	Autonomy Satisfaction × Relatedness Satisfaction (Peer)	BPN Frustration - Interaction (ARP) Model	Autonomy Frustration × Relatedness Frustration (Peer)
	BPN Satisfaction-Interaction (CRI) Model	Competence Satisfaction × Relatedness Satisfaction (In/TA)	BPN Frustration - Interaction (CRI) Model	Competence Frustration × Relatedness Frustration (In/TA)
	BPN Satisfaction-Interaction (CRP) Model	Competence Satisfaction × Relatedness Satisfaction (Peer)	BPN Frustration - Interaction (CRP) Model	Competence Frustration × Relatedness Frustration (Peer)
	BPN Satisfaction-Interaction (RR) Model	Relatedness Satisfaction (In/TA) × Relatedness Satisfaction (Peer)	BPN Frustration-Interaction (RR) Model	Relatedness Frustration (In/TA) × Relatedness Frustration (Peer)
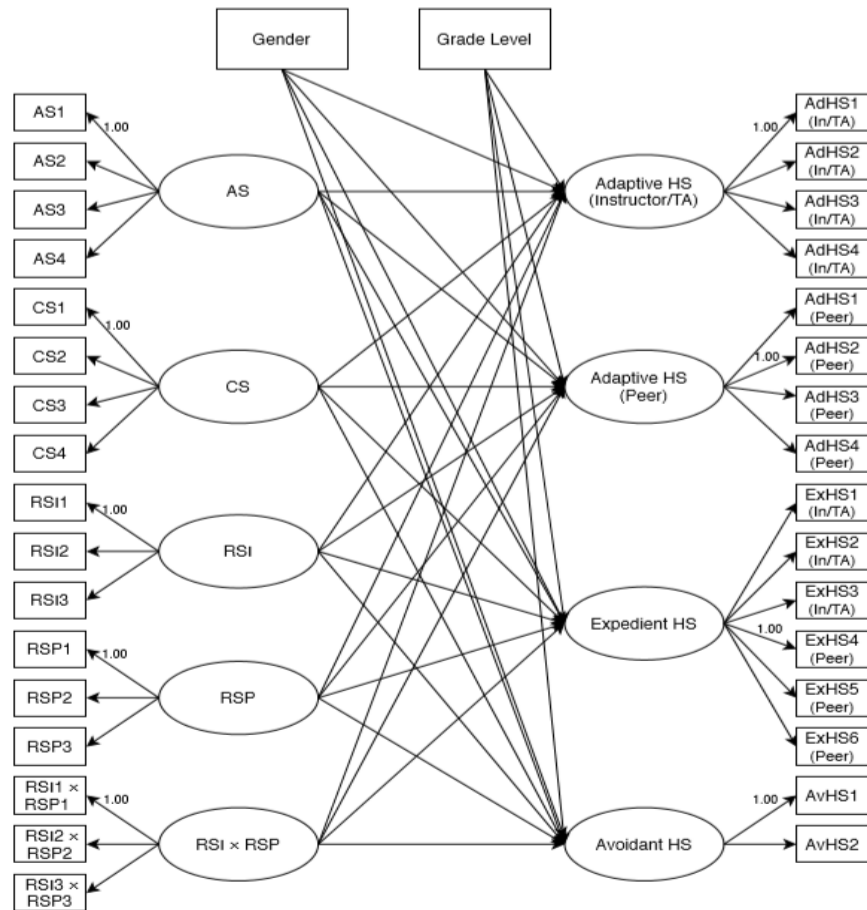
Figure 2. An example of the latent-interaction model in BPN Satisfaction Model (BPN Satisfaction-Interaction (RR) Model)
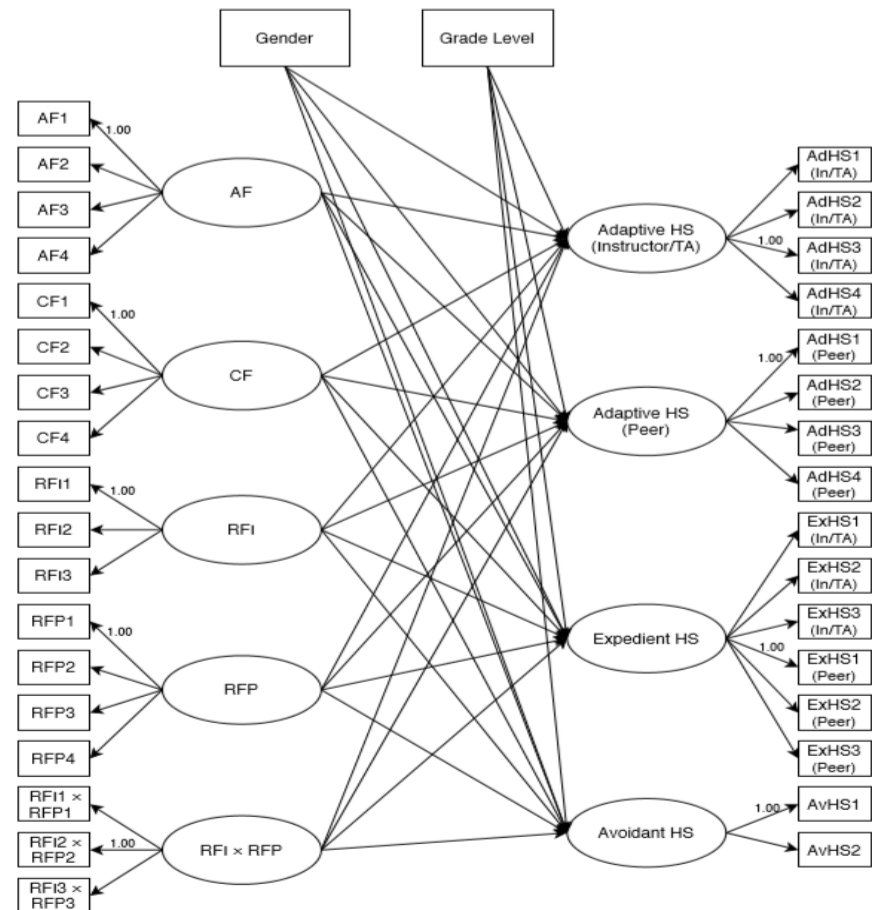
Figure 3. An example of the latent-interaction model in BPN Frustration model (BPN Frustration-Interaction (RR) Model)

Note. *AS* Autonomy Satisfaction, *CS* Competence Satisfaction, *RSI* Relatedness Satisfaction (instructor/TA), *RSP* Relatedness Satisfaction (peer), *AT* Autonomy Frustration, *CF* Competence Frustration, *RFI* Relatedness Frustration (instructor/TA), *RFP* Relatedness Frustration (peer)

RESULTS

Before preliminary and primary analyses, univariate and multivariate normality assumption tests showed that both academic HS and BPN items did not satisfy the assumption. Most of HS items exhibited a slight to moderate non-normality and a few severely departed from normality; skewness ranged from -1.85 to 2.40 and kurtosis from -1.40 to 5.34. For BPN items, there was a minor departure from normality in the BPN items; skewness from -0.98 to 1.18 and kurtosis from -1.20 to 0.77. Therefore, the MLR estimator, a maximum likelihood estimation with robust standard errors (Arminger & Schoenberg, 1989; Yuan & Hayashi, 2006), was used for more accurate estimates in this study.

Preliminary Analyses

Construct Validity of Academic Help Seeking Scores. I divided the total sample (N = 776) into two random samples. I used the slightly smaller sample ($n_{EFA} = 372$, 48%) for an EFA and the slightly larger sample ($n_{CFA} = 404$, 52%) for a CFA. Before EFA, a scree plot and a parallel analysis indicated that there were 4 to 5 factors for academic help seeking.

Exploratory Factor Analysis. The initial EFA identified systematic patterns among items. Specifically, items intended to measure Expedient Help Seeking tended to load together, as hypothesized. However, items intended to measure Adaptive Help Seeking did not load together on a single factor, but formed two separate factors based on help-seeking sources (i.e., the instructor/TA and peers). Regarding items intended to measure Help Seeking Avoidance, some loaded as intended however, interestingly, items that addressed not asking a specific source for help did not load on the avoidant help seeking factor, but instead loaded negatively on the Adaptive Help Seeking factor matching the specific source (i.e., the instructor/TA or peers).

After examining the initial EFA, I removed 14 items. Six of these items had low factor loadings (< .32; marked with an * in Appendix A) and three items cross-loaded on more than one factor (marked with an ** in Appendix A). Additionally, to focus on the two help-seeking sources of instructor/TA and peers, I removed six items about other sources of help (i.e., someone I know who is not in this course and unknown experts) (marked with an *** in Appendix A) The final EFA extracted four factors.

Confirmatory Factor Analysis. I next conducted a CFA with scores from the second sample, testing the four factors identified through EFA. The initial model fit from the CFA

was not acceptable; $x^2(df) = 400.700$ (98), $p < .001$, CFI = .849, TLI = .815, RMSEA = .090, and SRMR = .072. Modification indices suggested that error variances should be correlated for some items that shared similar wordings or the same help-seeking medium within or across the latent variables. For example, the items "asking instructor/TA to explain specific concepts or general ideas I don't understand" and "asking another student to help me understand specific concepts or general ideas needed for the assignment" loaded, as expected, on the different latent variables, *Adaptive HS from the Instructor/TA* and *Adaptive HS from a Peer,* respectively, but they shared some residuals due to similar wording or medium (i.e., in-person). Thus, I allowed some residuals to be correlated with each other; the final CFA model with correlated residuals (shown in Figure 4) showed an acceptable fit; $x^2(df) = 211.384$ (88), $p < .001$, CFI = .932, TLI = .907, RMSEA = .061, and SRMR = .061. All academic help seeking items are shown with standardized factor loadings and standard errors in Table 2.
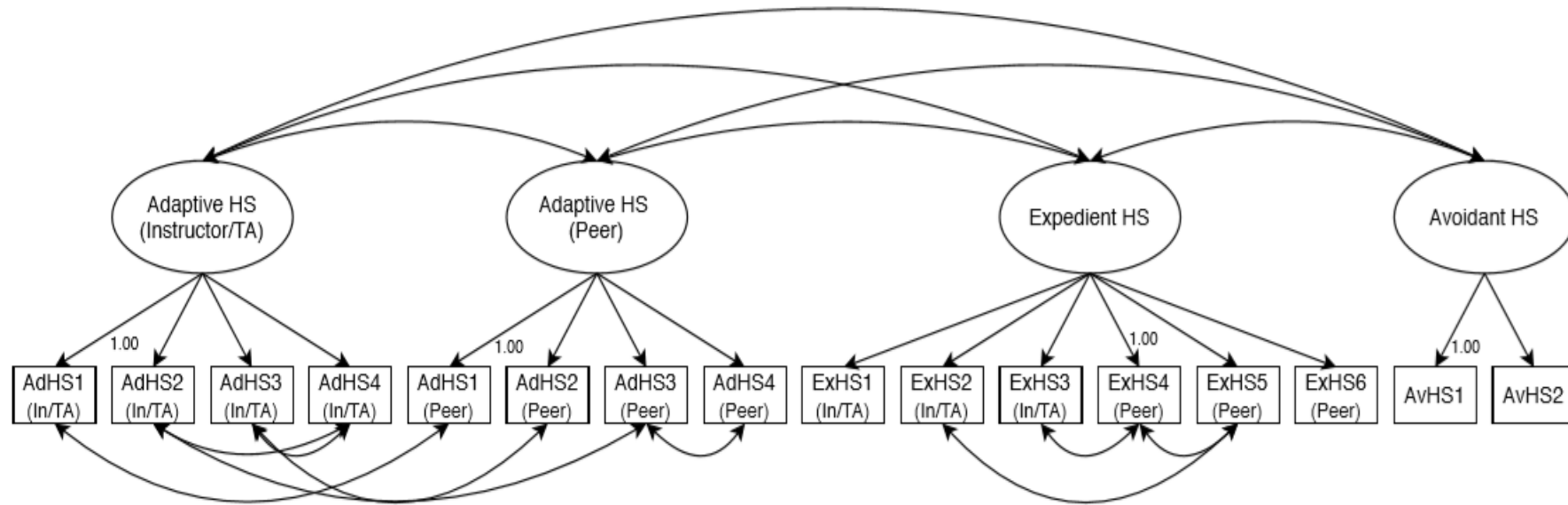
Figure 4. The Final CFA Model for Academic Help Seeking

Table 2. Standardized Factor Loadings and Standard Errors of HS Items from CFA (N=404)

Subscale	Item	When I don't understand part of an assignment I ….	β (SE)
Adaptive HS (Instructor/TA)	AdHS1 (In/TA)	don't message, e-mail, or post questions to the TA or instructor for help with the assignment. (reverse coded)	1.000
	AdHS2 (In/TA)	don't ask the TA or instructor for help with the assignment. (reverse coded)	.990 (.158)
	AdHS3 (In/TA)	e-mail or post questions to the instructor or TA to get hints or clues, but not the answer.	.835 (.087)
	AdHS4 (In/TA)	ask the instructor or TA to explain specific concepts or general ideas I don't understand, but not give me the answer.	.719 (.127)
Adaptive HS (Peer)	AdHS1 (Peer)	don't message, e-mail, or post questions to another student in the course for help with the assignment. (reverse coded)	1.000
	AdHS2 (Peer)	e-mail or post questions to another student(s) to get an explanation of concepts or information that I don't understand, but not the answer.	.932 (.113)
	AdHS3 (Peer)	don't ask another student in this course for help with the assignment, either during or after class. (reverse coded)	.671 (.098)
	AdHS4 (Peer)	ask another student to help me understand specific concepts or general ideas needed for the assignment, but not tell me the answer.	.546 (.106)
Expedient HS	ExHS1 (In/TA)	prefer the instructor or TA do the difficult parts of assignments for me, rather than explain how to do them.	.936 (.106)
	ExHS2 (In/TA)	message, e-mail, or post to the instructor or TA so they do the difficult parts for me, rather than explain the material so I can do the assignment on my own.	.893 (.108)
	ExHS3 (In/TA)	try to get the answer from the instructor or TA without an explanation of how to do it myself.	.859 (.109)
	ExHS4 (Peer)	ask another student to just give me the answer, without explaining how to do the problem myself.	1.000
	ExHS5 (Peer)	message, e-mail, or post questions to another student(s) in the course to get the answer(s), rather than an explanation of how to do it myself.	.770 (.098)
	ExHS6 (Peer)	ask another student to do the difficult parts of assignments for me, without explaining how to do them.	.778 (.095)
Avoidant HS	AvHS1	guess or put down any answer and don't ask anyone for help.	1.000
	AvHS2	skip difficult parts of assignments and don't ask anyone for help.	.742 (.075)

Note. All standardized factor loadings are significant at *p* < .001. The factor loading of one item in each latent variable is constrained to 1.000.

Construct Validity of Basic Psychological Need Satisfaction and Frustration Scores. To establish the factor structure of BPN satisfaction and frustration scores I compared the five hypothesized models using CFA. These five models were: a) 1-factor structure model (i.e., basic psychological need), b) 2-factor structure model (i.e., basic psychological need satisfaction and need frustration), c) 3-factor structure model (i.e., autonomy, competence, and relatedness), d) 6-factor structure model (i.e., autonomy satisfaction, competence satisfaction, relatedness satisfaction, autonomy frustration, competence frustration, and relatedness frustration), and e) 8-factor structure model (i.e., autonomy satisfaction, competence satisfaction, relatedness satisfaction from instructor/TA, relatedness satisfaction from peer, autonomy frustration, competence frustration, relatedness frustration from instructor/TA, and relatedness frustration from peer).

The models' fit indices, including $x^2(df)$, CFI, TLI, RMSEA, SRMR, AIC, and BIC, are presented in Table 3. In terms of chi-square statistics, all five models were statistically significant due to the large sample size. Regarding all other model fit indices, Models 1 through 4 showed poor model fits. Model 5 (i.e., the 8-factor structure model) had an adequate model fit; CFI (.927) > .90, TLI (.915) > .90, RMSEA (.056) < .60, SRMR (.056) < .80, and AIC & BIC were smaller than those in the other four models. Therefore, I chose the Model 5 as best representing the factor structure of BPN satisfaction and frustration scores. All items, with standardized factor loadings and standard errors, are presented in Table 4.

Table 3. Model Fit Indices of 5 BPN CFA Models (N=776)

Model		x^2 (*df*)	CFI	TLI	RMSEA (90% CI)	SRMR	AIC	BIC
Model 1	1-Factor Structure	4712.144 (377) ***	.528	.492	.137 (.133-.140)	.116	78807.988	79077.928
Model 2	2-Factor Structure	3960.257 (376) ***	.614	.583	.124 (.120-.127)	.104	77812.082	78086.677
Model 3	3-Factor Structure	3650.763 (374) ***	.653	.623	.118 (.114-.121)	.109	77351.798	77635.701
Model 4	6-Factor Structure	2314.340 (362) ***	.793	.768	.092 (.089-.096)	.086	75742.582	76082.335
Model 5	8-Factor Structure	1038.582 (349) ***	.927	.915	.056 (.052-.060)	.056	71909.782	72300.731

Note. ***p < .001. All model fit indices are robust maximum likelihood estimates (MLR).

Table 4. Standardized Factor Loadings and Standard Errors of BPN Items (N=776)

Subscale	Item	In this course, I feel…	β (SE)
Autonomy Satisfaction	AS1	free to do tasks and activities in my own way.	1.000
	AS2	like I have a say in choosing tasks and activities that I do.	.747 (.075)
	AS3	free to make decisions and choices about tasks and activities.	.915 (.066)
	AS4	like I can decide how I do the course work.	.942 (.060)
Competence Satisfaction	CS1	good about the way I am able to complete challenging activities.	1.000
	CS2	1 confident in my abilities to perform activities that personally challenge me.	.973 (.030)
	CS3	that I can complete tasks and activities that are personally challenging.	.857 (.041)
	CS4	that I can successfully complete difficult tasks and activities.	.995 (.034)
Relatedness Satisfaction (In/TA)	RSI1 (average)	comfortable with the instructor. comfortable with the TA.	1.000
	RSI2 (average)	that I like the instructor. that I like the TA.	.992 (.026)
	RSI3 (average)	that I respect the TA. that I respect the instructor.	.718 (.031)
Relatedness Satisfaction (Peer)	RSP1	connected to other students.	1.000
	RSP2	a sense of camaraderie with other students.	.887 (.035)
	RSP3	comfortable with the other students.	.685 (.050)
Autonomy Frustration	AF1	prevented from making choices about to the way do tasks or activities.	1.000
	AF2	that I can't do tasks or activities the way that I want to.	.869 (.079)
	AF3	pushed to do tasks or activities in certain ways.	.725 (.066)
	AF4	under pressure to agree with the instructor.	.955 (.076)
Competence Frustration	CF1	there are situations where I am made to feel inadequate.	1.000
	CF2	I feel incapable because I am not given opportunities to do my best.	.702 (.055)
	CF3	situations occur in which I am made to feel incompetent.	.977 (.035)
	CF4	there are times when I feel activities, tasks, or other people get in the way of my learning.	.406 (.052)
Relatedness Frustration (Instructor/TA)	RFI1	that the instructor or TA is dismissive of me.	1.000
	RFI2	that the instructor or TA doesn't like me.	.942 (.038)
	RFI3	that the instructor or TA doesn't want to interact with me.	.937 (.046)
Relatedness Frustration (Peer)	RFP1	that other students don't want to interact with me.	1.000
	RFP2	that other students don't like me.	.938 (.044)
	RFP3	excluded from the group of students I want to be part of.	.821 (.055)
	RFP4	that other students are dismissive of me.	.813 (.046)

Note. All standardized factor loadings are significant at *p* < .001. The factor loading of one item in each latent variable is constrained to 1.000. *AS* Autonomy Satisfaction, *CS* Competence Satisfaction, *RSI* Relatedness Satisfaction (instructor/TA), *RSP* Relatedness Satisfaction (peer), *AF* Autonomy Frustration, *CF* Competence Frustration, *RFI* Relatedness Frustration (instructor/TA), *RFP* Relatedness Frustration (peer)

Descriptive Analysis

      Bivariate correlations, means, standard deviations and ranges of variables are shown in Table 5. In terms of correlations between basic psychological needs, all psychological need satisfaction variables were correlated positively with each other and negatively with each psychological need frustration variable. All psychological need frustration variables were also positively associated with each other. The adaptive help seeking from the instructor/TA and from peers measures were positively related with expedient help seeking and negatively with help-seeking avoidance. The two maladaptive types of academic help seeking (i.e., expedient and avoidant) were positively associated with each other. In addition, all psychological need satisfaction variables were positively correlated with adaptive help seeking from the instructor/TA and negatively with avoidant help seeking. The two maladaptive help seeking types were positively related with all psychological need frustration variables.

      Perceived Difficulty of Chosen Course. The mean perceived difficulty of the course students chose was 5.45 (SD = 1.30, median = 6). This item was negatively skewed with skewness of -1.3 and kurtosis of 1.69. Students reported that, on average, they needed academic help with difficult mathematical assignments in the course moderately often (M = 3.91, SD = 1.40). The reported course difficulty and frequency of help needed were correlated significantly (r = 0.53, p < .001).

Table 5. Means, Standard Deviations, Ranges, and Bivariate Correlations (N=776)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Autonomy Satisfaction	–											
2. Competence Satisfaction	**.52*****	–										
3. Relatedness Satisfaction (Instructor/TA)	**.49*****	**.52*****	–									
4. Relatedness Satisfaction (Peer)	**.25*****	**.30*****	**.35*****	–								
5. Autonomy Frustration	**-.45*****	**-.40*****	**-.39*****	**-.17*****	–							
6. Competence Frustration	**-.30*****	**-.51*****	**-.42*****	**-.17*****	**.58*****	–						
7. Relatedness Frustration (Instructor/TA)	**-.25*****	**-.36*****	**-.63*****	**-.26*****	**.48*****	**.50*****	–					
8. Relatedness Frustration (Peer)	**-.10*****	**-.28*****	**-.25*****	**-.52*****	**.37*****	**.42*****	**.52*****	–				
9. Adaptive HS (Instructor/TA)	**.10*****	**.11*****	**.22*****	**.18*****	-.07	**-.07*****	**-.13*****	**-.08*****	–			
10. Adaptive HS (Peer)	-.01	.01	.04	**.31*****	.04	**.07*****	.00	**-.14*****	**.35*****	–		
11. Expedient HS	-.05	**-.30*****	**-.23*****	-.07	**.21*****	**.28*****	**.29*****	**.25*****	**.09*****	**.14*****	–	
12. Avoidant HS	**-.18*****	**-.36*****	**-.24*****	**-.23*****	**.21*****	**.27*****	**.24*****	**.22*****	**-.23*****	**-.18*****	**.39*****	–
M	3.91	4.81	5.21	4.79	3.64	3.36	2.31	2.40	3.72	4.52	2.03	2.66
SD	1.32	1.38	1.36	1.32	1.12	1.34	1.34	1.21	1.55	1.47	1.02	1.51
Range	1-7	1-7	1-7	1-7	1-7	1-6.75	1-7	1-7	1-7	1-7	1-6	1-7

Note. Bold coefficients represent statistical significance. (*$p < .05$, **$p < .01$, ***$p < .001$)

Primary Analyses

In order to examine how BPN were associated with the four types of academic help seeking, I used SEM to test two hypothesized models: one including BPN Satisfaction and the second with BPN Frustration. In both models, gender and grade level were included as covariates.

Associations between help seeking and BPN satisfaction. The BPN satisfaction model showed an acceptable fit, as shown in Table 6; $x^2(424) = 1121.592$, CFI = .926, TLI = .914, RMSEA = .048, and SRMR = .053. Significant standardized coefficients for the BPN Satisfaction Model are shown in Figure 5. Relatedness satisfaction with the instructor/TA (β = .27, $p < .001$), as well as with peers (β = .14, $p = .004$), were positively associated with adaptive help seeking from the instructor/TA. Relatedness satisfaction with peers also positively predicted adaptive help seeking from peers (β = .43, $p < .001$). Expedient help seeking was associated positively with autonomy satisfaction (β = .24, $p < .001$), and negatively with both competence satisfaction (β = -.34, $p < .001$) and relatedness satisfaction with the instructor/TA (β = -.13, $p < .001$). Both competence satisfaction (β = -.45, $p < .001$) and relatedness satisfaction with peers (β = -.13, $p = .007$) were associated negatively with avoidant help seeking. Also, men were moderately less likely than women to engage in adaptive help-seeking both with instructors and with peers. Furthermore, students in higher grade levels were more likely to engage in adaptive help seeking with the instructor that those in lower grades.

In terms of R-squared, the BPN Satisfaction Model explained 17-24% of the variance in academic help seeking. Specifically, the variance explained was: 1) 17% for adaptive help seeking from the instructor/TA; 2) 18% for adaptive help seeking from peers; 3) 17% for expedient help seeking; and 4) 24% for avoidant help seeking.

Associations between help seeking and BPN frustration. As shown in Table 6, the BPN frustration model showed an acceptable fit ($x^2(455) = 1097.930$, CFI = .915, TLI = .901, RMSEA = .045, and SRMR = .048), although it was not as good as for BPN satisfaction. Significant standardized coefficients for the BPN Frustration Model are shown in Figure 6. Adaptive help seeking from the instructor/TA was associated negatively with relatedness frustration with the instructor/TA (β = -.21, $p = .040$). Similarly, adaptive help seeking from peers was associated negatively with relatedness frustration with peers (β = -.35, $p < .001$). Expedient help seeking was positively associated with competence frustration (β = .15, $p = .028$) and relatedness frustration with the instructor/TA (β = .16, $p = .017$) as

44

well as with peers ($\beta = .11$, $p = .048$). Help-seeking avoidance was associated positively with competence frustration ($\beta = .24$, $p = .018$). None of the academic help seeking types were related to autonomy frustration. The control variables showed very similar relationships with outcomes in this model, except that men were less likely than women to engage in expedient help seeking.

The BPN frustration model explained 9-16% of the variance in academic help seeking, which was somewhat less than for the BPN satisfaction model. Specifically, the model explained: 1) 9% of the variance in adaptive help seeking from the instructor/TA; 2) 9% of the variance in adaptive help seeking from peers; 3) 16% of expedient help seeking; and 4) 16% of avoidant help seeking.

Table 6. Model Fit Indices of BPN Satisfaction and Frustration Models (N=776)

		BPN Satisfaction Model	BPN Frustration Model
x^2 (*df*)		1121.592 (424) ***	1097.930 (455) ***
CFI		.926	.915
TLI		.914	.901
RMSEA (90% CI)		.048 (.045-.052)	.045 (.042-.048)
SRMR		.053	.048
AIC		79663.690	84946.803
BIC		80133.630	85426.048
R-squared	Adaptive HS (Instructor/TA)	.171	.094
	Adaptive HS (Peer)	.177	.085
	Expedient HS	.169	.161
	Avoidant HS	.237	.156

Note. ***p < .001. All model fit indices are robust maximum likelihood estimates (MLR).
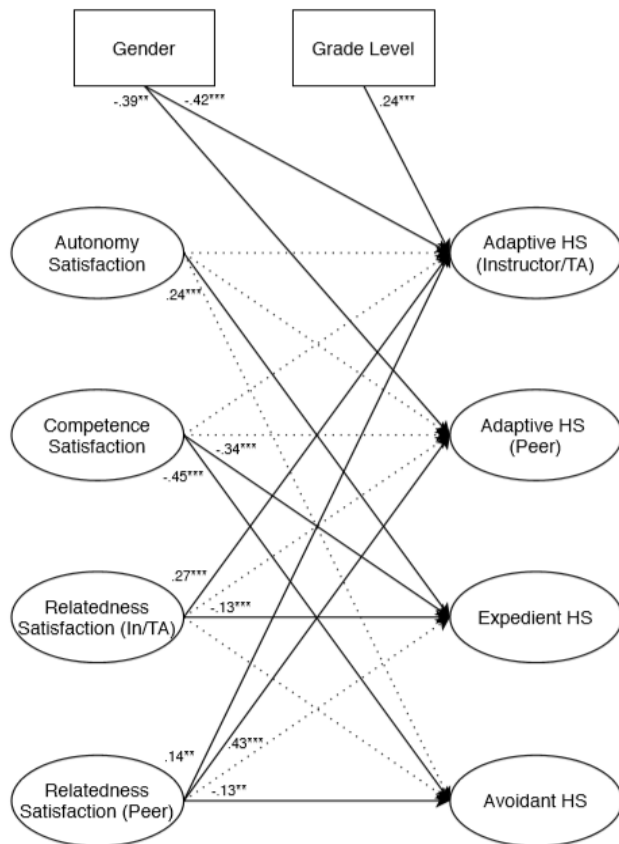
Figure 5. BPN Satisfaction Model
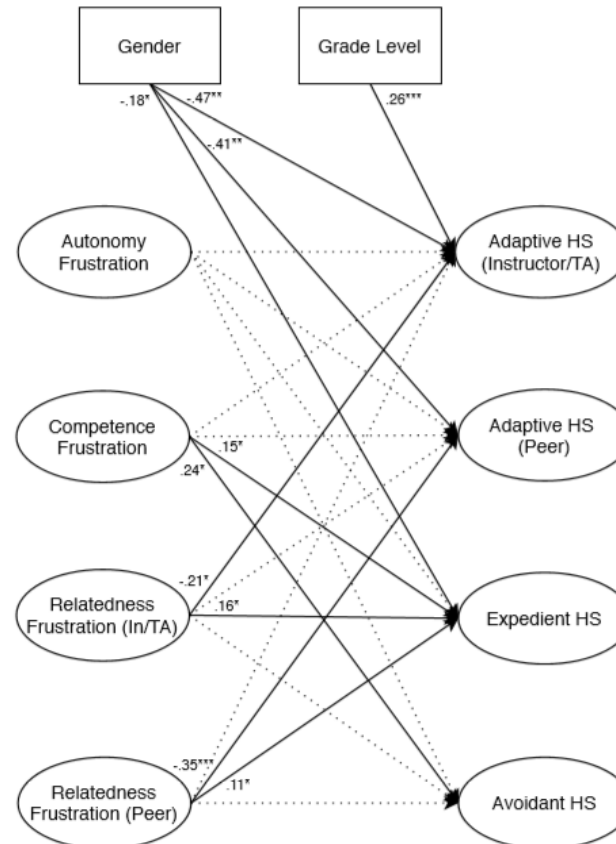
Figure 6. BPN Frustration Model

Note. Standardized coefficient estimators for the two BPN SEM models. Bold lines represent significant paths ($p < .05$) and dotted line show non-significant paths. Gender and Grade Level are entered as covariates; Gender was coded as Female=0 and Male=1, and Grade Level was coded as Freshmen=1, Sophomore=2, Junior=3, and Senior=4.

Analysis of Interaction Effects

There were six possible latent-interaction terms for each model (i.e., psychological need satisfaction and psychological need frustration), as explained in Method section. Thus, twelve latent-interaction models were conducted by including each latent-interaction term separately in the models; six for the BPN satisfaction model and six for the BPN frustration model. After conducting latent-interaction models, each interaction effect was further examined through simple-slopes analyses. Simple-slopes analyses and plots showed whether the association between academic help seeking and one basic psychological need was significant when another basic psychological need was at 1 SD below the mean, at the mean (i.e., between -1 SD and +1 SD), or at 1 SD above the mean. Gender and grade level were included as covariates in all latent-interaction models and simple-slopes analyses.

Interaction effects in the BPN satisfaction model. Model fit indices of all six latent-interaction models for interaction effects in the BPN satisfaction model were adequate or good; CFIs ranged from .917 to .925; TLIs .903 - .913; RMSEAs .044 - .048; and SRMRs .050 - .052. Additionally, across the six latent-interaction models, the variance explained was: 1) 18-20% for adaptive help seeking from the instructor/TA; 2) 18-19% for adaptive help seeking from peers; 3) 17-25% for expedient help seeking; and 4) 24-28% for avoidant help seeking. Model fit indices of each latent-interaction model were presented in Table 7. Since these six latent-interaction models were different but interrelated tests, I adjusted the significance level for each latent-interaction term to take account of the multiple analyses. Using the Bonferroni correction, I lowered the significance level to 0.008 by dividing the conventional p-value 0.05 by 6. There were five interactions effects for the model of basic psychological need satisfaction at the 0.008 significance level.

Table 7. Model Fit Indices of Latent-Interaction Models

Model Name	x^2(df)	CFI	TLI	RMSEA	SRMR	AIC	BIC	R-squared			
								Adaptive HS (In/TA)	Adaptive HS (Peer)	Expedient HS	Avoidant HS
BPN Satisfaction-Interaction (AC) Model	1281.417 (546) ***	.925	.913	.044	.051	94291.778	94836.162	.175	.179	.251	.283
BPN Frustration - Interaction (AC) Model	1269.503 (581) ***	.910	.897	.042	.047	100772.096	101325.787	.098	.089	.189	.191
BPN Satisfaction-Interaction (ARI) Model	1320.671 (512) ***	.918	.905	.048	.052	90288.174	90823.253	.188	.178	.222	.252
BPN Frustration - Interaction (ARI) Model	1250.225 (546) ***	.910	.896	.044	.047	95844.868	96389.253	.124	.087	.185	.169
BPN Satisfaction-Interaction (ARP) Model	1222.129 (512) ***	.925	.913	.045	.051	90810.783	91345.863	.193	.178	.186	.241
BPN Frustration - Interaction (ARP) Model	1292.711 (581) ***	.906	.892	.043	.048	99541.399	100095.090	.094	.086	.190	.175
BPN Satisfaction-Interaction (CRI) Model	1349.411 (512) ***	.917	.903	.048	.051	89995.737	90530.816	.183	.177	.200	.252
BPN Frustration - Interaction (CRI) Model	1241.543 (546) ***	.911	.898	.043	.047	96290.589	96834.974	.130	.088	.186	.160
BPN Satisfaction-Interaction (CRP) Model	1243.136 (512) ***	.924	.911	.046	.050	90588.104	91123.183	.177	.179	.173	.238
BPN Frustration - Interaction (CRP) Model	1297.657 (581) ***	.909	.896	.043	.047	99875.691	100429.381	.095	.089	.176	.163
BPN Satisfaction-Interaction (RR) Model	1292.600 (512) ***	.920	.907	.047	.051	90143.563	90678.642	.195	.188	.174	.246
BPN Frustration-Interaction (RR) Model	1254.728 (546) ***	.912	.899	.044	.047	95595.323	96139.708	.099	.088	.168	.157

Note. ***p < .001. All model fit indices are robust maximum likelihood estimates (MLR).

For *adaptive help seeking from the instructor/TA*, there was one interaction effect between relatedness satisfaction with the instructor/TA and relatedness satisfaction with peers. As shown in Figure 7 and Table 8, relatedness satisfaction with the instructor/TA had a positive relation with adaptive help seeking from the instructor/TA only when perceived relatedness satisfaction with peers was at the mean or 1 SD above the mean (βs = .25 and .48, ps < .001, respectively). The significant association between relatedness satisfaction with the instructor/TA and adaptive help seeking from the instructor/TA did not exist when relatedness satisfaction with peers was 1 SD below the mean (β = .05, p = .57).
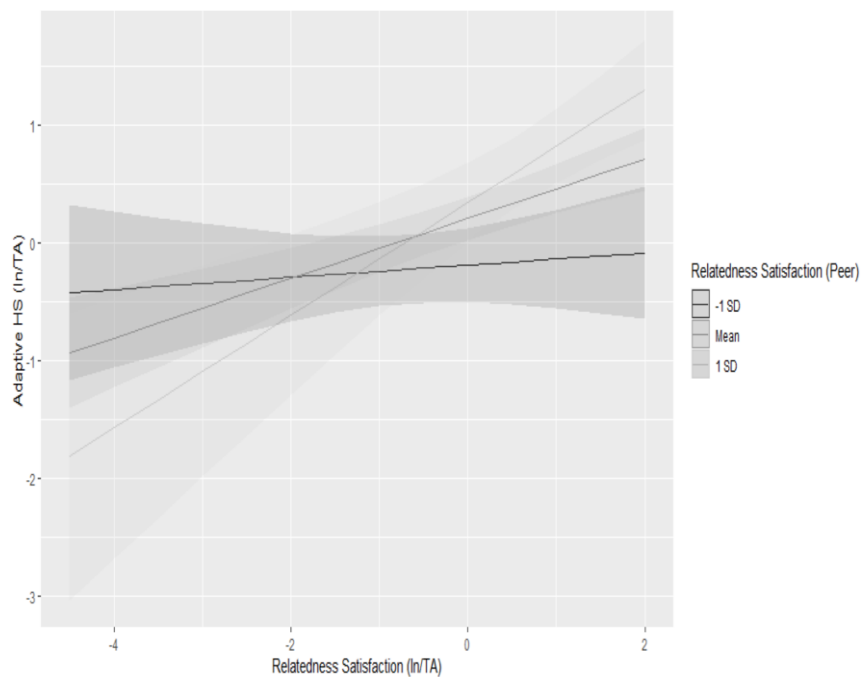
Figure 7. A simple-slopes plot of the interaction effect between Relatedness Satisfaction (In/TA) and Relatedness Satisfaction (Peer) on Adaptive Help Seeking (In/TA). All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 8. Simple-Slopes Analyses for Interaction Effects between Relatedness Satisfaction (In/TA) and Relatedness Satisfaction (Peer) on Adaptive HS (In/TA)

β	SE	p
Slope of Relatedness Satisfaction (In/TA) when Relatedness Satisfaction (Peer) = -1 SD		
0.05	0.09	.57
Slope of Relatedness Satisfaction (In/TA) when Relatedness Satisfaction (Peer) = Mean		
0.25	0.05	< .001
Slope of Relatedness Satisfaction (In/TA) when Relatedness Satisfaction (Peer) = +1 SD		
0.48	0.12	< .001

There were three interaction effects for *expedient help seeking*. First, as presented in Figure 8 and Table 9, there was a synergistic effect of autonomy satisfaction and competence satisfaction on expedient help seeking. That is, competence satisfaction was negatively associated with expedient help seeking regardless of the levels of autonomy satisfaction, but the magnitude of this negative association was larger when the level of autonomy satisfaction was higher (βs = -.14, -.28, and -.38 for autonomy satisfaction 1 SD below the mean, mean, and 1 SD above the mean, respectively, ps < .001).

Figure 8. A simple-slopes plot of the interaction effect between Autonomy Satisfaction and Competence Satisfaction on Expedient Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 9. Simple-Slopes Analyses for Interaction Effects between Autonomy Satisfaction and Competence Satisfaction on Expedient HS

β	SE	p
Slope of Competence Satisfaction when Autonomy Satisfaction = -1 SD		
-0.14	0.05	0.01
Slope of Competence Satisfaction when Autonomy Satisfaction = Mean		
-0.28	0.04	< .001
Slope of Competence Satisfaction when Autonomy Satisfaction = +1 SD		
-0.38	0.10	< .001

The second interaction for expedient help seeking was between relatedness satisfaction with the instructor/TA and autonomy satisfaction. Specifically, as shown in Figure 9 and Table 10, relatedness satisfaction with the instructor/TA was negatively related to expedient help seeking only when autonomy satisfaction was at the mean or above the mean (βs = -.21 and -.43, ps < .001, respectively). There was no significant association between relatedness satisfaction with the instructor/TA and expedient help seeking when autonomy satisfaction was 1 SD below the mean (β = -.03, p = .59).

Figure 9. A simple-slopes plot of the interaction effect between Autonomy Satisfaction and Relatedness Satisfaction (In/TA) on Expedient Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 10. Simple-Slopes Analyses for Interaction Effects between Autonomy Satisfaction and Relatedness Satisfaction (In/TA) on Expedient HS

β	SE	p
Slope of Relatedness Satisfaction (In/TA) when Autonomy Satisfaction = -1 SD		
-0.03	0.05	0.59
Slope of Relatedness Satisfaction (In/TA) when Autonomy Satisfaction = Mean		
-0.21	0.04	< .001
Slope of Relatedness Satisfaction (In/TA) when Autonomy Satisfaction = +1 SD		
-0.43	0.10	< .001

The third interaction for expedient help seeking involved relatedness satisfaction with the instructor/TA and competence satisfaction. As shown in Figure 10 and Table 11, competence satisfaction was negatively associated with expedient help seeking only when perceived relatedness satisfaction with the instructor/TA was at the mean or 1SD above the mean (βs = -.21 and -.18, ps = < .001 and .01, respectively). There was no significant association between the two variables when relatedness satisfaction with the instructor/TA was 1 SD below the mean (β = -.10, p = .13).
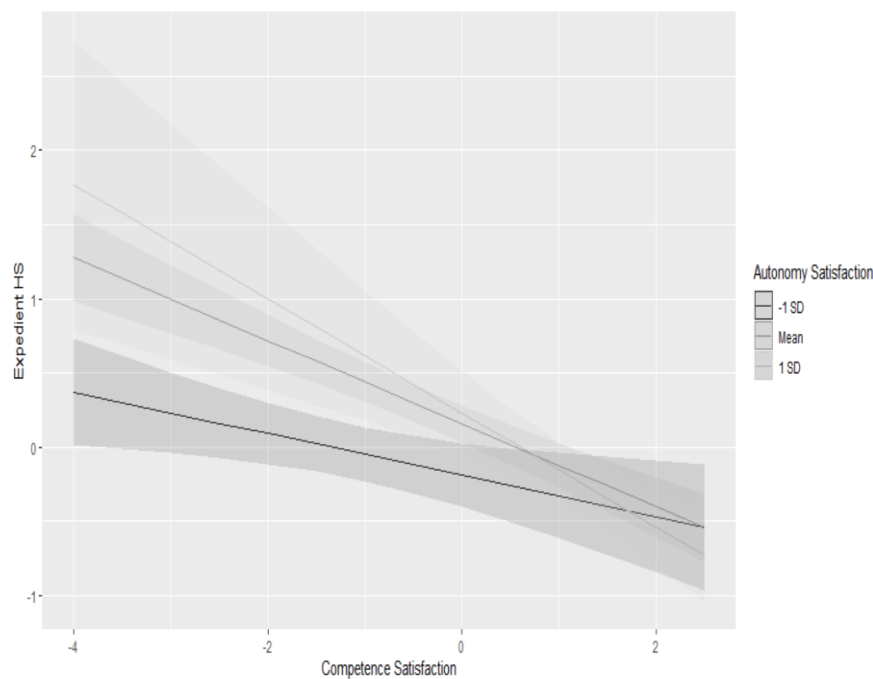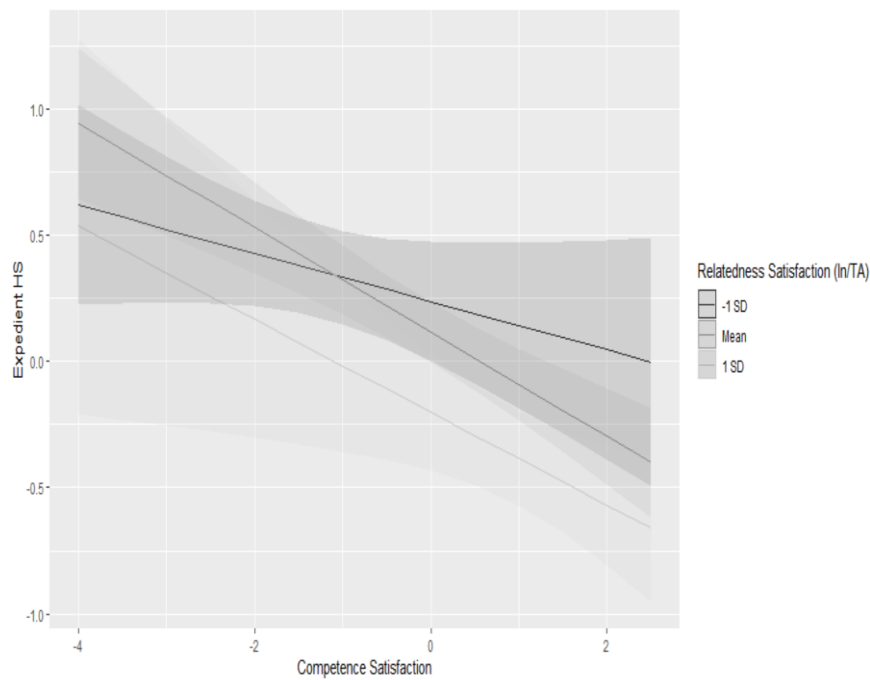

Figure 10. A simple-slopes plot of the interaction effect between Competence Satisfaction and Relatedness Satisfaction (In/TA) on Expedient Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 11. Simple-Slopes Analyses for Interaction Effects between Competence Satisfaction and Relatedness Satisfaction (In/TA) on Expedient HS

β	SE	p
Slope of Competence Satisfaction when Relatedness Satisfaction (In/TA) = -1 SD		
-0.10	0.06	0.13
Slope of Competence Satisfaction when Relatedness Satisfaction (In/TA) = Mean		
-0.21	0.04	< .001
Slope of Competence Satisfaction when Relatedness Satisfaction (In/TA) = +1 SD		
-0.18	0.07	0.01

For *help-seeking avoidance*, there was one interaction effect between autonomy satisfaction and competence satisfaction. Avoidant help seeking was negatively related to competence satisfaction regardless of levels of autonomy satisfaction. However, the magnitudes of the association were larger when autonomy satisfaction was at the mean or 1 SD above the mean (βs = -.48 and -.45, ps = < .001, respectively) than when autonomy satisfaction was 1 SD below the mean (β = -.21, p = .01; see Figure 11 and Table 12).
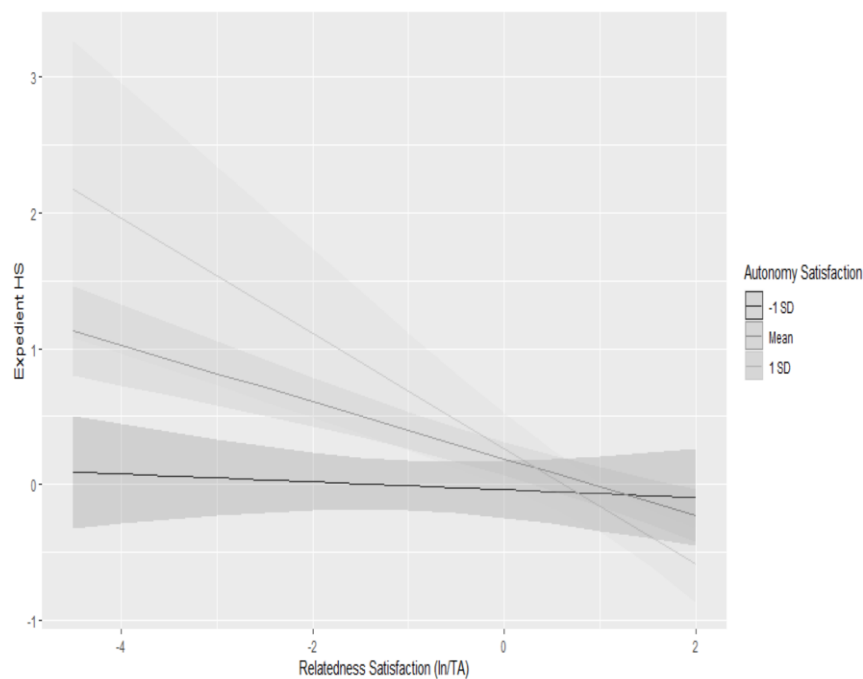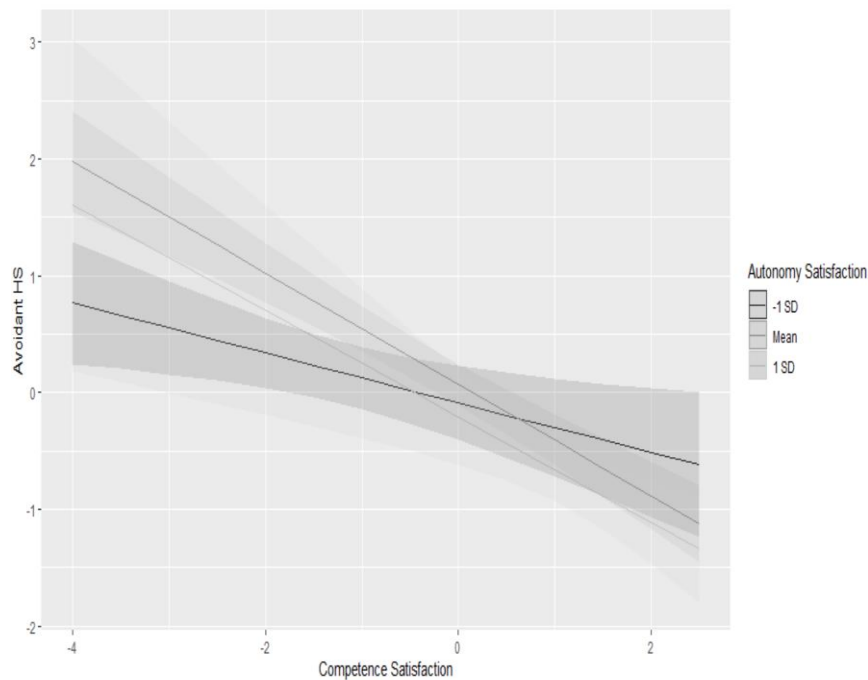

Figure 11. A simple-slopes plot of the interaction effect between Autonomy satisfaction and Competence Satisfaction on Avoidant Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 12. Simple-Slopes Analyses for Interaction Effects between Autonomy Satisfaction and Competence Satisfaction on Avoidant HS

β	SE	p
Slope of Competence Satisfaction when Autonomy Satisfaction = -1 SD		
-0.21	0.08	0.01
Slope of Competence Satisfaction when Autonomy Satisfaction = Mean		
-0.48	0.05	< .001
Slope of Competence Satisfaction when Autonomy Satisfaction = +1 SD		
-0.45	0.14	< .001

Interaction effects in the BPN frustration model. Most model fit indices of all six latent-interaction models were adequate or good, but the TLI was not acceptable; CFIs ranged from .906 to .912; TLIs .892 - .899; RMSEAs .042 - .044; and SRMRs .047 - .048. In terms of R-squared, the six latent-interaction models explained: 1) 9-13% of the variance in adaptive help seeking from the instructor/TA; 2) 8.6-8.9% of the variance in adaptive help seeking from peers; 3) 17-19% of expedient help seeking; and 4) 16-19% of avoidant help seeking. Model fit indices of each latent-interaction model were also shown in Table 7. Like the interaction effects in the BPN satisfaction model, the significance level for each latent-interaction term was adjusted using the Bonferroni correction to take account of the multiple analyses. There were four interaction effects between basic psychological need frustration variables for academic help seeking at the 0.008 significance level.

There were two interaction effects for *adaptive help seeking from the instructor/TA*. The first interaction was between autonomy frustration and relatedness frustration with the instructor/TA. Relatedness frustration with the instructor/TA was negatively associated with adaptive help seeking from the instructor/TA only when autonomy frustration was at the mean or 1 SD below the mean (βs = -.18 & -.32, ps = < .001 & .02, respectively; see Figure 12 & Table 13). However, there was no significant association between relatedness frustration with the instructor/TA and adaptive help seeking from the instructor/TA when autonomy frustration was 1 SD above the mean (β = .02, p = .83).

Figure 12. A simple-slopes plot of the interaction effect between Autonomy Frustration and Relatedness Frustration (In/TA) on Adaptive Help Seeking (In/TA). All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 13. Simple-Slopes Analyses for Interaction Effects between Autonomy Frustration and Relatedness Frustration (In/TA) on Adaptive HS (In/TA)

β	SE	p
Slope of Relatedness Frustration (In/TA) when Autonomy Frustration = -1 SD		
-0.32	0.14	0.02
Slope of Relatedness Frustration (In/TA) when Autonomy Frustration = Mean		
-0.18	0.05	< .001
Slope of Relatedness Frustration (In/TA) when Autonomy Frustration = +1 SD		
0.02	0.10	0.83

The second interaction for adaptive help seeking from the instructor/TA was between competence frustration and relatedness frustration with the instructor/TA. Relatedness frustration with the instructor/TA was negatively associated with adaptive help seeking from the instructor/TA only when competence frustration was at the mean or 1 SD below the mean (βs = -.18 & -.61, $p s$ = < .001, respectively; see Figure 13 & Table 14). There was no significant relation between the two variables when competence frustration was 1 SD above the mean (β = .00, p = .97).
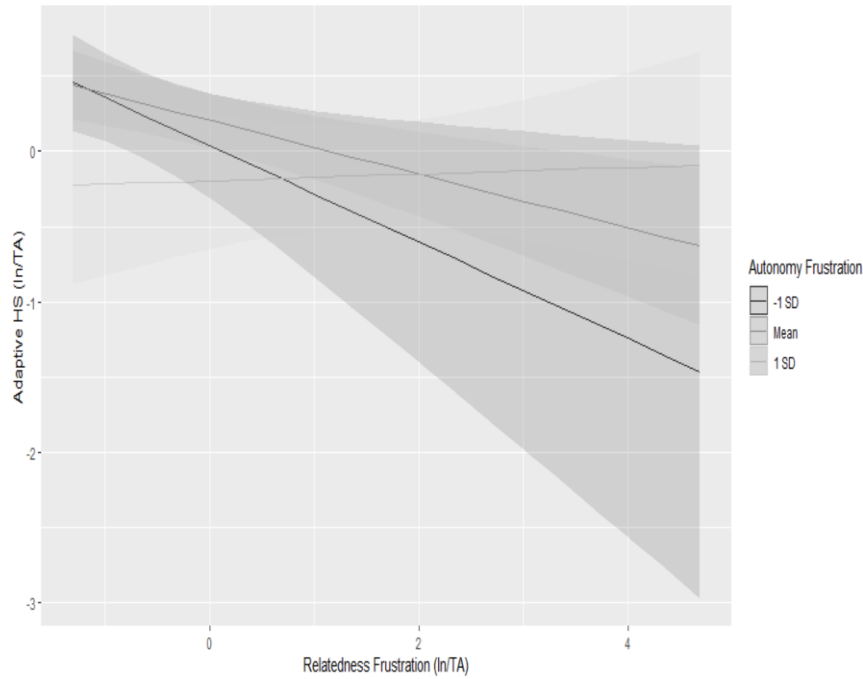
Figure 13. A simple-slopes plot of the interaction effect between Competence Frustration and Relatedness Frustration (In/TA) on Adaptive Help Seeking (In/TA). All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 14. Simple-Slopes Analyses for Interaction Effects between Competence Frustration and Relatedness Frustration (In/TA) on Adaptive HS (In/TA)

β	SE	p
Slope of Relatedness Frustration (In/TA) when Competence Frustration = -1 SD		
-0.61	0.15	< .001
Slope of Relatedness Frustration (In/TA) when Competence Frustration = Mean		
-0.18	0.06	< .001
Slope of Relatedness Frustration (In/TA) when Competence Frustration = +1 SD		
0.00	0.08	0.97

There was one interaction effect between competence frustration and autonomy frustration for *expedient help seeking*. Competence frustration had a positive relation to expedient help seeking only when autonomy frustration was at the mean or 1 SD below the mean (βs = .21 and .26, ps < .001, respectively; see Figure 14 & Table 15). When autonomy frustration was 1 SD above the mean, there was no significant association between the two variables (β = .04, p = .69).

57
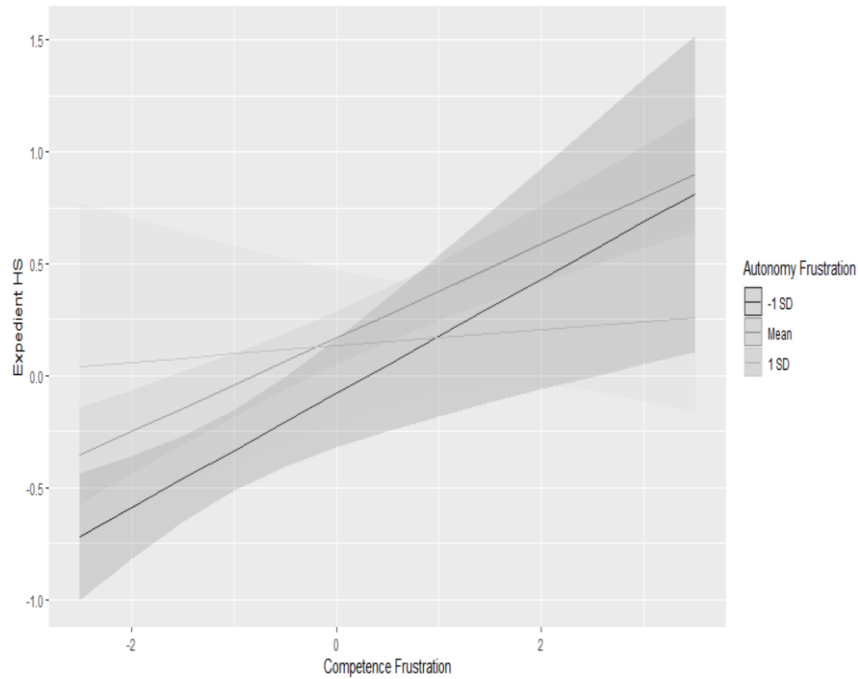
Figure 14. A simple-slopes plot of the interaction effect between Autonomy Frustration and Competence Frustration on Expedient Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 15. Simple-Slopes Analyses for Interaction Effects between Autonomy Frustration and Competence Frustration on Expedient HS

β	SE	p
Slope of Competence Frustration when Autonomy Frustration = -1 SD		
0.26	0.08	< .001
Slope of Competence Frustration when Autonomy Frustration = Mean		
0.21	0.03	< .001
Slope of Competence Frustration when Autonomy Frustration = +1 SD		
0.04	0.09	0.69

Finally, there was one interaction for *avoidant help seeking*. Specifically, competence frustration was positively associated with avoidant help seeking only when autonomy frustration was at the mean ($\beta = .31$, $p < .001$) or 1 SD below the mean ($\beta = .38$, $p < .001$), as shown in Figure 15 and Table 16. This positive relation did not exist when autonomy frustration was 1 SD above the mean ($\beta = .03$, $p = .83$).
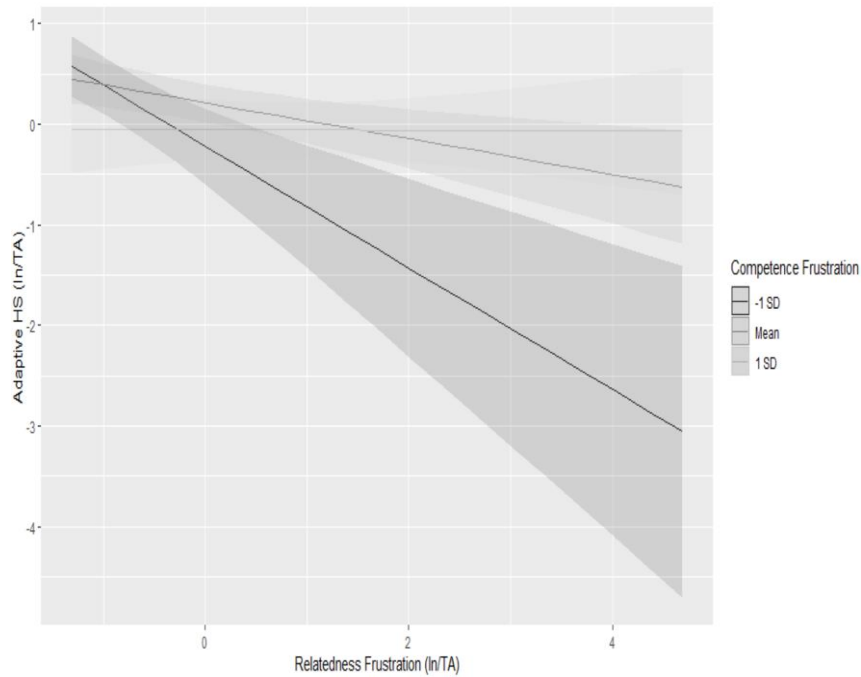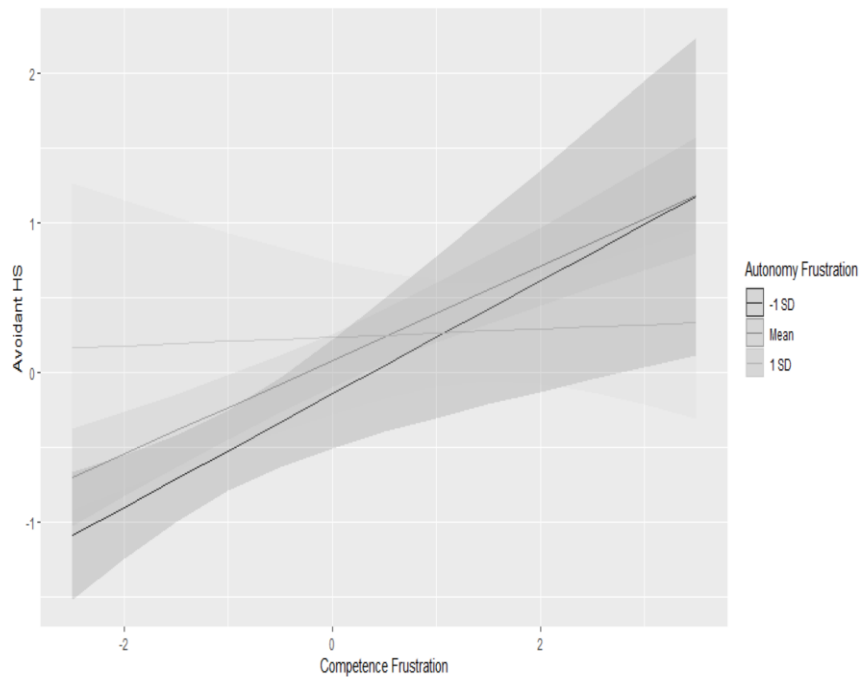
Figure 15. A simple-slopes plot of the interaction effect between Competence Frustration and Autonomy Frustration on Avoidant Help Seeking. All variables are mean-centered; scores on the x and y axes indicate extent of deviation from the mean. Additionally, 95% confidence bands are identified in the plot.

Table 16. Simple-Slopes Analyses for Interaction Effects between Autonomy Frustration and Competence Frustration on Avoidant HS

β	SE	p
Slope of Competence Frustration when Autonomy Frustration = -1 SD		
0.38	0.12	< .001
Slope of Competence Frustration when Autonomy Frustration = Mean		
0.31	0.05	< .001
Slope of Competence Frustration when Autonomy Frustration = +1 SD		
0.03	0.14	0.83

DISCUSSION

In this study I: 1) revised and created new academic help seeking measures including both in-person and online means of asking for help, 2) identified the factor structure of basic psychological needs and then examined 3) how different types of academic help seeking were associated with a sense of basic psychological need satisfaction and frustration in STEM courses that undergraduates perceived as challenging. This study adds to the literature in two ways. Specifically, it: (1) elaborates the factor structures of academic help seeking and basic psychological need by reflecting recent trends (i.e., asking help online and psychological need frustration, respectively) and (2) provides a richer explanation of how academic help seeking is related to three psychological needs through examining not only main effect of each need but also interaction effects between these needs.

Types and Sources of Academic Help Seeking of STEM Undergraduates

In this study I examined three types of academic help seeking (adaptive, expedient, and avoidant) engaged in by STEM undergraduates, together with a range of possible sources of help (from instructors or TAs, peers, unknown others). I also included both in-person and technology-mediated sources of help (e.g., email, web sites).

The results showed that when seeking adaptive help, students differentiated among different sources, according to whether help was sought from the instructor/TA, peers, or unknown others. By contrast, students did not differentiate among sources for expedient help seeking. That is, students perceived expedient help seeking from the instructor/TA and from peers as equivalent, whereas adaptive help seeking from the instructor/TA was distinct from the same type of help from peers. In addition, more disturbances were correlated among adaptive help seeking items within and across two sources. In other words, adaptive help seeking items shared some residuals in terms of mediums or similar wordings, indicating a more complicated picture of adaptive help seeking compared to expedient help seeking.

Such results are similar to those of Karabenick's (2003), where cluster analysis identified four groups of academic help seeking patterns with undergraduates in chemistry classes. Based on five help-seeking indicators (i.e., adaptive help seeking, expedient help seeking, target (formal), help-seeking threat, and help seeking avoidance), those four groups were 1) Strategic/Adaptive Formal, 2) Strategic/Adaptive Informal, 3) Non-Strategic, and 4) Avoidant. The Strategic/Adaptive Formal group included students who were likely to seek

adaptive help from instructors, whereas the Strategic/Adaptive Informal group indicated those who tended to engage in adaptive help from peers. Non-Strategic and Avoidant groups reflected low adaptive help seeking and more help-seeking expedience, avoidance, and threat, but were not distinguished by whether the source was formal or not. More studies of whether such different patterns of academic help seeking types and sources are replicated in other grade levels are needed.

Furthermore, students did not differentiate whether they sought adaptive help in person or electronically from the instructor/TA; the same pattern was found for seeking adaptive help from peers. However, in terms of help-seeking avoidance, students' in-class avoidant help seeking was distinct from them avoiding help seeking online. Two additional items for online help-seeking avoidance (i.e., searching things or doing activities that were not related to assignments) did not load on the measure of avoidant help seeking in class. More items will be needed to further investigate the online form of help-seeking avoidance.

Another interesting result in terms of avoidant help seeking involved the established avoidance measure that included items about "not asking someone for help" and either "guessing answer(s)" or "putting down any answer". However, in the present study, "not asking a specific source for help" did not load on the Avoidant Help Seeking factor, but rather loaded negatively on the Adaptive Help Seeking factor. "Not asking a specific source for help" is a passive form of help-seeking avoidance, whereas "guessing" or "putting down any answer" is a more active form which implies that students may not care about the completion of assignments or correct answers. Therefore, further research on avoidant help seeking needs to distinguish these two forms of help-seeking avoidance and pay more attention to the active form.

Structure of Basic Psychological Needs

Result of the CFA indicated that undergraduate STEM students perceived basic psychological need satisfaction and frustration in the classroom as qualitatively different. In particular, relatedness satisfaction and frustration were further distinguished based on the source of the relationship. That is, the 8-factor structure, which differentiates relatedness satisfaction with the instructor/TA and with peers, and relatedness frustration with the instructor/TA and with peers, explained the data better than the 6-factor structure model (which merged the two sources for relatedness satisfaction and relatedness frustration) did. This was consistent with recent studies that basic psychological need satisfaction was discrete

from basic psychological need frustration in other areas, such as in sport contexts (Bartholomew et al., 2011; Gunnell et al., 2013) and in general life (Chen et al., 2015). In particular, relatedness was further distinguished based on the sources. This result extends the structure of basic psychological need by elaborating different sources or targets of relatedness in the classroom. The result is also aligned with recent studies showing that differential relational sources are unique predictors of engagement and motivation across the grade levels (Furrer & Skinner, 2003; Legault et al., 2006; Wang & Eccles, 2012).

Gender and Grade

Female students were more likely to seek adaptive help from both the instructor/TA as well as from peers compared to male students. Such results appear in both the BPN Satisfaction and BPN Frustration Models and are also replicated in all latent-interaction models. Those results are also consistent with previous studies showing that, across grade levels and disciplines, female students were more adaptive seekers than male students were (Marchand & Skinner, 2007; Roussel et al., 2011; Ryan & Shim, 2012; Schenke et al., 2015).

Additionally, female students tended to engage in expedient help seeking more than male students did, according to the BPN Frustration Model. However, such a result was not replicated in the BPN Satisfaction Model. Furthermore, it is not consistent with previous studies that female students are less likely to seek expedient help than male students (Ryan & Shim, 2012; Schenke et al., 2015). Given that Schenke et al.'s (2015) were high schoolers in math courses, differences in developmental levels might explain the different results involving expedient help seeking and gender. However, since the result that female students were more likely to seek expedient help than male students was not replicated in the BPN Satisfaction Model, which showed a better fit than the BPN Frustration Model did, more studies are needed to clarify this issue.

There was no significant association between avoidant help seeking and gender in this study. This result is also contrary to previous studies whereby female students were less likely to avoid asking help than male students were (Middleton & Midgley, 1997; Schenke et al., 2015). Such an inconsistent result might be due to differences in participants' developmental levels.

In addition, as undergraduate STEM students move to a higher grade, they tend to use adaptive help seeking from the instructor/TA in this study. Such a result is shown in both the BPN Satisfaction and BPN Frustration Models and is replicated in all latent-interaction

models. Such results are consistent with Schenke et al. (2015) that high schoolers were more likely to ask adaptive help than middle schoolers were in math courses. This might be because the content is getting more difficult and students feel more capable of engaging in self-regulated learning as they advance to a higher grade in late adolescence (Won et al., 2019). However, some studies showed inconsistent results that students' adaptive help seeking declined developmentally from early to late adolescence (Lee et al., 2017; Marchand & Skinner, 2007; Ryan & Shim, 2012). Thus, more studies are needed to examine whether such inconsistent results are due to differences in developmental stages or disciplines.

Academic Help Seeking and Basic Psychological Need

This study examined how academic help seeking is associated with basic psychological need satisfaction and frustration. Both main effects and interaction effects demonstrated that basic psychological need satisfaction models explain the data better than the basic psychological need frustration models do, which has not been compared in other studies.

Academic Help Seeking and Basic Psychological Need Satisfaction

There were some synergistic effects between basic psychological need satisfaction for academic help seeking. In other words, associations between one basic psychological need satisfaction and academic help seeking became stronger when another basic psychological need satisfaction was met.

Adaptive Help Seeking from the Instructor/TA. In addition to two main effects of relatedness satisfaction with the instructor/TA, as well as from peers, there was one interaction effect between relatedness satisfaction with the instructor/TA and relatedness satisfaction with peers on adaptive help seeking from the instructor/TA. Students feeling a sense of relatedness with the instructor/TA tended to seek adaptive help from the instructor/TA only when they perceived some extent of relatedness satisfaction with their peers. If their relatedness satisfaction with peers was not met, the association between relatedness satisfaction with the instructor/TA and adaptive help seeking from the instructor/TA was no longer significant. That is, for relatedness satisfaction with the instructor/TA to be associated with adaptive help seeking from the instructor/TA, relatedness satisfaction with peers was needed.

Adaptive Help Seeking from Peers. There was one main effect of relatedness satisfaction with peers and no interaction effect on adaptive help seeking from peers. Students feeling close to peers were more likely to seek adaptive help from peers. This sole main effect on adaptive help seeking from peers was different from adaptive help seeking from the instructor/TA, which was associated not only with relatedness satisfaction with the instructor/TA but also with relatedness satisfaction with peers. That is, although adaptive help seeking from the instructor/TA and adaptive help seeking from peers are the same type of academic help seeking, they are related to basic psychological need satisfaction differently.

Expedient Help Seeking. There were three main effects and three interaction effects for expedient help seeking. Interaction effects showed that two main effects of competence satisfaction and relatedness satisfaction with the instructor TA had a negative association with expedient help seeking were stronger when students felt some extent of autonomy satisfaction. In addition, students who met a sense of competence satisfaction were less likely to seek expedient help, but only when they felt close to the instructor/TA. If their relatedness satisfaction with the instructor/TA was low, such a relation did not exist anymore. Relatedness satisfaction with the instructor/TA not only had a negative association with expedient help seeking, which was moderated by autonomy satisfaction, but also moderated the negative relation between competence satisfaction and expedient help seeking.

Avoidant Help Seeking. There were two main effects of competence satisfaction and relatedness satisfaction with peers, as well as one interaction effect. According to the interaction effects, the main effect that students feeling competent were less likely to avoid help was increased when their autonomy satisfaction met. That is, competence satisfaction was sufficient itself for students not to avoid asking help, but feeling autonomous played a function as catalysts for this association.

Academic Help Seeking and Basic Psychological Need Frustration

Adaptive Help Seeking from the Instructor/TA. There was a main effect of relatedness frustration with the instructor/TA on adaptive help seeking from the instructor/TA. However, interaction effects demonstrated that such an association was shown only when autonomy frustration or competence frustration was at or below the mean. This means that students feeling disconnected with the instructor/TA were less likely to seek adaptive help from the instructor/TA; but autonomy frustration or competence frustration was needed as a moderator.

Adaptive Help Seeking from Peers. There was only one main effect of relatedness frustration with peers on adaptive help seeking from peers. In other words, students feeling excluded or disconnected from peers did not tend to seek adaptive help from peers. However, there was no interaction effect between psychological need frustration on adaptive help seeking from peers like the BPN satisfaction model.

Expedient Help Seeking. There were main effects of competence frustration and relatedness frustration with the instructor/TA, as well as with peers, on expedient help seeking. One interaction effect showed that the main effect of competence frustration was shown only when autonomy frustration was at or below the mean. That is, a moderating role of autonomy frustration was needed for competence frustration to play a part in expedient help seeking.

Avoidant Help Seeking. There was a main effect of competence frustration on avoidant help seeking; students who felt their competence need frustrated were more likely to avoid seeking help. One interaction effect demonstrated that such a positive main effect existed only when autonomy frustration was at or below the mean. In other words, autonomy frustration as a moderator was needed for competence frustration to play a role in help seeking avoidance.

Summary of Academic Help Seeking and Basic Psychological Need for STEM Students

Given the main effects and interaction effects of basic psychological need in both models, there were important findings. First, according to the main effects, the need for autonomy did not play a main role in academic help seeking; its satisfaction was associated only with expedient help seeking and its frustration was not significantly related to any type of help seeking. However, autonomy was a prominent moderator; autonomy satisfaction was included in 3 of the 5 significant interactions and autonomy frustration was involved in 3 of the 4 significant interactions. This is in contrast with previous studies that found that autonomy satisfaction itself had a main effect on motivation and engagement (Ciani et al., 2011; Marchand & Skinner, 2007). Further studies examining whether such a result can be only applied to academic help seeking of undergraduate STEM students in challenging courses are needed.

The need for competence played a main role in two maladaptive types of academic help seeking; main effects showed that both competence satisfaction and frustration were significantly associated with expedient help seeking and help-seeking avoidance, but not with

the two adaptive help seeking types. In particular, competence was the best predictor of avoidant help seeking. The effect size for the association between competence satisfaction and avoidant help seeking was large ($\beta = -.45$, $p < .001$); and competence frustration was also positively related to avoidant help seeking. Such results are consistent with the finding that perceived incompetence was the most influential among three psychological needs in predicting whether elementary and middle school students concealed their academic difficulties and did not ask for help (Marchand and Skinner, 2007). Previous studies also supported such an association between competence need and help-seeking avoidance in that students with low competence were less likely to ask help, while those with high competence were more willing to seek help if they needed in elementary and middle schools (Ryan et al., 1998; Ryan et al., 2005). Furthermore, competence was involved in most interactions for the two maladaptive types of help seeking; competence satisfaction was included in 3 of the 4 significant interactions on and competence frustration was involved in 2 significant interactions on expedient and avoidant help seeking. Although there was no main effect of competence for adaptive help seeking, it moderated the relations between relatedness with the instructor/TA and adaptive help seeking from the instructor/TA.

The need for relatedness, which has received less attention in SDT research compared to autonomy and competence needs, played an important role in academic help seeking. In particular, relatedness was the best predictor of adaptive help seeking; relatedness with the instructor/TA was significantly associated with adaptive help seeking from the instructor/TA, whereas relatedness with peers was significantly related to adaptive help seeking from peers. This is consistent with Marchand and Skinner's (2007) finding that relatedness satisfaction was most influential in predicting early adolescents' adaptive help seeking.

In addition to main effects, in the present study relatedness satisfaction with the two sources interacted with each other to promote adaptive help seeking from the instructor/TA. Relatedness satisfaction with peers played an important role in not only adaptive help seeking from peers, but also in adaptive help seeking from the instructor/TA through main effects as well as interaction effects. According to Vasconcellos et al.'s (2019) meta-analyzing research on SDT within physical education class, students' overall relatedness in PE class were from teachers and peers, but more from peers. Teachers were the source of relatedness, but the more powerful source for autonomy and competence needs in class, whereas peers had a greater impact on perceived relatedness than teachers did in class. Therefore, it could be hypothesized that relatedness satisfaction with differential sources played a unique role in

adaptive help seeking, and feeling connected to peers was associated with overall adaptive help seeking via contributing more to overall relatedness in class.

Moreover, relatedness satisfaction with the instructor/TA played a role in expedient help seeking through main effects as well as interaction effects. It was involved in 2 of the 3 interactions on expedient help seeking. In other words, emotional relationships that STEM students perceive in challenging math courses are essential for motivation and engagement. Students generally have to learn a lot of difficult math content during one semester. Many challenging tasks and assignments may make relationships they experience in courses more task oriented. However, this study emphasizes STEM students' relatedness satisfaction for adaptive motivation in difficult courses. In addition, if the two sources (i.e., instructor/TA and peers) had been combined, we would not have learned how each source played a unique role in academic help seeking. Particularly, this study investigated how each source interacted with each other to be associated with adaptive forms of engagement, extending previous studies showing how differential relational sources were independently associated with motivation and engagement (Furrer & Skinner, 2003; Song et al., 2015).

In summary, this study shows a complicated and dynamic picture of basic psychological needs for academic help seeking of STEM undergraduates; one psychological need is moderated by another psychological need on the one hand, and moderates the association between another psychological need and academic help seeking on the other hand. In addition, this study builds on previous studies of academic help seeking that have primarily focused on main effects of competence or relatedness needs, through examining interaction effects between these psychological needs and with autonomy need.

Implications for University Educators

Although both BPN Satisfaction and Frustration Models showed adequate model fits, the BPN Satisfaction Model was better at explaining different types of academic help seeking based on the SDT perspective. That is, as educators, it is important to eliminate the factors in class that make students feel thwarted in terms of their BPN, but it is even more essential to emphasize and make explicit the factors that promote their BPN satisfaction in class (e.g., positive competence-enhancing feedback). In particular, given that students are more likely to engage in adaptive help seeking from the instructor/TA when they perceive both the instructor/TA and peers as meeting their relatedness need in class, interventions for fostering academic help seeing would be best implemented with building relatedness with the

67

instructor/TA coupled with collaborative learning environments. However, educators also need to consider types or purposes of course evaluation systems. For example, it is important to consider whether peers would still be one of the main sources for academic help seeking in courses are graded on a curve or used to select students for more advanced courses or programs, or whether relatedness or cooperation with peers would still be related to asking peers for help in competitive environments. According to Makara and Karabenick (2013a), students' expectation of whether a specific source will give help or not influences their help seeking behaviors. If grading is normative (i.e., students compete with each other for limited grades at each level), they are less likely to expect that they can receive academic help from their peers and patterns of academic help seeking would likely be different.

Limitations and Directions for the Future Study

First, like many previous studies on academic help seeking, this study used student self-reports to measure their academic help seeking behaviors. There are a few studies using other methods, such as observations and experiments (e.g., Butler & Neuman, 1995) to measure help seeking behaviors. More studies with diverse methods will be needed to have a better understanding of how students seek academic help in a specific context.

Second, the average score for the previous semester's GPA reported by sophomore to senior participants ($n = 478$) was 3.42/4.00. Based on the grading system in that university, 3.42/4.0 was slightly above a B+ (3.3). In addition, given that a median GPA was 3.5 and this data was negatively skewed, most participants in this study were higher achievers than an average. Thus, results in this study may be best applied to the limited range of the population, a high-performing group of students, and more studies with diverse samples in the challenging STEM course will be needed.

Third, although one adaptive help seeking online item was not used in this study because it did not load on any latent variable of adaptive help seeking, students reported that they used search engines or online encyclopedias the most when they needed help for assignments. The average score for this item was 6.09 on a 7-point Likert scale. The median was 7 and these data were negatively skewed. Therefore, further studies of how students used search engines or online encyclopedias to receive adaptive help are needed. For example, how do students perceive adaptive help seeking online as different from adaptive help seeking from relational sources? Does adaptive help seeking online show similar patterns in relations with motivational variables with adaptive help seeking from relational sources? In

addition, since two avoidant help seeking online items also did not load on the traditional form of help-seeking avoidance, more studies examining students' help-seeking avoidance online are needed through qualitative studies or adding more items.

Finally, this study demonstrated that emotional aspects of relationships with the instructor/TA and peers, which have been underemphasized in higher education settings, were important for adaptive help seeking. In studies on academic help seeking of college students, instructional support has mainly examined classroom goal structure (Karabenick, 2004) or instructor support for asking questions (Karabenick, 1994; Karabenick & Sharma, 1994), in contrast to studies with K-12 students that focus on various aspects of relationships (Marchand & Skinner, 2007; Newman & Schwager, 1993; Shim et al., 2013). This might be because there is less chance to form a close relatedness with the instructor/TA and peers due to many large-sized lectures and shorter-term semesters (i.e., six months) in college compared to in K-12 education settings. However, feeling emotionally connected with the instructor/TA and peers was also important for undergraduates to seek adaptive help in their challenging courses. Thus, further studies on emotional relatedness with the instructor/TA and peers in class will contribute to understanding how to encourage undergraduates to seek adaptive help. This may include identifying instructor/TA or peer behaviors or discourse that students perceive as creating a close and comfortable class environment, or the kind of activities and tasks that promote a sense of relatedness with the instructor/TA or peers in difficult STEM courses.

REFERENCES

Aleven, V., McLaren, B. M., & Koedinger, K. R. (2006). Toward computer-based tutoring of help-seeking skills. In S. A. Karabenick, & R. S. Newman (Eds.), *Help seeking in academic settings: Goals, groups, and contexts* (pp. 255-291). Mahwah, N.J.: Lawrence Erlbaum.

Arminger, G., & Schoenberg, R. (1989). Pseudo maximum likelihood estimation and a test for misspecification in mean and covariance structure models. *Psychometrika, 54*, 409-426.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261-271.

Bartholomew, K., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin, 37*, 1459-1473.

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education, 84*, 740-756.

Butler, R., & Neuman, O. (1995). Effects of task and ego achievement goals on help-seeking behaviors and attitudes. *Journal of Educational Psychology, 87*, 261-271.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E., Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, R., Sheldon, K., Soenens, B., Petegem, S., & Verstuyf, J. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion, 39*, 216-236.

Cheng, K., & Tsai, C. (2011). An investigation of Taiwan university students' perceptions of online academic help seeking, and their web-based learning self-efficacy. *Internet and Higher Education, 14*(3), 150-157.

Ciani, K. D., Sheldon, K. M., Hilpert, J. C., & Easter, M. A. (2011). Antecedents and trajectories of achievement goals: A self-determination theory perspective. *British Journal of Educational Psychology, 81*, 223-243.

Cockcroft Committee. (1982). *Mathematics Counts*, HMSO, London.

Coenders, G., Batista-Foguet, J. M., & Saris, W. E. (2008). Simple, efficient and distribution-free approach to interaction effects in complex structural equation models. *Quality & Quantity, 42*, 369-396.

Costa, S., Ntoumanis, N., & Bartholomew, K. (2015). Predicting the brighter and darker sides of interpersonal relationships: Does psychological need thwarting matter? *Motivation and Emotion, 39*, 11-24.

Daempfle, P. A. (2003). An analysis of the high attrition rates among first year college science, math, and engineering majors. *Journal of College Student Retention: Research, Theory, and Practice, 5*, 37-52.

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality, 19*, 109-134.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*, 325-346.

Dennis, J. M., Phinney, J. S., & Chuateco, L. I. (2005). The role of motivation, parental support, and peer support in the academic success of ethnic minority first-generation college students. *Journal of College Student Development, 46*, 223-236.

Drew, C. (2011, November 4). Why science majors change their minds (It's just so darn hard). *The New York Times,* p. ED16. http://www.nytimes.com/2011/11/06/education/edlife/ why-science-majors-change-their-mind-its-just-so-darnhard.html?pagewanted=all&_r=0

Dysvik, A., Kuvaas, B., & Gagné, M. (2013). An investigation of the unique, synergistic and balanced relationships between basic psychological needs and intrinsic motivation. *Journal of Applied Social Psychology, 43*, 1050-1064.

Earl, S. R., Taylor, I. M., Meijen, C., & Passfield, L. (2017). Autonomy and competence frustration in young adolescent classrooms: Different associations with active and passive disengagement. *Learning and Instruction, 49*, 32-40.

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin, 21*, 215-225.

Freeman, T. M., Anderman, L. H., & Jensen, J. M. (2007). Sense of belonging in college freshmen at the classroom and campus levels. *The Journal of Experimental Education, 75*, 203-220.

Froiland, J. M. & Oros, E. (2014). Intrinsic motivation, perceived competence and classroom engagement as longitudinal predictors of adolescent reading achievement. *Educational Psychology, 34,* 119-132.

Froiland, J. M. & Worrell, F. C. (2016). Intrinsic motivation, learning goals, engagement, and achievement in a diverse high school. *Psychology in the Schools, 53,* 321-336.

Froiland, J., Worrell, F., & Oh, H. (2019). Teacher-student relationships, psychological need satisfaction, and happiness among diverse students. *Psychology in the Schools, 56*, 856-870.

Furrer, C., & Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology, 95*, 148-162.

Gillet, N., Lafrenière, M., Vallerand, R. J., Huart, I., & Fouquereau, E. (2014). The effects of autonomous and controlled regulation of performance-approach goals on well-being: A process model. *British Journal of Social Psychology, 53*, 154-174.

Gonida, E. N., Karabenick, S. A., Makara, K. A., & Hatzikyriakou, G. A. (2014). Perceived parent goals and student goal orientations as predictors of seeking or not seeking help: Does age matter? *Learning and Instruction, 33*, 120-130.

Gunnell, K. E., Crocker, P., Wilson, P. M., Mack, D. E., & Zumbo, B. D. (2013). Psychological need satisfaction and thwarting: A test of Basic Psychological Needs Theory in physical activity contexts. *Psychology of Sport & Exercise, 14*, 599-607.

Holdren, J. P., & Lander, E. S. (2012). *Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics (Executive Report)*. Washington, D.C.: President's Council of Advisors on Science and Technology.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Hull, C. L. (1943). *Principles of behavior: An introduction to behavior theory*. New York: Appleton-Century-Crofts.

Jang, H., Kim, E. J., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction, 43*, 27-38.

Jang, H., Reeve, J., Ryan, R., & Kim, A. (2009). Can self-determination theory explain what underlies the productive, satisfying learning experiences of collectivistically oriented Korean students? *Journal of Educational Psychology, 101*, 644-661.

Karabenick, S. A. (1994). Relation of perceived teacher support of student questioning to students' beliefs about teacher attributions for questioning and perceived classroom learning environment. *Learning and Individual Differences, 6*, 187-204.

Karabenick, S. A. (2003). Seeking help in large college classes: A person-centered approach. *Contemporary Educational Psychology, 28*, 37-58.

Karabenick, S. A. (2004). Perceived achievement goal structure and college student help seeking. *Journal of Educational Psychology, 96*, 569-581.

Karabenick, S. A., & Knapp, J. R. (1991). Relationship of academic help seeking to the use of learning strategies and other instrumental achievement behavior in college students. *Journal of Educational Psychology, 83*, 221-230.

Karabenick, S., & Puustinen, M. (2013). *Advances in help-seeking research and applications the role of emerging technologies*. Charlotte, N.C.: Information Age Pub.

Karabenick, S. A., & Sharma, R. (1994). Perceived teacher support of student questioning in the college classroom: Its relation to student characteristics and role in the classroom

questioning process. *Journal of Educational Psychology, 86*, 90-103.

Karimi, S., & Sotoodeh, B. (2019). The mediating role of intrinsic motivation in the relationship between basic psychological needs satisfaction and academic engagement in agriculture students. *Teaching in Higher Education*, https://doi.org/10.1080/13562517.2019.1623775

Knapp, J., & Karabenick, S. A. (1988). Incidence of formal and informal academic help-seeking in higher education. *Journal of College Student Development, 29*, 223-227.

Komarraju, M., Karau, S. J., & Schmeck, R. R. (2009). Role of the Big Five personality traits in predicting college students' academic motivation and achievement. *Learning and Individual Differences, 19*, 47-52.

Komorraju, M., Musulkin, S., & Bhattacharya, G. (2010). The role of student-faculty interactions in developing college students' academic self-concept, motivation, and achievement. *Journal of College Student Development, 51*, 332-342.

Lee, H. J., Bong, C., & Hong, S. (2017). The long-term effects of early adolescents' achievement goals on help-seeking behavior development and college academic engagement and achievement [청소년 초기 성취목표가 도움요청행동 발달과 대학 학업참여 및 성취에 미치는 장기적 효과]. *Studies on Korean Youth [한국청소년연구], 28*(4), 137-165.

Legault, L., Green-Demers, I., & Pelletier, L. (2006). Why do high school students lack motivation in the classroom? Toward an understanding of academic amotivation and the role of social support. *Journal of Educational Psychology, 98*, 567-582.

Lin, G., Wen, Z., Marsh, H. W., & Lin, H. (2010). Structural equation models of latent interactions: Clarification of orthogonalizing and double-mean-centering strategies. *Structural Equation Modeling: A Multidisciplinary Journal, 17*, 374-391.

Makara, K. A., & Karabenick, S. A. (2013a). Characterizing sources of academic help in the age of expanding educational technology: A new conceptual framework. In S. A. Karabenick & M. Puustinen (Eds.), *Advances in help-seeking research and applications: The role of emerging technologies* (pp. 37-72). Charlotte, NC: Information Age.

Makara, K. A., & Karabenick, S. A. (2013b, August). *A plethora of personal and impersonal online and non-online academic help seeking sources in higher education*. Presented at the European Association of Research on Learning and Instruction, Munich, Germany.

Marchand, G., & Skinner, E. A. (2007). Motivational dynamics of children's academic help-seeking and concealment. *Journal of Educational Psychology, 99*, 65-82.

Marsh, H. W., Wen, Z., & Hau, K. (2004). Structural equation models of latent interactions: Evaluation of alternative estimation strategies and indicator construction. *Psychological Methods, 9*, 275-300.

Micari, M., & Pazos, P. (2012). Connecting to the professor: Impact of the student-faculty

relationship in a highly challenging course. *College Teaching, 60*, 41-47.

Middleton, M. J., & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *Journal of Educational Psychology, 89*, 710-718.

Nelson-Le Gall, S. (1981). Help-seeking: An understudied problem-solving skill in children. *Developmental Review, 1*, 224-246.

Newman, R. S. (1998a). Adaptive help seeking: A role of social interaction in self-regulated learning. In S. A. Karabenick (Ed.), *Strategic help seeking: Implications for learning and teaching* (pp. 13-37). Mahwah, NJ: Erlbaum.

Newman, R. S. (1998b). Students' help seeking during problem solving: Influences of personal and contextual achievement goals. *Journal of Educational Psychology, 90*, 644-658.

Newman, R. S., & Schwager, M. T. (1993). Students' perceptions of the teacher and classmates in relation to reported help seeking in math class. *The Elementary School Journal, 94*, 3-17.

Pajares, F., Cheong, Y. F., & Oberman, P. (2004). Psychometric analysis of computer science help seeking scales. *Educational and Psychological Measurement, 64*, 496-514.

Rocchi, M., Pelletier, L., Cheung, S., Baxter, D., & Beaudry, S. (2017a). Assessing need-supportive and need-thwarting interpersonal behaviours: The Interpersonal Behaviours Questionnaire (IBQ). *Personality and Individual Differences, 104*, 423-433.

Rocchi, M., Pelletier, L., & Desmarais, P. (2017b). The validity of the Interpersonal Behaviors Questionnaire (IBQ) in sport. *Measurement in Physical Education and Exercise Science, 21*(1), 15-25.

Roussel, P., Elliot, A. J., & Feltman, R. (2011). The influence of achievement goals and social goals on help-seeking from peers in an academic context. *Learning and Instruction, 21*(3), 394-403.

Ryan, R., & Deci, E. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press.

Ryan, A. M., Gheen, M. H., & Midgley, C. (1998). Why do some students avoid asking for help? An examination of the interplay among students' academic efficacy, teachers' social-emotional role, and the classroom goal structure. *Journal of Educational Psychology, 90*, 528-535.

Ryan, A. M., Hicks, L., & Midgley, C. (1997). Social goals, academic goals, and avoiding seeking help in the classroom. *The Journal of Early Adolescence, 17*, 152-171.

Ryan, A. M., Patrick, H., & Shim, S. (2005). Differential profiles of students identified by their teacher as having avoidant, appropriate, or dependent help-seeking tendencies in the classroom. *Journal of Educational Psychology, 97*, 275-285.

Ryan, A. M., & Pintrich, P. R. (1997). Should I ask for help? The role of motivation and

attitudes in adolescents' help seeking in math class. *Journal of Educational Psychology, 89*, 329-341.

Ryan, A. M., & Pintrich, P. R. (1998). Achievement and social motivational influences on help seeking in the classroom. In S. A. Karabenick (Ed.), *Strategic help seeking: Implications for learning and teaching* (pp. 117-139). Mahwah, NJ: Lawrence Erlbaum Associates.

Ryan, A. M., & Shim, S. S. (2012). Changes in help seeking from peers during early adolescence: Associations with changes in achievement and perceptions of teachers. *Journal of Educational Psychology, 104*, 1122-1134.

Ryan, A. M., & Shin, H. (2011). Help-seeking tendencies during early adolescence: An examination of motivational correlates and consequences for achievement. *Learning and Instruction, 21*, 247-256.

Schenke, K., Lam, A. C., Conley, A. M., & Karabenick, S. A. (2015). Adolescents' help seeking in mathematics classrooms: Relations between achievement and perceived classroom environmental influences over one school year. *Contemporary Educational Psychology, 41*, 133-146.

Shim, S., Kiefer, S. M., & Wang, C. (2013). Help seeking among peers: The role of goal structure and peer climate. *The Journal of Educational Research, 106*, 290-300.

Song, J., Bong, M., Lee, K., & Kim, S. (2015). Longitudinal investigation into the role of perceived social support in adolescents' academic motivation and achievement. *Journal of Educational Psychology, 107*, 821-841.

Stodolsky, S. S., Salk, S., & Glaessner, B. (1991). Student views about learning math and social studies. *American educational research journal, 28*, 89-116.

Tian, L., Chen, H., & Huebner, E. S. (2014). The longitudinal relationships between basic psychological needs satisfaction at school and school-related subjective well-being in adolescents. *Social Indicators Research, 119*, 353-372.

Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology, 94*, 88-106.

Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion, 44*, 1-31.

Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2019). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology.* Advance online publication. https://doi.org/10.1037/edu0000420

Wang, M., & Eccles, J. S. (2012). Social support matters: Longitudinal effects of social support on three dimensions of school engagement from middle to high school. *Child*

Development, 83, 877-895.

Wang, Y., Tian, L., & Huebner, E. S. (2019). Basic psychological needs satisfaction at school, behavioral school engagement, and academic achievement: Longitudinal reciprocal relations among elementary school students. *Contemporary Educational Psychology, 56*, 130-139.

Won, S., Hensley, L. C., & Wolters, C. A. (2019). Brief research report: Sense of belonging and academic help-seeking as self-regulated learning. *Journal of Experimental Education,* https://doi.org/10.1080/00220973.2019.1703095

Won, S., Wolters, C. A., & Mueller, S. A. (2018). Sense of belonging and self-regulated learning: Testing achievement goals as mediators. *The Journal of Experimental Education, 86*, 402-418.

Wu, Y., Wen, Z., Marsh, H. W., & Hau, K. T. (2013). A comparison of strategies for forming product indicators for unequal numbers of items in structural equation models of latent interactions. *Structural Equation Modeling*, *20*, 551-567.

Yuan, K.-H., & Hayashi, K. (2006). Standard errors in covariance structure models: Asymptotics versus bootstrap. *British Journal of Mathematical and Statistical Psychology, 59*, 397-417.

APPENDIX A. MEASURES OF DEMOGRAPHICS, ACADEMIC HELP SEEKING, BASIC PSYCHOLOGICAL NEED SATISFACTION AND FRUSTRATION IN MAJOR COURSE

Demographics
Please tell us a little about yourself.

1. What is your gender?
_____ Male
_____ Female

2. What is your class standing?
_____ Freshman
_____ Sophomore
_____ Junior
_____ Senior

3. What is your ethnicity?
_____ White
_____ Hispanic or Latino/a
_____ African American or Black
_____ Native American or American Indian
_____ Asian/Pacific Islander
_____ Other

4. What is your major? _____

5. What was your high school GPA? _____

6. If you are not a Freshman, what was your previous semester's GPA? _____

Answer the Next Questions with a Specific Course in Mind.
For this survey please answer the questions **thinking about a specific course you are taking this semester for your STEM major that has** *at least 3 assignments involving mathematics*.
If you are taking more than 1 class like this, please choose the most difficult.

1. What is the Course Number and Name? _____

2. How difficult is this course?
   1 = *Very easy*
   2 = *Easy*
   3 = *Slightly easy*
   4 = *Neutral*
   5 = *Slightly difficult*
   6 = *Difficult*
   7 = *Very difficult*

3. How often do you need help doing difficult mathematical assignments in this course?
    1 = *Never*
    2 = *Rarely (less than 10% of the time)*
    3 = *Occasionally (about 30% of the time)*
    4 = *Sometimes (about 50% of the time)*
    5 = *Frequently (about 70% of the time)*
    6 = *Usually (about 90% of the time)*
    7 = *Every Time*

Think about the most difficult course you are taking for your STEM major that involves at least 3 assignments with mathematics.
In this course, **think about times when you need help doing difficult *mathematical assignments*** and **ask someone** (e.g., instructor, teaching assistant, or student) **in that course <u>in person</u>** (i.e., not electronically).

How true are each of these statements for you?
    1 = *Completely false*
    2 = *Somewhat false*
    3 = *Slightly false*
    4 = *Neither true nor false*
    5 = *Slightly true*
    6 = *Somewhat true*
    7 = *Completely true*

When I don't understand part of an assignment I ….
1. ask the instructor or TA to explain specific concepts or general ideas I don't understand, but not give me the answer.
2. ask another student to just give me the answer, without explaining how to do the problem myself.
3. guess or put down any answer and don't ask anyone for help.
4. try to get hints or clues, but not the answer, from another student(s).*
5. ask someone I know who is <u>not</u> in this course to do the difficult parts for me.**
6. don't ask the TA or instructor for help with the assignment.
7. ask another student to do the difficult parts of assignments for me, without explaining how to do them.
8. ask someone I know who is <u>not</u> in this course to explain specific concepts or general ideas I don't understand, but not give me the answer.***
9. try to get the answer from the instructor or TA without an explanation of how to do it myself.
10. don't ask another student in this course for help with the assignment, either during or after class.
11. prefer to be given hints or clues, but not the answer, from the instructor or TA.*
12. don't ask someone I know who is <u>not</u> in this course for help.***
13. prefer the instructor or TA do the difficult parts of assignments for me, rather than explain how to do them.
14. skip difficult parts of assignments and don't ask anyone for help.
15. ask another student to help me understand specific concepts or general ideas needed for the assignment, but not tell me the answer.

In this course, think about times **when you need help doing difficult *mathematical assignments*** and **use web-based tools** (e.g., computer or a cell phone) **for help**.

How true are each of these statements for you?
> 1 = *Completely false*
> 2 = *Somewhat false*
> 3 = *Slightly false*
> 4 = *Neither true nor false*
> 5 = *Slightly true*
> 6 = *Somewhat true*
> 7 = *Completely true*

When I don't understand part of an assignment I ….
1. message or e-mail someone I know who is <u>not</u> in this course for the answer.**
2. e-mail or post questions to the instructor or TA to get hints or clues, but not the answer.
3. search for things that are not related to assignments using search engines or encyclopedias.*
4. try to find the answer(s) using search engines (e.g., Google).*
5. message or e-mail someone I know who is <u>not</u> in this course for an explanation of concepts I don't understand, but not tell me the answer.***
6. don't e-mail or post questions to unknown experts for help with the assignment.**
7. message, e-mail, or post questions to another student(s) in the course to get the answer(s), rather than an explanation of how to do it myself.
8. don't message or e-mail someone I know who is <u>not</u> in this course for help with the assignment.***
9. e-mail or post questions to another student(s) to get an explanation of concepts or information that I don't understand, but not the answer.
10. message, e-mail, or post to the instructor or TA so they do the difficult parts for me, rather than explain the material so I can do the assignment on my own.
11. do activities online that are not related to assignments (e.g., online shopping, game).*
12. e-mail or post questions to an unknown expert(s) to get an explanation of concepts or general ideas needed for the assignment, but not the answer.***
13. don't message, e-mail, or post questions to another student in the course for help with the assignment.
14. message, e-mail, or post questions to unknown experts to get the answer(s), rather than to explain the content related to the assignment.***
15. don't message, e-mail, or post questions to the TA or instructor for help with the assignment.
16. use search engines or on-line encyclopedias (e.g., Google, YouTube) to find information that will help me understand the content better.*

Reminder: When answering please think about the most difficult course you are taking for your STEM major that involves at least 3 assignments with mathematics.
You are nearly finished; this is the last page of questions.
When you read questions below, think about **how you generally feel about this course.**

How true are each of these statements for you?
> 1 = *Completely false*
> 2 = *Somewhat false*
> 3 = *Slightly false*

4 = *Neither true nor false*
5 = *Slightly true*
6 = *Somewhat true*
7 = *Completely true*

In this course I feel …..
1. confident in my abilities to perform activities that personally challenge me.
2. comfortable with the instructor.
3. free to do tasks and activities in my own way.
4. that other students are dismissive of me.
5. good about the way I am able to complete challenging activities.
6. there are times when I feel activities, tasks, or other people get in the way of my learning.
7. that I can't do tasks or activities the way that I want to.
8. comfortable with the TA.
9. like I have a say in choosing tasks and activities that I do.
10. that the instructor or TA doesn't like me.
11. comfortable with the other students.
12. there are situations where I am made to feel inadequate.
13. pushed to do tasks or activities in certain ways.
14. that I like the instructor.
15. that the instructor or TA is dismissive of me.
16. I feel incapable because I am not given opportunities to do my best.
17. free to make decisions and choices about tasks and activities.
18. that I respect the TA.
19. that I can complete tasks and activities that are personally challenging.
20. excluded from the group of students I want to be part of.
21. situations occur in which I am made to feel incompetent.
22. that I respect the instructor.
23. under pressure to agree with the instructor.
24. like I can decide how I do the course work.
25. that other students don't like me.
26. that I like the TA.
27. a sense of camaraderie with other students.
28. that other students don't want to interact with me.
29. prevented from making choices about to the way do tasks or activities.
30. that I can successfully complete difficult tasks and activities.
31. connected to other students.
32. that the instructor or TA doesn't want to interact with me.

APPENDIX B. ORIGINAL MEASURES OF ACADEMIC HELP SEEKING, AND BASIC PSYCHOLOGICAL NEED SATISFACTION AND FRUSTRATION

Academic Help Seeking (Pajares et al., 2004)

Instrumental Help Seeking

1. When I ask my computer science teacher for help, I prefer to be given hints or clues rather than the answer.
2. When I am having trouble and ask the computer science teacher for help, I like to be given examples of similar problems we have done.
3. When I ask the teacher for help with something I don't understand, I ask the teacher to explain it to me rather than just give me the answer.
4. When I ask my teacher for help in this class, I only want as much help as necessary to complete the work myself.
5. When I ask my teacher for help understanding the material in this class, I prefer that the teacher help me understand the general ideas rather than simply tell me the answer.
6. When I ask a student for help with my computer science work, I don't want that student to give away the whole answer.
7. When I ask a student for help understanding the material in this class, I prefer that the student help me understand the general ideas rather than simply tell me the answer.
8. When I ask a student for help in this class, I want to be helped to complete the work myself rather than have the work done for me.
9. When I ask a student for help in this class, I prefer to be given hints or clues rather than the answer.
10. When I ask a student for help with something I don't understand, I ask the student to explain it to me rather than just give me the answer.

Expedient Help Seeking

1. When I ask the teacher for help in this class, I prefer that the teacher do the work for me rather than explain to me how to do it.
2. When I ask my teacher for help on something I don't understand, I prefer that the teacher do it for me.
3. When I ask my teacher for help on something I don't understand, I prefer the teacher to just give me the answer rather than to explain it.
4. When I ask the teacher for help with my work, I prefer to be given the answer rather than an explanation of how to do the work myself.
5. When I ask my teacher for help, I want the teacher to do the work for me rather than help me be able to complete the work myself.
6. When I ask a student for help on something I don't understand, I prefer that student to just give me the answer rather than to explain it.
7. When I ask a student for help with my work, I prefer that the student do the work for me rather than explain to me how to do it.
8. When I ask another student for help on something I don't understand, I ask that student to do it for me.
9. When I ask a student for help in this class, I want the work done for me rather than be helped to complete the work myself.
10. When I ask a student for help with my work, I prefer to be given the answer rather than an explanation of how to do the work myself.

Help-Seeking Avoidance

1. I don't ask for help in this class even when the work is too hard to solve on my own.
2. If I need help to do a computer science problem, I prefer to skip it rather than to ask for help.

3. I don't ask for help in this class even if I don't understand the lesson.
4. If I didn't understand something in this class, I would guess rather than ask someone for help.
5. I would rather do worse on an assignment I couldn't finish than ask for help in this class.
6. Even if the work was too hard to do on my own, I wouldn't ask for help in this class.
7. I would put down any answer rather than ask for help in this class.
8. I don't ask questions in this class even if I don't understand the lesson.
9. If work in this class is too hard, I don't do it rather than ask for help.

Online Academic Help Seeking (OAHS; Cheng & Tsai, 2011)

Information searching
1. When I have an academic problem, I will seek a relevant solution using search engines (e.g., Google, Yahoo).
2. When I have an academic problem, I will seek a relevant solution using Wikipedia.

Formal query
1. When I have an academic problem, I will email the instructor or class assistants to make a query.
2. When I have an academic problem, I will query the instructor or class assistants on the web-based course forum or guestbook for a relevant solution.
3. When I have an academic problem, I will query the instructor or class assistants by Instant Message Software (e.g., MSN, Skype).
4. When I have an academic problem, I will query the instructor or class assistants through possible online channels.

Informal query
1. When I have an academic problem, I will post a message on relevant web forums requesting unknown experts' help.
2. When I have an academic problem, I will ask for peers' help through some popular blog systems (e.g., Plurk, Twitter).
3. When I have an academic problem, I will post a query on relevant knowledge community websites (e.g., Yahoo! Knowledge).
4. When I have an academic problem, I will find the proper websites, forums or Bulletin Board System (BBS) to ask for unknown experts' help.

Likelihood of Going to Different Sources (Makara & Karabenick, 2013b)

Personal
1. Talking to other students in your classes during or after class.
2. Talking to the instructor during class time or office hours.
3. E-mailing or posting a question online to the instructor.
4. E-mailing or posting a question online to students in your classes.

Impersonal
1. Referring to the class material (e.g., textbook, notes you took)
2. Searching through an online search engine or encyclopedia (e.g., Google, Wikipedia)
3. Searching online resources specific to your class (e.g., course websites, course discussion forum)
4. Searching for resources through the library (e.g., online databases available through [the university], etc.)

Self
1. Solving the problem by thinking about it in a new way, trying to remember what you learned, etc.

Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015)

Autonomy Satisfaction
    1. I feel a sense of choice and freedom in the things I undertake.
    2. I feel that my decisions reflect what I really want.
    3. I feel my choices express who I really am.
    4. I feel I have been doing what really interests me.

Competence Satisfaction
    1. I feel confident that I can do things well.
    2. I feel capable at what I do.
    3. I feel competent to achieve my goals.
    4. I feel I can successfully complete difficult tasks.

Relatedness Satisfaction
    1. I feel that the people I care about also care about me.
    2. I feel connected with people who care for me, and for whom I care.
    3. I feel close and connected with other people who are important to me.
    4. I experience a warm feeling with the people I spend time with.

Autonomy Frustration
    1. Most of the things I do feel like ''I have to"
    2. I feel forced to do many things I wouldn't choose to do.
    3. I feel pressured to do too many things.
    4. My daily activities feel like a chain of obligations.

Competence Frustration
    1. I have serious doubts about whether I can do things well.
    2. I feel disappointed with many of my performance.
    3. I feel insecure about my abilities.
    4. I feel like a failure because of the mistakes I make.

Relatedness Frustration
    1. I feel excluded from the group I want to belong to.
    2. I feel that people who are important to me are cold and distant towards me.
    3. I have the impression that people I spend time with dislike me.
    4. I feel the relationships I have are just superficial.

Basic Psychological Need Satisfaction and Frustration in Physical Activity (Gunnell et al., 2013)

"Please answer the following questions by considering how you typically feel when you engage in physical activity."

Autonomy Satisfaction
    1. I feel like I am in charge of my physical activity program decisions.
    2. I feel free to make my own physical activity program decisions.
    3. I feel free to do physical activity in my own ways.
    4. I feel like I have a say in choosing the physical activities that I do.
    5. I feel free to choose which physical activities I participate in.
    6. I feel like I am the one who decide what physical activities I do.

Competence Satisfaction
    1. I feel that I am able to complete physical activities that are personally challenging.
    2. I feel confident I can do even the most challenging physical activities.
    3. I feel confident in my ability to perform physical activities that personally challenge me.
    4. I feel good about the way I am able to complete challenging physical activities.
    5. I feel like I am capable of doing even the most challenging physical activities.
    6. I feel capable of completing physical activities that are challenging to me.

*Relatedness Satisfaction*1.

1. I feel attached to my physical activity companions because they accept me for who I am.
2. I feel I share a common bond with people who are important to me when we do physical activity together.
3. I feel close to my physical activity companions who appreciate how difficult physical activity can be.
4. I feel a sense of camaraderie with my physical activity companions because we do physical activity for the same reason.
5. I feel connected to the people who I interact with while we do physical activity together.
6. I feel like I get along well with other people who I interact with while we do physical activity together.

Autonomy Frustration
1. I feel prevented from making choices with regard to the way I engage in physical activity.
2. I feel pushed to behave in certain ways.
3. I feel under pressure to agree with the physical activity regime I am provided.
4. I feel forced to follow physical activity decisions made for me.

Competence Frustration
1. There are situations where I am made to feel inadequate.
2. I feel inadequate because I am not given opportunities to fulfill my potential.
3. Situations occur in which I am made to feel inadequate.
4. There are times when I am told things that make me feel incompetent.

Relatedness Frustration
1. I feel other people dislike me.
2. I feel others can be dismissive of me.
3. I feel I am rejected by those around me.
4. I feel that other people are envious when I achieve success.

Teacher-Student Relationships (Froiland, Worrell, & Oh (2019)
1. feeling comfortable with their teachers
2. liking their teachers
3. respecting their teachers