Leveraging Educational Technology to Overcome Social Obstacles to Help Seeking

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Abstract

This dissertation provides initial empirical evidence for Expectancy Value Theory for Help Sources and generates design recommendations for online courses based on the newfound understanding between theory and student behavior. My high-level research goals are pursued in the context of help seeking in the presence of reputation systems in MOOC discussion forums. Educational technology can be intentionally designed and introduced in such a way as to maintain the benefits of existing technology while reducing negative impact on learning-relevant behaviors. I do this through the lens of student expectancy and values for the help source, and costs of pursuing that help.

Within this thesis I present three online survey experiments, one is intended to provide empirical evidence for the connection between Expectancy Value Theory for Help Sources and student help seeking outcomes. The remaining two survey experiments are designed to further investigate the results of a system for help exchange through the lens of Expectancy Value Theory for Help Sources. The first survey supports the existence of beliefs for help sources, although careful design of value manipulations is necessary to isolate value beliefs from expectancy beliefs for the help source.

In a field experiment investigating the design of a help exchange system, I explore the connection between common reputation system features and Expectancy Value Theory for Help Sources. This provides support for the theory outside of a controlled laboratory setting. This Quick Helper MOOC Experiment and the supporting Quick Helper Theory Survey Experiment show that voting within a reputation system context decreases the number of peers invited to be helpers possibly through an increase in evaluation anxiety. Help giver badges ca reduce this evaluation anxiety and mitigate the negative impact of voting.

I performed a final field experiment in a small private online course to examine these issues in a more naturalistic setting outside of the Quick Helper help exchange system. I explored learning expectancy-emphasizing email prompts and voting in the course discussion forum, and how these manipulations impacted larger, more nuanced dependent variables such as help seeking and learning. Results from this experiment are not as strong as the more tightly controlled survey experiments and Quick Helper MOOC field experiment, but we still see support in the general direction of our original hypotheses.

From these experiments I generate a series of design recommendations for instructors of online courses implementing discussion forums: (1) reputation systems can have a positive effect on student engagement in discussion forums, but there may be a negative effect on help seeking and other vulnerable learning-relevant behaviors, (2) The negative impact of evaluation anxiety from voting can be mitigated through the use of either help giver badges or using only upvoting instead of up/downvoting which may reduce evaluation anxiety, and (4) Email prompts with dilute implementation have questionable impact on student contributions in discussion forums.

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1   Introduction

Expectancy Value Theory has successfully explained students' achievement-related choices in face-to-face classrooms, but that evidence is yet to exist for Expectancy Value Theory for Help Sources (EVT-HS). EVT-HS has the potential to help inform the design of online systems focusing on help exchange, but it is unknown how well the theory will align with observations in technologically enhanced learning environments (TELs), where computer mediated communication might somehow obscure student perceived expectancies, values, and costs. In this dissertation, I build on Expectancy Value Theory for Help Sources to understand and explain student behaviors in online learning environments. Empirical evidence from exploring the connections between theory and behavior is then used to generate design recommendations to improve the learning experience for students. This thesis endeavors to answer the following research questions:

1. *Can we use Expectancy Value Theory for Help Sources to understand student behavior in online learning environments?*
   – *(Can we use Expectancy Value Theory for Help Sources to predict Helper Selection in a Massive Open Online Course?)*
2. *How might we leverage our understanding of Expectancy Value Theory for Help Sources and student behavior to improve online learning environments?*
   – *(Can Expectancy Value Theory for Help Sources explain how best to use common reputation system features?)*

To explore the practicality of these high-level questions about EVT-HS for online learning environments, I ground my work in online course discussion forums. Many online classrooms today use technology that was designed for other contexts, without adequate thought to the consequences for students. A reputation system, while useful or necessary in auction websites and Question and Answer Systems, may impact behaviors that are unique or particularly important in learning contexts. While reputation systems have been shown to have a positive effect on engagement in Massive Open Online Courses (MOOCs), this thesis suggests a potentially harmful impact on help seeking. Using EVT-HS I examine how to increase student expectancy, value, and cost beliefs for the presented help sources within existing and commonly implemented reputation system features, specifically: badges, helper expertise or profile information, up/downvoting on all forum posts, and email prompts.

Results from this work indicate that student self-reported expectancies, values, and costs can be impacted through experimental manipulations. In an in vivo experiment, up/downvoting reduced the number of peer helpers invited to answer a question, and this negative effect can be mitigated through additional interventions that reduce evaluation anxiety fears. However, when exploring these same topics in a less controlled field experimental setup, many of the anticipated effects are obscured. Reputation systems overall have a positive effect on student engagement, but the potential for negative impact on learning-relevant behaviors such as help seeking can be reduced while maintaining the benefits gained.

This thesis is intended for designers and instructors of online courses deciding which commonly used features to implement in their course discussion forums. It is also intended as an initial empirical investigation into the practical applications of Expectancy Value Theory for Help Sources. This initial

foundation should support future avenues of research in understanding the connection between other systemfeatures not mentioned in this document and student help seeking behaviors.

As Internet connectivity and learning become more entwined, the need to balance the positive effects of engagement that reputation systems bring against the public threats to self-esteem that explicit evaluation introduces will grow in importance. Massive Open Online Courses rely upon interactive discussion forums where instructors and students can ask questions, discuss ideas, and provide help to each other, but this exchange is only possible if students feel safe to ask their questions. In the following chapters I explore the topics of help seeking, MOOCs, reputation systems, Expectancy Value Theory, evaluation anxiety, and my experiments that connect them.

Help Seeking in Learning Contexts introduces the theoretical constructs of Expectancy Value Theory, Expectancy Value Theory for Help Sources (EVT-HS), evaluation anxiety, as well as a help seeking model. I then discuss how these constructs relate to current research in help seeking in Massive Open Online Courses (MOOCs). This chapter also provides prior work that supports the inclusion of social costs such as evaluation anxiety into models of help seeking.

Empirical Evidence for Expectancy Value Theory for Help Sources explores initial empirical evidence for EVT-HS and the first part of a three-part online survey experiment. The first survey experiment ("EVT Helper Survey Experiment") investigates whether our measurements for EVT-HS, evaluation anxiety, and intention to seek help are connected in the direction suggested by the theory.

The survey experiments provide sufficient support from self-reported survey items for further investigation of EVT-HS in a live system ("QH MOOC Experiment") described in ***Applying Expectancy Value Theory for Help Sources to a Help Seeking System***. This Quick Helper system was designed to support help exchange in MOOC discussion forums using a social recommendation algorithm. I then further examine our results through the second ("QH Theory Survey") part of the survey experiment, allowing us to better understand how common reputation system features relate to EVT-HS and the peer helper selection process. The third survey experiment ("Quick Helper Contrast Survey Experiment") examines the relationship between our manipulations and Expectancy Value Theory of the help seeking process as well as Expectancy Value Theory of Help Sources.

Applying Expectancy Value Theory to a Discussion Forum describes the final field experiment ("SPOC Experiment") and looks more broadly at increasing learning expectancies for participation in a discussion forum as well as a manipulation within voting itself. A "Vignette Survey" suggests endorsing learning goals as a means of reducing evaluation anxiety in the SPOC Experiment. Dependent measures are less controlled than in the Quick Helper experiments, but results support existing research on help seeking and email prompts in online course discussion forums.

2   Help Seeking in Learning Contexts

Appropriate help seeking is a necessary skill in becoming a successful self-regulated learner and it is highly correlated with student achievement in the classroom (Newman, 1994; Magnusson & Perry, 1992). Students who do not seek help with difficult concepts, or who fail to consult with instructors, or who request inappropriate help are not as likely to experience success as students who seek help effectively (Magnusson & Perry, 1992). Seeking help when necessary assists students in understanding complex concepts that they do not understand or are unable to comprehend on their own (Ryan & Pintrich, 1997). However, the process of identifying a help need to actually pursuing that help is a complex path. Not all students successfully find their way. In this chapter I discuss many of the social and non-social factors that influence student decisions to seek help.

Nelson-Le Gall (1981) proposes one model of help seeking in which the student must:

> (1) first become aware of a help need,
> (2) decide to seek help from an external source,
> (3) identify potential helpers,
> (4) implement strategies for engaging the helper, and
> (5) reflect upon the help seeking attempt.

Generalizing from this and other help seeking models (see also: Gross & McMullen, 1983) shows that each include metacognitive processing for identifying the help need, perceived costs and benefits, help seeking goals, selecting a help source, and obtaining that help.

The first step toward help seeking revealed by Nelson-Le Gall's task analysis is identifying a help need. If students have the metacognitive capabilities to monitor their progress and can detect when they encounter a problem, then it is possible for them to proceed to the next step in the help seeking model. However, if students are not aware that they have encountered an obstacle, then they will not seek help when necessary (Nelson-Le Gall, 1981). Research shows that this metacognitive ability to identify a help need is developed through maturation and experience (Markman, 1977), although more recent work in interactive learning environments has been specifically focusing on tutoring this skill (Roll et al., 2007).

In order to make the decision to seek help, a person must first weigh the costs and benefits of doing so. Asking for assistance can help a student complete a task, but it can come with social and personal costs such as feeling less competent or receiving less credit (Nelson-Le Gall, 1981). Not everyone is equally as sensitive or aware of these costs and benefits. A student's disposition and goals may also affect the choice. All of these factors will be explored further in this dissertation.

Once a decision has been made to seek help, one must next select a helper. In this step, the decision is influenced by the student's perceptions and knowledge of potential helpers as well as the social situation. These perceptions and situational factors include the sex and age of both the help-seeker and the helper, the role relationship and status of both parties, perceived willingness to help, perceived competence of the helper, and socioeconomic status (Nelson-Le Gall, 1981). These perceptions and situational factors are of

particular interest because they can often be intentionally designed, especially within interactive learning environments in which the system connects students to the help they require.

Once the learner has decided to seek help, and decided on a helper, there are a variety of outcomes to expect, dependent upon the student's goals in seeking help. Help-avoidance, executive (or expedient) help seeking, or instrumental help seeking (Nelson-Le Gall, 1981) are also similar to avoidant, autonomous, and dependent help seeking behaviors (Nadler, 1997). One can either ask for help or not, but one can also ask for help simply to complete a task quicker or to learn more. There is also a distinction to be made among help seeking, information-seeking, feedback-seeking (Lee, 1997), answer requests, or error checks (Puustinen et al.,2011). Beyond general categories, one can also examine help seeking based upon linguistic features such as the directness and politeness of the help being sought (Puustinen et al.,2011).

If the desired help is not acquired, students are then forced to reevaluate their strategies for obtaining help and may repeat the previous steps until help is achieved (Nelson-Le Gall, 1981).

2.1   Help Seeking

While the steps of the help seeking model suggest that this is a simple, straightforward process, each of these steps encompasses additional substeps. That is, "deciding to seek help from an external source" and selecting who that external source may be is a complex process on its own that requires more than just the metacognitive awareness of a help need. Individual learners have varying perceptions of how help seeking impacts their self-presentation. In some cases, a learner might think that help seeking means they are incompetent, or that seeking help will challenge their sense of autonomy, or that their potential helper is of too high status from which to request help, or a myriad other social and contextual factors. We divide these factors by source into the following groups followed by a sample of relevant examples:

- **Personal Factors.** A student's individual choice to seek help is influenced by their sensitivity to evaluation apprehension such as public threat to self-esteem (Pajares et al.,2004; Karabenick, 2003; Tessler & Schwartz, 1972) and other socially influenced individual factors such as performance and mastery achievement goals (Huet et al.,2011). Seeking help can also be influenced by one's perceived private threats to self-esteem (Pajares et al.,2004; Karabenick, 2003), a need for autonomy and self-reliance (Deci & Ryan, 1987), deep or shallow learning strategies (Karabenick & Knapp, 1991), academic efficacy (Ryan et al.,1998), epistemological beliefs (Bartholomé, 2006), the learner's opinions of help seeking (Pajares et al.,2004), companionate peer relations (Makara & Karabenick, 2013), value for school (Makara & Karabenick, 2013), and gender (Ryan & Pintrich, 1997).
- **Contextual Factors.** Various features of the situation and the task may impact student help seeking. One example is whether the learner is interested in the task (Bartholomé, 2006), but other work also explored the achievement goals of the learning situation and how that interacts with students' personal achievement goals (Newman, 1998).Also, Makara & Karabenick (2013) suggests that along with whether the help source is a peer or instructor (informal/formal), whether the help is considered personal or impersonal, mediated or face-to-face, and dynamic or static may impact student help seeking. Individuals' academic achievement goals impact their help seeking attitudes (Ryan et al., 1997), and varying academic achievement goals can be endorsed by an instructor, impacting students' achievement goals (Meece et al., 2006) and therefore their help seeking behaviors.
- **Help-Provider Factors.** These aspects include usability factors such as whether help is easy to use (Huet et al.,2011), whether the help is perceived as useful (Huet et al.,2011), and whether the source of the help is from a computer or a human (Karabenick & Knapp, 1988)

Furthermore, while at first it may appear that help seeking should always be correlated with learning, that is not always the case. In this document I use the term "maladaptive help seeking strategies" to describe help seeking efforts when the student does not need help or seeks inappropriate help. These maladaptive help seeking strategies include seeking help simply to complete a task expediently or in some cases seeking executive help rather than hints that may allow the student to become more autonomous (Karabenick, 2004). However, not all instances of requesting an answer rather than a hint are maladaptive. Shih et al (2011) developed a time-based model for determining if students are using the answer to a question as a worked example. And so, in some cases, students use the answer to a question not just as a means of progressing through a problem set, but also as a means of comparing their own thinking and cognitive models to the helper-provided correct response. Due to varying help seeking goals and differences in types of help provided to students, experiments must not only measure whether help is sought, but whether that help leads to learning.

2.1.1 Help Seeking Personal Factors

Of particular note is the possibility that students may not decide to seek help, even though they are aware that they need it due to a fear that their instructor or fellow classmates may view them as less competent (Nelson-Le Gall, 1981). There are many reasons students may choose to seek or avoid requesting help. Butler (1998) found three orientations to help-avoidance from student ratings: (1) striving for independent mastery, (2) concerns for masking poor ability, and (3) beliefs that seeking help would not increase the time required to attain task completion.

The first two of these avoidance strategies are comparable to personal factors I discussed before: (1) a need for autonomy, (2) public and private threats to self-esteem, whereas the expediency orientation does not map properly to either. We can also view the first two help-avoidance strategies as mastery-focused and performance-focused within achievement goal orientation theory: mastery-approach (a desire to gain competence), performance-approach (a desire to perform better than others), and performance-avoidance (a desire to not perform worse than others), see Hulleman et al (2010).

Certainly, one's concerns about performance relative to others, or simply about gaining (or not losing) competence affects whether help is sought. We know that mastery goals are positive predictors of help seeking whereas performance-avoidance goals are negative predictors (Roussel et al., 2011). Ryan & Pintrich (1997) further shows that student perceptions of threats and benefits of help seeking partially mediate the effects of goals for relative ability, task-focused & extrinsic goals, and perceptions of cognitive competence on help-avoidance with perceived threats not mediating adaptive help seeking strategies. In a similar vein, researchers have examined how ego- and task-focused goals impact help seeking and avoidance strategies. Butler & Neuman (1995) found that students in ego-focused conditions explained help-avoidance as necessary for masking incompetencies while students in the task-focused conditions explained help-avoidance in terms of gaining independent mastery.

Ryan et al (1998) point to several of these factors, mainly: student academic efficacy, teachers' beliefs about attending to student emotional needs, and student perceptions of the classroom goal structure. However, Karabenick & Knapp (1991) explored college students' help seeking behaviors and found that the behavior was directly related to self-esteem, inversely related to student perceptions of help seeking as threatening, and positively related to cognitive metacognitive learning strategies. In summary, student

goals, goals of the classroom, self-efficacy, self-esteem, teacher beliefs, and student beliefs about help seeking all influence whether or not a student seeks help in the classroom.

However, much of this work on achievement goal orientation and help seeking looks only within individual contexts, and fails to tease apart the way teacher and peer roles may have individual and different impacts on help seeking strategies. Ryan & Pintrich, (1997) looks at this question. Student "relative ability goals" (similar to performance goals), "task-focused goals" (mastery goals), social status goals (i.e., wanting to be popular), intimacy goals (i.e., wanting to form positive relationships with fellow students), and attitudes about help seeking were measured. Students with high performance and social status goals perceived higher threat and avoided seeking help. Mastery goals were related to negatively perceiving threat and help-avoidance, while intimacy goals were correlated negatively with avoiding help seeking. So student self-reported social concerns as well as their achievement goals are related to whether or not they avoid help. If we assume that demonstrating high levels of social status and performance goals is similar to being sensitive to evaluation apprehension and public threats to self-esteem, then the correlation between those goals and help-avoidance is expected,

Another important research question involves examining how help-avoidance orientation and help seeking strategies are affected by an increase of fear of being judged and how that fear of being judged might be alleviated. Mechanisms for alleviating a fear of being judged may come through the learning environment, or through targeted belief and skill training.

2.1.2 Help Seeking in Interactive Learning Environments

While help seeking in classroom environments provides basic theory for the process of help seeking in face-to-face settings, research on help seeking in interactive learning environments (ILEs) can explain how help seeking in technology-supported learning environments functions. Help seeking in a classroom environment is very different from help seeking in ILEs or other computer-based learning environments. The affordances of technology enhanced learning environments provide for some unique opportunities that are not typically encountered in traditional classrooms. These affordances include, but are not limited to: on-demand help for every student, requesting and receiving help without peers' awareness, automated help, long-distance help from human instructors, hyperlinked reference materials, cognitive modeling and state tracking, and bottom-out hints (Aleven et al.,2003).

However, much of the classroom help seeking process can be adapted to ILEs, including those with on-demand help (Aleven et al.,2003). By providing feedback, students need less self-monitoring to become aware of their need for help, thereby reducing metacognitive load. When deciding to seek help from an ILE, students may be less concerned with being seen as incompetent, but using help may have other negative consequences that do not occur in classroom situations, such as a decrease in visual displays of students mastered skills in systems like the cognitive tutors of Koedinger & Corbett (2006). When identifying potential helpers, the ILE itself may offer several additional options, such as a hint, glossary, or web search functions. However, when actually eliciting help, the learner may be faced with some added difficulties, depending on the ILE. Not all ILEs can interpret natural language, nor are all ILEs equipped to give context-sensitive help. For the ILEs in which help-receiving is most efficient, students may be less likely to reflect on the help seeking episode in depth.

Likewise, introducing a new technology, even if it supports help seeking can be cognitive overloading and require guided structure from an instructor. Makitalo-Siegl et al (2011) found that students in a condition receiving structured assistance from their teacher used less help from the web-based inquiry learning tool, but learned more than those students assigned to the condition with less guidance. This effect might lessen over time as both the students and the teacher become more familiar with the advantages of using the technology, but their results speak to the importance of a proper introduction of new technologies in learning situations.

Roll et al (2007) took a different direction and focuses on teaching help seeking as a metacognitive skill. Their Help Tutor is an intelligent tutoring system that specifically focuses on preparing students to be better future learners by providing feedback about their help seeking behaviors. Various factors are considered in their help model, including the student's knowledge, how much time the student waits before requesting a hint, how many hints the student has requested, and so on. While Roll et al (2007) did not incorporate student dispositions and attitudes about help seeking into their model, other authors have explored this relationship. Huet et al (2011) did not find a relationship between mastery-goals and help seeking behaviors as expected, but they did find that students with mastery goals perceived a high level of threat to their autonomy. Furthermore, they found that performance-goals were positively correlated with the threat of being considered incompetent as well as using less help.

2.2   Expectancy Value Theory

Students' decisions to pursue learning goals are determined by their expectancies for success, and the values they place on the outcomes that come from that success. Eccles & Wigfield (2002)'s Expectancy Value Theory[1] provides a larger model that includes these expectancies and values, but also incorporates students' beliefs and self-schemata. This model can be applied to a wide range of learning-oriented behaviors, including help seeking. I will be focusing on the direct antecedents that determine students' achievement-related choices and performance: the expectation of success and subjective task value. I apply Expectancy Value Theory at the help seeking process level, and later introduce Expectancy Value Theory for Help Sources for understanding student behavior when selecting a help source.

Expectancy Value Theory for Help Sources is derived from Expectancy Value Theory, although due to its more targeted focus there are some differences. Both beliefs about the help source and more general beliefs about help seeking expectancies and values are important factors in the process of deciding to seek help. In this chapter I describe and distinguish Expectancy Value Theory from EVT-HS.

2.2.1   Modern Expectancy Value Theory

The Expectancy Value Theory (EVT) of modern educational psychology incorporates students' ability beliefs, expectancies for success on a particular task, and four different task values (i.e., intrinsic, utility, attainment, and cost) (Eccles et al., 1983) as shown in Figure 1. Initial development of Expectancy Value

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[1] While Eccles & Wigfield's Expectancy Value Theory overlaps considerably at a high-level with the Vroom et al. (2005) Expectancy Theory, these are two separate theories. Expectancy Value Theory has its roots in Atkinson (1964) and does not appear to reference the Expectancy Theory that originates from organizational psychology.

Theory pointed to a multiplicative effect of expectancies and values on achievement, as shown in Table 1. Under this model, if a student did not expect to succeed on a task, even high value beliefs could not compensate for a '0' expectancy. Likewise, sufficiently low value for a task might not be possible to be compensated by high success expectancy. However, more recent work has pointed toward expectancy for success being more predictive of performance and value beliefs being more predictive of achievement-related choice and effort (Trautwein et al., 2012).

Trautwein et al. (2012) provides evidence for the relationship between expectancy and value for a task to be enhancing. That is, in their model, both expectancy and value positively predicted performance and their interaction produced a stronger than additive effect on performance. These results held true in both mathematics and English language learning domains, which suggests that the interaction of expectancy for success and task values should be included as a term in Expectancy Value Theory analyses and models. Trautwein et al. (2012) also included costs of performing a task alongside intrinsic, utility, and attainment values which is similar to other work incorporating costs into Expectancy Value Theory (Eccles & Wigfield, 2002). While "low cost" was significantly correlated with the other values, the correlation between utility values and low cost were generally strongest. The authors hypothesized that low cost and utility values represent extrinsic values, while the attainment and intrinsic values were considered more intrinsic. However, this explanation assumes a particular definition of costs. Specifically, cost was measured with the following items: "I'd have to sacrifice a lot of free time to be good at mathematics/English" and "I'd have to invest a lot of time to get good grades in mathematics/English." These costs are largely private in nature, and do not take into account other more public concerns which is the focus of this thesis' section on Evaluation Apprehension.
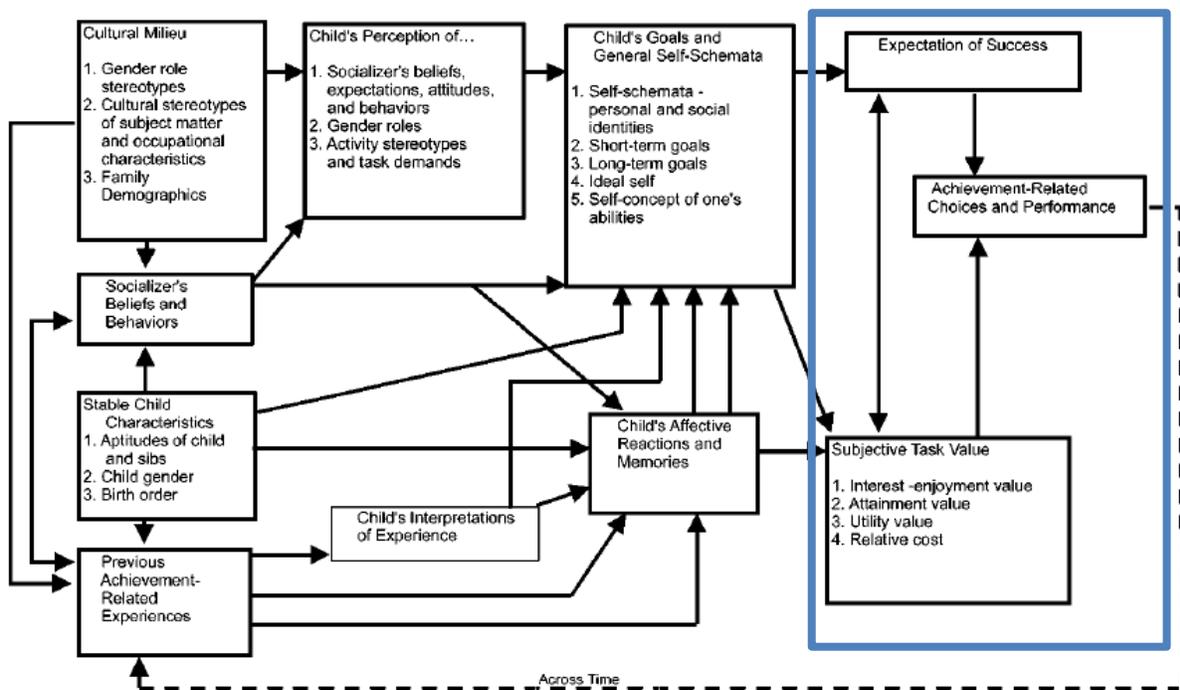
Figure 1. Eccles & Wigfield Expectancy-Value Model.

Expectancy of success also has multiple dimensions in modern Expectancy Value Theory. These dimensions consist of broad ability beliefs about competence in a particular domain, and a more narrow expectancy of success on a specific upcoming task. Research has shown that these two dimensions are highly correlated, and in many real-world achievement situations they are empirically indistinguishable (Eccles & Wigfield, 2002). Trautwein et al. (2012) measured expectancy for success in math and English with a self-concept instrument with items such as "I am good at mathematics/English" and "I have difficulty understanding everything to do with mathematics/English". It is a common practice of modern research on Expectancy Value Theory to use similar self-concept items rather than expectancy for success items for a specific upcoming task.

Table 1. Some examples of potential outcomes in seeking help. The coefficients of the outcomes are determined by the expectancies and values for those outcomes. Whether or not help is sought is determined by the combination of the outcome coefficients.

Goal: Answer a homework question I cannot solve → Seeking Help		
Outcomes	**Expectancy/Likelihood**	**Value/Importance**
Receive useful help to answer the question	Expectation I will receive good help	Value of receiving good help
Become a better student	Expectation I will become a better student	Importance of becoming a better student
Others will think I'm stupid if I ask for help.	Expectation that others will think I'm stupid if I ask for help.	Value of others not thinking I'm stupid.

While the Trautwein et al. (2012) work looks at general success in math or English, it is possible to look at expectancies and values at many levels or on different tasks, although much Expectancy Value Theory research tends to focus at the higher-level domain expectancies and values. An example of an alternative achievement outcome might be help seeking, which has remained relatively unexplored in the Expectancy Value Theory literature. As an example, a student wants to answer a homework question she cannot solve, and so she decides that seeking help is one path to complete her homework. Whether or not she seeks help will be determined by a consideration of all the outcomes that might happen in the pursuit of help seeking. This includes outcomes such as receiving good help, with expectation being the perceived likelihood of the help seeking effort resulting in good help (i.e., expectation of success in help seeking in general) and the importance the student places on that good help, as shown in Table 1. Other outcomes may include the belief that help seeking will make her a better student, whether seeking help means she is dumb (i.e., private costs), and whether help seeking will make her less competent in comparison to her peers (i.e., public costs). Each of these additional outcomes have values, such as how important it is to the student to complete her homework, how important it is to the student to become a better student, how important it is not be dumb, and how important it is to not look incompetent in front of peers.

While Table 1 shows expectancies for success for general help seeking abilities, it is also quite possible that more specific expectations for success in help seeking might be included here. While domain-centric Expectancy Value Theory has directed expectancies for success to be measured more generally at the self-concept level, it is important to include expectancies for success on a specific upcoming task into initial investigations of Expectancy Value Theory for help seeking.

Furthermore, first-level outcomes described in Table 1 may have second-level outcomes, such as receiving good help resulting in answering the homework question and improving the homework score. The likelihood of achieving this second-level outcome, and the value place on answering the homework question (receiving a good homework score, doing well in the course, etc.) are all part of the expectancies and values of the second/third/…/nth level outcomes. These may also influence the student's decision toward performing the learning-oriented behavior of help seeking, shown in Figure 2.
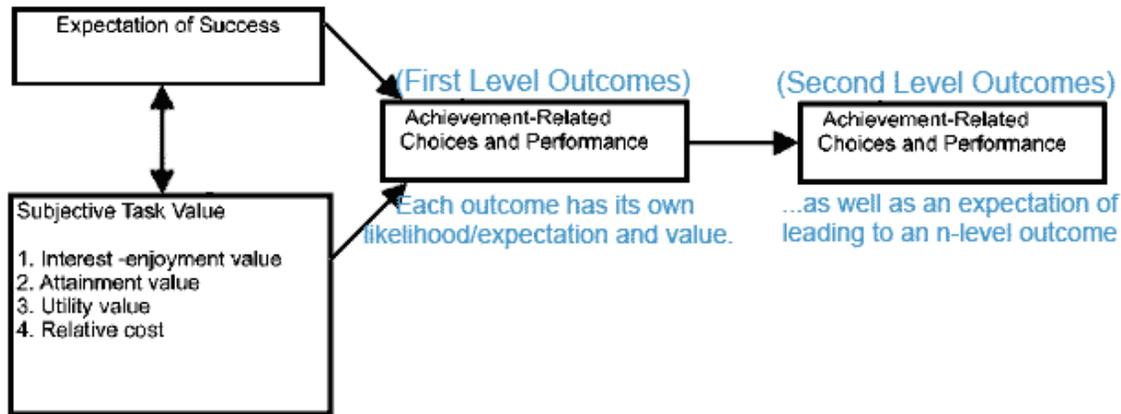

Figure 2. Eccles & Wigfield Expectancy-Value Model, focusing on immediate antecedents to learning-oriented behavior, extended with expectancies and values for a second-level outcome.

2.2.2 Expectancy Value Theory of Help Sources

As mentioned previously, the Nelson-Le Gall (1981) help seeking model provides the following steps:

(1) first become aware of a help need,
(2) decide to seek help from an external source,
(3) identify potential helpers,
(4) implement strategies for engaging the helper, and
(5) reflect upon the help seeking attempt.

The process of pursuing help, once the student has decided to seek help requires (3) selecting a source from which to seek help and then (4) to follow through with the help request. While the actual pursuing of the help can be understood through the Eccles & Wigfield Expectancy Value Theory model as previously described, the selection of a help source can be better examined through Makara & Karabenick's (2013) Expectancy Value model of help seeking for help sources, below:
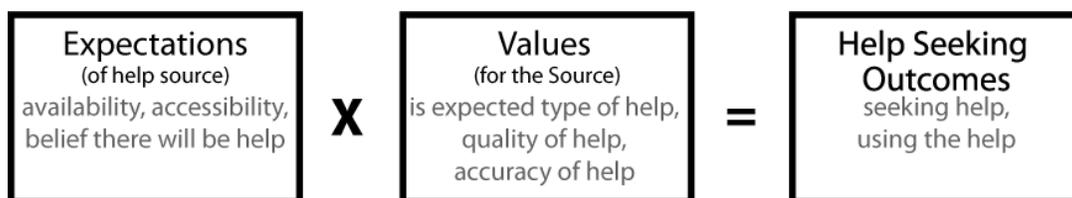

Figure 3. Makara & Karabenick Expectancy Value Theory (2013) for help sources model

Expectations for help from a particular help source are based on beliefs about whether that source will be available to provide help, whether that source is accessible, and a basic belief that there will be obtainable help from that particular source. Values for a help source originate from whether that help source will be able to provide the expected type of help such as the expected quality ad accuracy. This model functions as an initial theoretical explanation for how students select and seek help from a particular resource, but empirical support for this framing of expectancies for success and values is not yet empirically validated.

Makara & Karabenick (2013) define expectations for success from the help source as the belief there will be help which is more about the help source rather than student self-concept. A student might have general self-concept beliefs about their past successes in help seeking in general, but also self-concept beliefs for the pursuit of help from a particular help source. It is currently unknown how these two levels of expectations for success in help seeking combine to influence help seeking from a particular source.

Expectancy Value Theory for Help Sources also largely focuses on utility value for the values for the help source. This is likely due to the other, more intrinsically-related value types being less relevant in a help seeking concept. Attainment value was measured by items in Trautwein et al. (2012) such as, "Mathematics/English is important to me personally." Intrinsic value was measured by items such as, "I enjoy puzzling over mathematics/English problems." It seems unlikely that students would enjoy seeking help and consider attaining help as a personal value. However, Makara & Karabenick (2013) could certainly have included cost items in their model of Expectancy Value Theory for Help Sources. While cost can be measured as an amount of time-required to achieve the task as in Trautwein et al. (2012), it can also be measured as public and private threats to self-esteem, and inconveniencing a particular help source. Just as with expectation for success in help seeking, students can perceive costs at the help seeking level (i.e., "Others would think I was dumb if I ask for help in this class", Wolters et al., 2003), but also at the help source level (i.e., "This helper would think I was dumb if I asked them for help in this class."). While costs were not explicitly included in Makara & Karabenick (2013), an examination of costs' function in seeking help from a particular source is an additional purpose of this thesis.

In determining from whom/where to seek help and whether to actually pursue that help, we must consider student expectations and values for the help from a help source. This examination should incorporate costs for seeking help as part of gaining a wider understanding of beliefs for a help source. Better understanding the relationship between expectancies and values for a help source and student self-concept beliefs about their help seeking is an additional goal.

2.3   Costs of Seeking Help

This section introduces costs of seeking help with a particular focus on social costs of seeking help. Costs are typically considered one of many possible values (alongside attainment, intrinsic, and utility values). But there are also many different types of costs. Costly outcomes can include private threats to self-esteem (i.e., "If I ask for help, it means I'm not competent"), public threats to self-esteem (i.e., "If I ask for help the teacher will think I'm not competent"), face threatening acts (i.e., "It will inconvenience the teacher to help me"), among others. Costs were not included in the Expectancy Value for Help Sources Theory explicitly, but certainly one help source could induce more costs than another (i.e., "If I ask the teacher for help, she will think I'm not competent, but if I ask for help from this discussion forum

strangers on the Internet might think I'm not competent"). Although, costs of seeking help often function at the help seeking process level, rather than the help sources level.

With regard to our research questions surrounding the application of EVT-HS to selecting help sources in online courses, social costs are of particular interest. When looking specifically at voting in reputation systems, one of the most apparent costs of help seeking is evaluation anxiety or the fear of being judged.

2.3.1 Evaluation Apprehension

Evaluation apprehension, or a person's concern about being evaluated (Guerin, 1986), can be impacted by numerous contextual factors and is also similar to perceived public threats to self-esteem (Karabenick, 2003; Shapiro, 1983). Both of these factors are related to impression management strategies to prevent others from perceiving one as incompetent. In this section, we focus on the effect of evaluation apprehension (used interchangeably in this document with "evaluation anxiety") in learning contexts.

Anxiety related to the potential to be evaluated, whether implied or explicitly stated, is known as evaluation apprehension (Cottrell et al., 1968). Learning often requires evaluation, either from others such as the teacher or from within when self-monitoring one's progress, and so the issue of anxiety around evaluation potential is relevant to learners. However, a review of the literature does not appear to reveal evaluation apprehension systematically studied with regards to its effects on help seeking. Evaluation apprehension is referred to, specifically in reference to its relationship with threats to public self-esteem, as in Nadler (1997) in which he posits that threat to public self-esteem is an explanatory concept for participants avoiding seeking help on ego-central tasks, and that this "suggests that one avoids the seeking of help because of evaluation apprehension concerns."

One possible reason for why there is not significant research linking evaluation apprehension to public threats to self-esteem and help seeking is due to the origins of evaluation apprehension as a construct. Traditionally, evaluation apprehension is examined in contrast to "mere presence" in the social facilitation literature. A participant performs a task and the presence of an audience enhances the participants' dominant responses. Zajonc (1965) proposes that the enhanced dominant response is due to the mere presence of an audience, although papers since then have pointed to the evaluative potential of that audience, rather than just their presence, being the true mechanism behind that enhancement (Cottrell et al., 1968). As an example, Martens & Landers (1972) grouped participants into alone, dyad, triad, and tetrad coactor conditions in which coactors can (1) see the participants' behavior & performance outcomes (direct), (2) only see the performance outcomes (indirect), and (3) can see neither (no evaluation). Results showed that participants in tetrads experienced lower performances than individuals in dyads and triads and that participants in the direct evaluation condition performed significantly worse than those in the indirect and no evaluation conditions. The fact that there was no significant performance difference between the alone condition and no evaluation conditions suggests further support for Cottrell's (1968) hypothesis that mere presence alone is not a sufficient condition for impairing performance. When performing in front of others with increased potential to evaluate, participants performed worse. While these studies have explored evaluation apprehension's effect on dominant response performances, without a specific measure for evaluation apprehension anxiety, it would be difficult to examine the relationship between evaluation apprehension and help seeking.

More modern investigations of evaluation apprehension look at impact on dominant responses depending upon the task difficulty and whether the evaluation being provided is presented as instrumental for future performances (Geen, 1983). This work also began measuring participants' perceived levels of evaluation apprehension through general anxiety measurements before and after the experimental task. Geen's (1983) measure of evaluation anxiety consisted of the state form of the Spielberger State-Trait Anxiety Inventory. Items in this part of the inventory include: "I am tense; I am worried" and "I feel calm; I feel secure." Current methods to measure evaluation anxiety look not only at experienced evaluation apprehension, but also the cause of the evaluation apprehension (Leary et al., 1986; Bagley, 2007). First, to measure experienced evaluation apprehension, a subset of items used to measure negative affect are used as a scale. These items are included in Appendix A. and include negative affects specifically related to anxiety: nervous, worried, calm, tense, and relaxed (Leary et al., 1986).

Howley et al. (2014) explored the impact of robots on evaluation anxiety and help seeking in a one-on-one tutoring setting and Appendix E. discusses these results in more depth. Results showed that students learned significantly less from a human teacher as compared to a robot teacher, human helper, and robot helper. This significant reduction in learning was partially due to the fact that participants asked the human teacher marginally fewer questions. While students asked marginally fewer questions from human teachers than the human helper, the authors did not see the same distinction made for robot teachers and helpers. So, human teachers were hypothesized to increase evaluation anxiety more than human helpers and either of the robot conditions. This experiment shows that evaluation anxiety may very well have impact on help seeking, and that the fear of being judged can possibly be reduced through the intentional design and presentation of the technology enhanced learning environment.

2.4 Discussion

In this thesis I focus on three steps of the help seeking process to investigate how learning science theory and educational technology can be leveraged to improve learning environments. These three steps include: "decide to seek help from an external source", "identify potential helpers", and "implement strategies for engaging the helper". I focus on these three steps as the potential for immediate impact to reduce obstacles to effective participation is tremendous. These three steps also lend themselves well to a lens of Expectancy Value Theory for understanding how student beliefs impact their help seeking and response to social obstacles. Expectancy Value Theory may be used to explain whether or not students seek help (i.e., the help seeking process level) and Expectancy Value Theory for Help Sources can potentially explain how students identify potential helpers.

This chapter has introduced the Expectancy Value Theory for Help Sources as the main lens through which I will explore student help seeking in online course discussion forums. This thesis introduces initial empirical evidence to support the different factors of EVT-HS. While Expectancy Value Theory often formulates costs as a time expenditure to achieve a particular outcome, this chapter also proposes evaluation anxiety (or evaluation apprehension) as an additional important cost, particularly for help seeking and other behaviors that render a student somewhat vulnerable to others' judgment.

3   Help Seeking in MOOCs

Massive Open Online Courses (MOOCs) arose in popularity in recent years, due to the potential to offer high quality instruction to tens of thousands of students for minimal or no cost. With the growing number of MOOC students there is also a growing demand for supporting those students' learning in a scalable manner. Students use interactive discussion forums to seek help and have their questions answered by classmates and instructors, but often those questions end up lost beneath other students' posts. To successfully support help exchange in large online courses, designers of MOOCs must address many issues, but the potential rewards for students are tremendous. In this chapter, I provide an overview of issues encountered in MOOCs and some previously explored means of reducing these issues and increasing positive outcomes.

Massive Open Online Courses began with a course on connectivism and connective learning in 2008 (Mackness et al. 2010), but has grown to include a variety of different MOOC course hosting sites, including edX, Coursera, and NovoEd among others. Initial research on these courses focused on the kinds of students MOOCs attract, the surprisingly high dropout rates, and clickstream data logged from user interactions with the systems (Martin, 2012). Growing interest in MOOC research lead to an expanding range of research questions examining everything from the role of reputation systems in Massive Open Online Courses (Coetzee et al. 2014) to discussion forum analyses (Yang et al., 2014b) to in-class comparisons (Colvin 2014).

Forums are a common means of developing communication and community within MOOCs, but the large scale of these courses introduces several issues. Forums commonly lose participation due to poor thread management and an overwhelming number of discussion forum threads (Mak et al. 2010). When these forums fail to properly sustain a sense of community, high rates of student dropout often follow. Yang et al. (2014a) approached this problem by implementing a thread recommendation algorithm which recommends a discussion forum post to a student based upon peer relations, content of previous posts, and prior forum activity. However, this recommendation algorithm can also be repurposed to recommend potential peer helpers to the student seeking help.

3.1   Confusion and Dropout in MOOCs

In work with collaborators, we explored how student confusion in discussion forums related to dropout rates in Algebra and Microeconomics MOOC courses (Yang et al., 2015). Our linguistic measure of confusion was determined by a machine learning classification algorithm that was trained on Mechanical Turk participants' ratings of levels of confusion. What we found was that student confusion lead to increased dropout from the MOOCs. However, if students' confused discussion forum post was marked as 'resolved', then this could reduce their likelihood of dropping out by 22%. Receiving responses from peers on a confused post could likewise reduce the likelihood of that confused student dropping out by 14%. Confusion without resolution from instructors or peers might easily transition that student to dropping out, but expressing that confusion in a discussion forum may also lead to dropout if it is not resolved. Oftentimes, most threads in discussion forums do not have instructor intervention (in this study, 13% in the Algebra course and 18% in the Microeconomics course), so resolution of confusion often rests

on fellow students participating in the forums. This work suggests that connecting students on discussion forums to the help they need can have a positive impact on student dropout.

3.2   Reputation Systems

Reputation Systems are often implemented in MOOCs to encourage engagement within the discussion forums, although their history is rooted in large online communities for establishing trust relationships as well as crowd-sourcing the organization of content. Auction websites (such as www.ebay.com), review websites (such as www.tripadvisor.com), as well as Q&A forums (such as www.stackoverflow.com) all use reputation systems as a way of fostering trust amongst strangers on the Internet (Resnick et al., 2000). reputation systems lubricate the process for online commerce and exchange of services, goods, or expertise between strangers on the Internet. Judgments of reputation and reliability are involved anytime we need to work with new, unknown people and these evaluations are based on the information available to us (Golbeck and Hendler 2004). In this way, reputation systems provide valuable structure for trust-based interaction, but they can also provide crowd-sourced organization.

Figure 4. A screenshot of the www.stackoverflow.com main page showing featured posts based on reputation system usage.

As an example, Stackoverflow.com, as shown in Figure 4, is a Question and Answer forum for both "professional and enthusiast" computer programmers. Users post questions to the website that may then be answered by other users. Users receive points for all activities (including asking and answering questions). However, other users can vote on answers and questions, and so more positive votes receive more reputation points. A user that votes down a particular answer will lose 1 reputation point, possibly as a means to stop users from downvoting excessively. As a user gains more points, they are able to access progressively more features on the site, including the ability to vote up, vote down and act as a

moderator (i.e., edit other users' content). This functions as a reward system to not only encourage users to produce higher quality or more popular content, but also to engage increasingly more with the website and the community. Posts that are upvoted more than other posts may appear under the "Interesting", "Featured", or "Hot" tags, and so the reputation system is also leveraged as a way of crowd-sourcing an organization of the website content.

Many MOOCs implement reputation systems in their discussion forums for many of the same reasons as www.stackoverflow.com: to encourage engagement with the discussion forums and organize content from thousands of students. Coetzee et al. (2014) determined that the usage of reputation systems improves the response time and number of responses to discussion threads. The authors used a reputation system based on upvoting of user discussion posts and comments, assigning a reputation score to users that in time provided them with forum moderation capabilities. While students using the forum version with the reputation system experienced improved response time to posts, people were less likely to post to that forum. That is, the reputation system with upvoting (and no downvoting) increased the number of posts, but decreased the number of people posting. The authors also found that the basic forum, without a reputation system, actually contained more questions. This suggests that reputation systems might negatively impact help seeking. Furthermore, there was no effect of the reputation system on final grades or on forum retention which suggests is that a reputation system provides some benefits to increasing engagement in MOOC discussion forums, but not all of the effects may be positive. Particularly when considering evaluative up/downvoting, course designers must consider help seeking and other learning-relevant behaviors. Interaction archetypes such as voting that were designed for purposes outside of learning contexts may have unintended consequences on valuable behaviors within learning contexts.

Often included within reputation systems, and commonly used in online learning environments are badging systems. In some MOOCs, badges are awarded to students for achieving particular goals or completing certain activities (Cross 2013; Laso et al. 2013). These badges can be viewed as an approach to providing feedback of successful progress to students, but can also be used as extrinsic rewards motivating more interaction and participation in course materials. Mozilla's Open Badge Infrastructure[2] and other badging frameworks attempt to standardize badging systems so an individual's learning can be more easily understood across the Internet (Laso et al. 2013). However, if these badges are displayed they may also be provided to a reputation system. Badging systems have the potential to not just reward students for good behavior, but also to signal to other students the achievement of certain milestones.

3.3 Message Prompts

Another researched means for encouraging engagement with online course content and discussion forums is the use of goal-oriented prompts or messages. Recent work has provided mixed results about the effectiveness of these message prompts on participation and learning-relevant behaviors.

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[2] http://openbadges.org/

Williams et al. (2013) found different results in their implementation of message prompts, but the authors were not looking at behavior in a discussion forum. Instead, Growth Mindset messages from Dweck (2006) were displayed above math problems in Khan Academy[3]. The growth mindset condition emphasized that intelligence is expandable with prompts such as "Remember, the more you practice the smarter you become!" in contrast to the control messages such as, "This might be a tough problem, but we know you can do it." Students in the growth mindset condition experienced more success overall: they attempted (successfully) more problems, were more likely to acquire exercise proficiencies, and solved a larger proportion of attempted problems correctly.

Kizilcec et al. (2014) revealed different findings when prompting students via email. Students in a MOOC were emailed once at the beginning of the course and sent a second email to students who had not yet contributed to the course discussion forum later on in the course. These email prompts endorsed either a collectivist ("Your participation benefits everyone."), individualist ("You benefit from participating."), or neutral mindset ("There is a forum."). The results showed that the emails had negligible impact on encouraging new students to contribute to the discussion forum at both one and ten week post-prompt time points. However, when looking at the number of contributions to the forum, the authors found that the individualist and collectivist messages predicted marginally fewer posts than the neutral messages at the one week time point. After ten weeks, the relationship was no longer statistically significant, but the trend in the same direction remained. The authors hypothesized that the persuasion attempt was too apparent, resulting in a negative response from students. It is also suggested that by emphasizing the learning nature of the discussion forum might actually work to reduce the perceived social purposes of the discussion forum that might be some students' motivation for forum participation.

Email prompts are also implemented outside of learning contexts such as in Zhu et al. (2013) where the authors examined the relationship between types of email prompts on Wikipedia editor contributions (edits to articles). The email prompts included feedback related to an editor's contribution that was positive, negative, directive, or social in nature. Results also differentiated based upon the experience of the editor: novice (less than six months experience) or experienced. Results showed that providing email prompts containing feedback with specific suggestion for improving the article and constructively critical (i.e., negative) feedback increased efforts on the article being critiqued. However, positive feedback and social salutations only had a positive effect on overall article edits for newcomer editors. One possible explanation for the manipulation only impacting novice authors was similar to that of Kizilcec et al. (2014). Essentially, participants experienced a negative emotional response to a challenge to their expertise, or to being persuaded and chose the path of action which is being advocated against.

Present work shows that depending on the design and context of the message prompts and the desired outcome of those prompts, results can vary widely. Further investigation is necessary to better understand how message prompts can be designed to positively impact student learning-relevant behaviors and encourage quality contributions to online course discussion forums.

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[3] www.khanacademy.com

3.4 Discussion

In online learning communities, there are many sources of information that can be leveraged in reputation systems and other approaches for positively influencing student interactions, but in this dissertation I explore how this information influences help seeking decisions through the lens of Expectancy Value Theory for Help Sources as well as evaluation anxiety. Learning goals adopted for use in online classrooms may not be the same goals for contexts outside of learning and so it is unknown how using technology to achieve one outcome elsewhere impacts learning outcomes in online courses.

Confusion is MOOC discussion forums can lead to increased dropout and responding to the confusion alleviates some of the dropout. Reputation systems are commonly employed in MOOCs to increase engagement and responses in MOOC discussion forums. But Coetzee et al. (2014) introduces initial evidence questioning the benefits of reputation systems for question asking inside a MOOC discussion forum. It is possible that reputation systems may have a negative impact on help seeking and may not be the best avenue through which to motivate alleviation student confusion.

4   Empirical Evidence for Expectancy Value Theory for Help Sources

The first step for answering our first research question is to ascertain whether Expectancy Value Theory for Help Sources can be used to explain student help seeking behavior. I am grounding this question within the context of a MOOC, because understanding and improving help exchange in these courses can have a large impact on student dropout (Yang et al., 2015). This initial survey experiment is designed to examine how manipulations derived from Expectancy Value Theory for Help Sources connect to EVT-HS beliefs and evaluation anxiety measurements.

4.1   EVT Helper Survey Experiment

The EVT Helper portion of the survey connects potential helper manipulations to items measuring expectancy value beliefs toward the help source, evaluation anxiety, and intention to seek help. The purpose of this experiment is to serve as initial empirical evidence for the relationships between expectancy for the help source, values for the help source, and help seeking outcomes as proposed in Makara & Karabenick (2013). This experiment also provides initial empirical evidence for including evaluation anxiety as a social concern in help seeking from a particular source.

Expectancies, values, and costs for the help source can be manipulated through the presentation of potential help sources. Potential helper screenshots should directly manipulate perceptions of expectancy and value for help sources. The helper screenshot, as shown in Figure 5, is on a blue background with an anonymized profile image and username, and one of four possible sentences that represent our experimental manipulation:

(1) "This person is a fellow student" (control)
(2) "This person is available to give help" (expectancy)
(3) "This person offers high quality help" (value)
(4) "This person will evaluate the quality of your question" (cost)

By deriving these sentences directly from the Makara & Karabenick (2013) Expectancy Value Theory for Help Sources, I intend to test whether the theory in its most direct form has the hypothesized effect on help seeking attitudes towards the help sources.
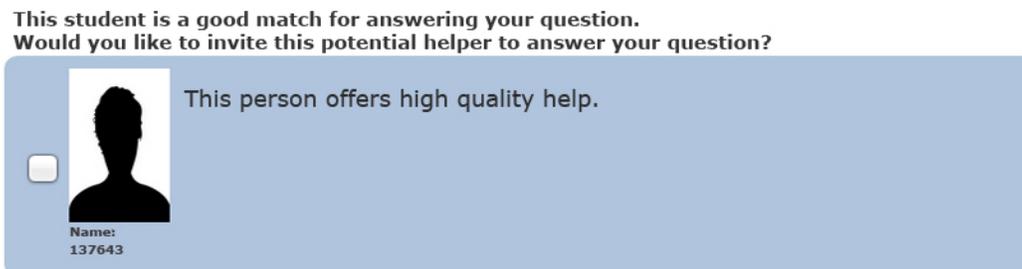
Figure 5. A Helper screenshot with the 'values for help source' manipulation sentence. Other sentences were used for the other three conditions.

4.1.1   Research Hypotheses

Our research hypotheses are derived from the direct relationship between the EVT-HS theory, and our manipulations. There is a set of hypotheses dedicated to the relationship between the manipulations and the beliefs, and an additional set of hypotheses related to the beliefs and the help seeking outcome. Figure 6 presents our tested hypotheses and the associated significant relationships.

EVT Helper Survey Experiment
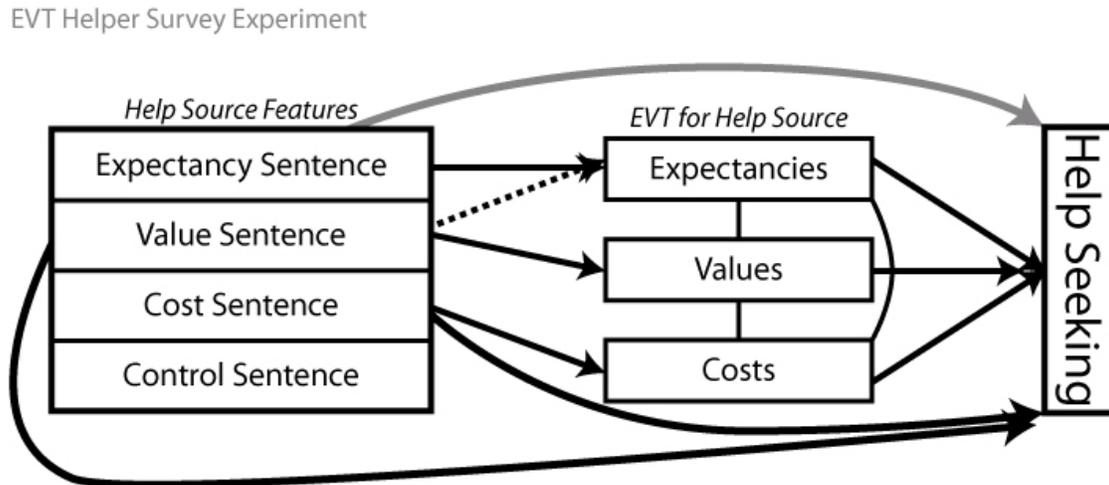
Figure 6. The hypotheses results model for the EVT Helper Survey Experiment. Black solid lines indicate supported hypotheses, grey solid lines are unsupported hypotheses, and black dotted lines are un-hypothesized relationships. Arrow-less lines indicate correlations. Hypotheses were supported, except the value sentence manipulated expectancy beliefs statistically indistinguishably from the expectancy sentence.

4.1.1.1   *Connecting Manipulations to Beliefs*

1. The Expectancy Sentence ("This person is available to give help") will increase self-reported expectations for the help source, more than the Control Sentence (and other sentence conditions).
    - (*Partial Support*) The Value Sentence and Expectancy Sentence resulted in significantly more self-reported Expectancy Beliefs for the help source, than the Cost and Control Sentences, $F(3,159)=13.68$, p <0.001, $R^2 = 0.68$.
2. The Value Sentence ("This person offers high quality help") will increase self-reported values of the help source, more than the Control Sentence (and other sentence conditions).
    - (*Supported*) The Value Sentence predicts significantly more self-reported Value Beliefs than the Expectancy and Control Sentences which predict more than the Cost Sentence, $F(3,159)=35.35$, p<0.0001, $R^2=0.64$.
3. The Cost Sentence ("This person will evaluate the quality of your question") will increase self-reported costs for the help source, more than the Control Sentence (and other sentence conditions).
    - (*Supported*) The Cost Sentence significantly predicts more Cost Beliefs (i.e., evaluation anxiety) than the Expectancy and Value Sentences, with the Control Sentence being statistically indistinguishable from the Cost and Expectancy conditions, $F(3,159)=2.80$, p $= 0.04$, $R^2=0.75$.

4.1.1.2   *Connecting Beliefs to Intention to Seek Help*

4. The EVT-HS beliefs should connect to help seeking outcomes.

a) Expectancy for Help Sources Beliefs should significantly positively predict intentions to seek help, *Supported:* $F(1,165)=401.11$, $p<0.0001$, $R^2=0.79$.
b) Value for Help Sources Beliefs should significantly positively predict intentions to seek help, *Supported:* $F(1,213)=245.77$, $p<0.0001$, $R^2=0.77$.
c) Cost beliefs (i.e., evaluation anxiety) should significantly negatively predict intentions to seek help, *Supported:* $F(1,212)=25.83$, $p<0.0001$, $R^2=0.69$.
d) Expectancies and Values for the Help Source should interact as an enhancing model on the prediction of intention to seek help, *Partially Supported:* $\beta = -0.03$, $t(200) = -1.69$, $p = 0.09$, $R^2=0.86$.

4.1.2 Study Design and Methodology

54 participants were recruited from Carnegie Mellon's Center for Behavioral and Decision Research Participant Pool (CBDR), as they share common age and educational levels with students in a MOOC. Each participant saw each of the four help source sentences in this within-subjects portion of the survey experiment (i.e., cost, expectancy, value, and control).

4.1.2.1 Survey Items

Dependent measures were evaluation anxiety items from Leary et al. (1986) detailed in Appendix A.-Costs of Seeking Help in a Particular Context, intention to seek and avoid help from the self-regulated learning literature in Wolters et al. (2005) (included in Appendix A.-Expectancies and Values of Help Sources) and newly designed items derived from the Expectancy Value Theory for Help Sources (in Appendix A.-Expectancies and Values of Help Sources). Cronbach's α for the Expectancy Beliefs for Help Sources items was 0.93 and for Value Beliefs for Help Sources, α = 0.96.

4.1.2.2 Statistical Approach

All analyses connecting categorical experimental manipulations to numerical beliefs scales were performed as an ANOVA with `RespondentID` as a random effect to account for the within-subjects experimental design. Since each participant saw all four of the sentence manipulations (control, expectancy, value, and cost), the categorical condition variable had four levels or three degrees of freedom. Analyses connecting the theory beliefs scales to intention to seek help were performed as a linear regression with `RespondentID` as a random effect as well. Post-hoc analyses connecting levels of variables to outcomes were performed via Student's t-tests.

4.1.3 Results

In general, as shown in Figure 6, our hypotheses were mostly supported, except the Value Sentence manipulation impacted expectancy for the help source beliefs, just as much as the Expectancy Sentence manipulation did. Statistical relationships are reported underneath the hypotheses in Research Hypotheses.

There was also a significant interaction between the evaluation anxiety and [positive] values for the help source variables on intention to seek help, $\beta = .12$, $t(210) = 2.47$, $p = 0.01$, as shown in Figure 7. As the values for the help source rise, the perceived evaluation anxiety caused by that help source decreases, although less steeply. This suggests that when students believe a helper will provide good quality help, they are also slightly less afraid of being evaluated by that helper. Evaluation anxiety for the help source may very well be functioning as a negative value belief.
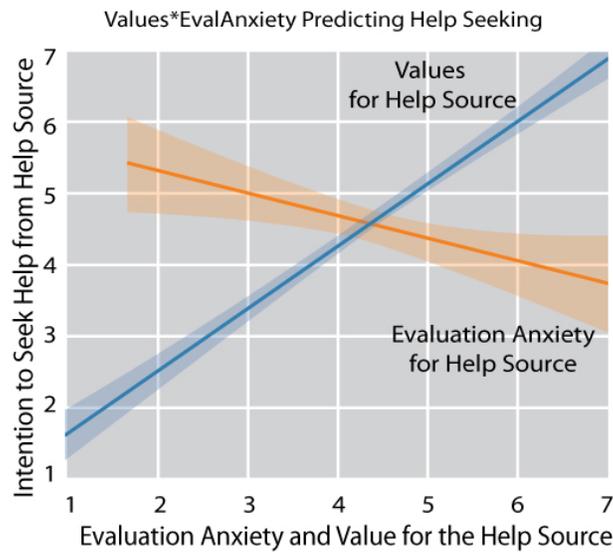
Figure 7. A line of fit with confidence of fit shading showing a significant interaction between values for the help source and evaluation anxiety on intention to seek help. As values for the help source increased, evaluation anxiety decreased.

Trautwein et al. (2012) suggests that expectancies and values in a domain-centric Expectancy Value Theory model should contain an interaction between expectancy and value with an enhancing effect. A marginal interaction between expectancies and values for the help source was found, $\beta = -0.03$, $t(200) = -1.69$, $p = 0.09$, $R^2=0.86$. However, the interaction term did not quite have an enhancing effect, as shown in Figure 8. It appears that the value beliefs for the help source hit the 1.73 standard deviation maximum, and a ceiling effect occurred, preventing a clear enhancing interaction from occurring.
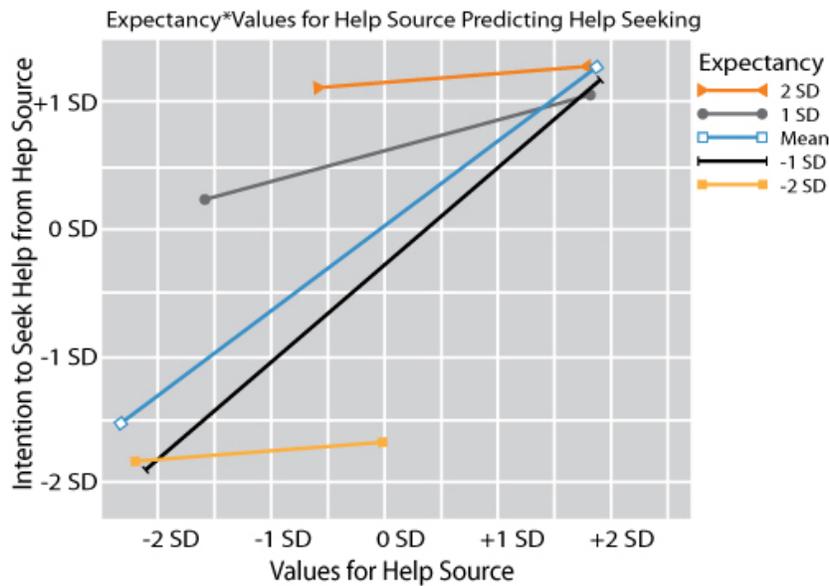

Figure 8. Expectancy and Value predicting Intention to Seek Help shown as standard deviations from the mean. An enhancing interaction would show these lines fanning outwards. Instead, there is likely a ceiling effect..

4.1.3.1   Path Analysis Modeling

In order to confirm our hypotheses and investigate how additional factors of the causal model are linked, I performed a preliminary path analysis using TETRAD V[4]. Structural equation models can be used to test mediation hypotheses, estimate total effects, and separate direct and indirect effects within a unified framework. Tetrad is a causal model simulator and estimator. Many of its model search algorithms are discussed in Spirtes et al. (2000). When a hypothesis model is rejected, Tetrad can be used to search for models that are both theoretically possible and also consistent with the provided data. In my analyses, the GES search algorithm is combined with prior background knowledge to constrain the space of the models that are searched. For these experiments, I assume that the independent variables are exogenous and causally independent. The EVT-HS beliefs are prior to intention to seek or avoid help.

The accepted logic of hypotheses testing is inverted in path analysis such that the p-value represents the probability of seeing more deviation between the covariance matrix implied by the estimated model and the observed covariance matrix, based on the null hypothesis that the model estimated was the true model. And so, a low p-value suggests that the model can be rejected and a high p-value means that it cannot.
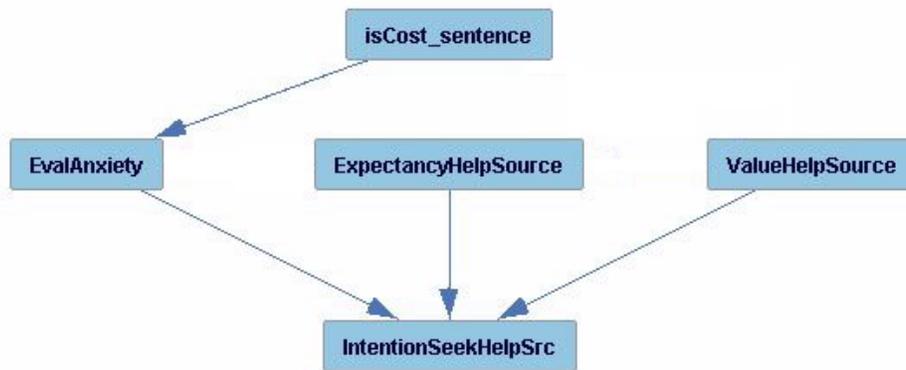
Figure 9. Prior knowledge model for our hypotheses for the cost manipulation sentence to the theory portion of the model. Directed edges represent a required direct causal relationship relative to other model variables. The three different levels show constrained causal ordering relationships (i.e., "isCost_Sentence" can cause evaluation anxiety, but not the reverse). Prior knowledge models are used to constrain the space in which the GES algorithm searches for matching causal models.

I set required relationships on the causal model represented by the hypotheses as shown in Figure 9. By forbidding a direct relationship between the experimental manipulation and intention to seek help the EVT-HS beliefs variables are forced to be mediators of that relationship. The directed edges in the graph represent a direct causal relationship. No restrictions were set on the relationship between the EVT-HS beliefs variables, and so the GES algorithm searched pattern space for an optimal model to fit within other given constraints. We see in Figure 10 a model that fits the data well (X^2=1.56, df=3, BIC=-14.6, p=0.67). This model suggests causal relationships that reinforce our hypotheses and previously discussed results.

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[4] http://www.phil.cmu.edu/tetrad/

When constructing a model based upon our hypotheses related to the value sentence manipulation, it was similar to that shown in Figure 9, except the relationship between the sentence condition and value beliefs was required. The model discovered by a GES search, shown in Figure 10, also generally confirms our original hypotheses and fits the data well (X^2=1.56, df=3, BIC=-14.6, p=0.67). Figure 11 shows a similar causal model for the value sentence returned by GES search which fits the data well (X^2=1.18, df=3, BIC=-14.9, p=0.76). Figure 12 shows the corresponding causal model for the expectancy sentence which also fits the data moderately well (X^2=6.67, df=4, BIC=-14.8, p=0.16). All three sentence variables cannot be included in the same model due to their collinearity.

In general, these causal models provide support for our previous results and hypotheses. The models also all generally support a relationship between expectancies and values for the help source, and expectancies and evaluation anxiety for the help source. We see once again that the value sentence manipulation has an impact on both expectancies and values for the help source, but these causal models also suggest that the expectancy sentence impacts value beliefs and the cost sentence impacts value beliefs for the help source.

Figure 10. The model found by GES, showing the cost sentence manipulation, and its relationship to EVT-HS beliefs as mediators on intention to seek help from the source.

Figure 11. The model found by GES, showing the value sentence manipulation, and its relationship to EVT-HS beliefs as mediators on intention to seek help. An orange arrow indicates an undirected relationship.
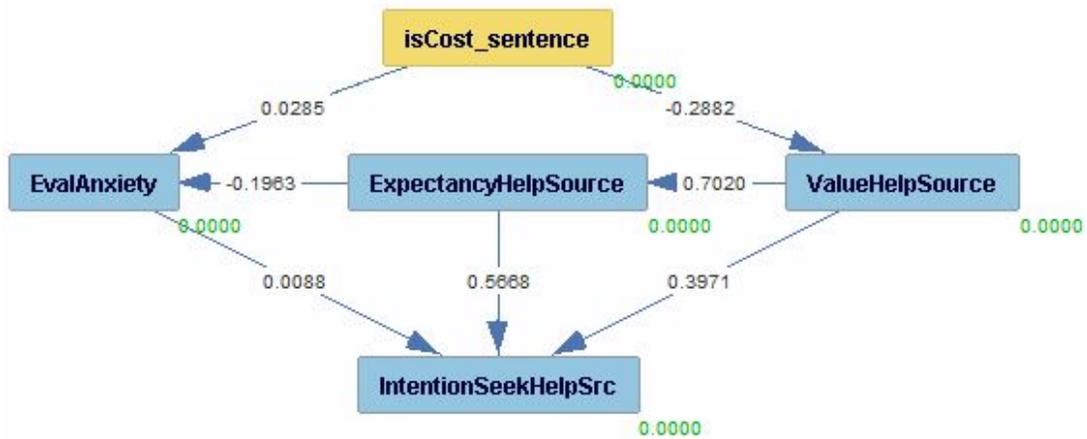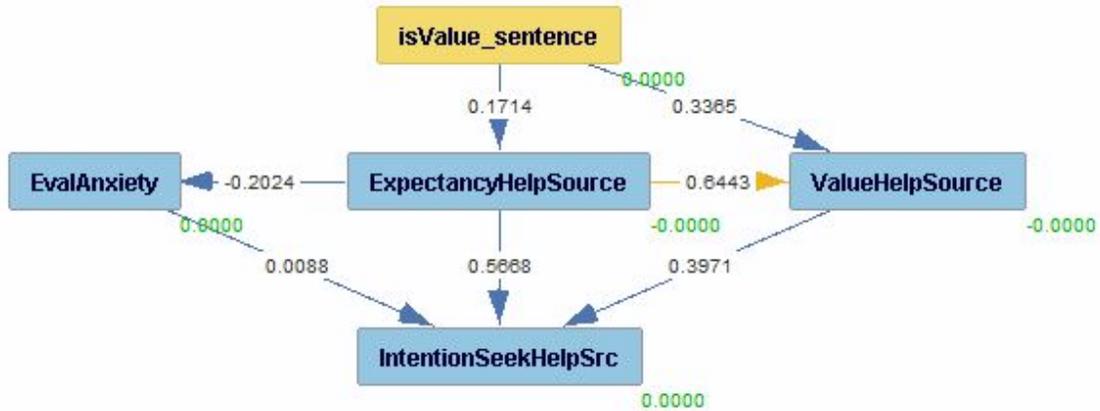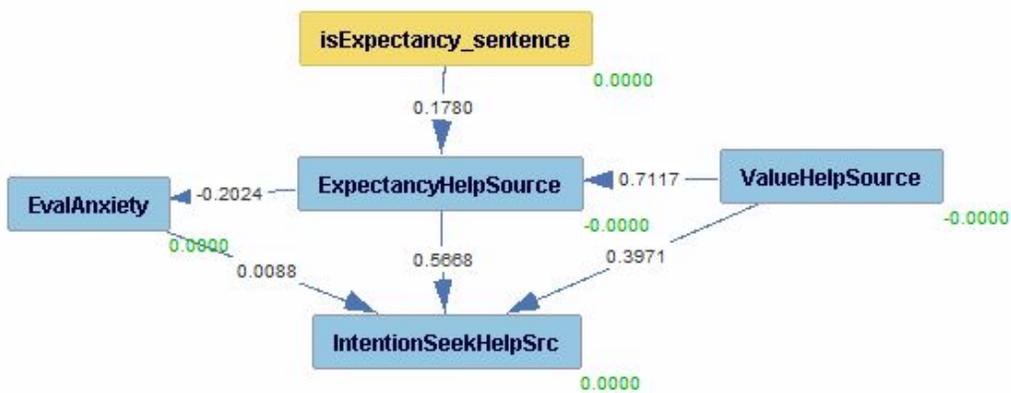

Figure 12. The model found by GES, showing the expectancy sentence manipulation, and its relationship to EVT-HS beliefs as mediators on intention to seek help.

4.1.4   Limitations

This survey experiment employed the use of a hypothetical online classroom and assumed the participant had a hypothetical question to ask in order to provide context. While our results provide some confidence in the environmental validity of this method, the ecological validity might be questionable. Furthermore, each manipulation only had one sentence, and so respondent beliefs might be in response to the phrasing of the question and not the larger theory manipulation the sentence was designed to represent.

I was unable to manipulate Value Beliefs for the Help Source separately from Expectancy Beliefs for the Help Source. A few possible explanations consist of: (1) the Expectancy Beliefs items could be inaccurately constructed, (2) the value manipulation sentence was inaccurately constructed, or (3) the Expectancy Value Theory for Help Sources requires refinement. Possibilities (1) and (3) remain and are connected, as the Expectancy Belief items were derived directly from the theory. As part of these possibilities, value beliefs might be difficult to separate from expectancy beliefs. It is possible that (2), the value manipulation sentence, in using an active verb (This person offers high quality help), suggests that the helper is available. However, an even stronger manipulation may be necessary, possibly, "We don't know if this person can give you help, but they can give good quality help." It may not be possible to realistically manipulate value beliefs separately from expectancy beliefs for the help source. Future work should investigate the design of manipulatives that can impact values for the help source beliefs separately from expectancy beliefs.

4.2   Chapter Discussion

From our results, we see that the EVT-HS beliefs impact help seeking outcomes as hypothesized, and that our inclusion and measuring of evaluation anxiety for the help source appears to function as designed. This initial evidence supports Expectancy Value Theory for Help Sources in its proposed form. From a more practical perspective, value beliefs for the help source are difficult to manipulate separately from expectancy beliefs. A student could believe that if resource A gives good quality help, then they probably are available to give help. From a practical standpoint this is less of an issue, as course designers can focus on educational technology that raise either (or both) expectancies or value beliefs for the help source to garner a positive impact on help seeking.

However, from a theoretical standpoint, the fact that values cannot be easily manipulated separately from expectancy beliefs for the help sources suggests that Expectancy Value Theory for Help Sources might require some refinement to be more useful in explaining the specifics of seeking help from a particular source. The hypothesized relationship between our measures of expectancies, values, and costs to intention to seek help was supported, which implies that it is not purely a question of theory, but a matter of manipulating the theory beliefs in a real-world setting.

Furthermore, while an enhancing interaction between expectancies and values for the help source was expected, the marginal interaction did not appear to fulfill the hypothesized enhancing relationship. A ceiling effect is likely a partial explanation.

5 Applying Expectancy Value Theory for Help Sources to a Help Seeking System

Reputation Systems, as realized in MOOCs have many features that may positively or negatively impact students' intention to seek help. In this chapter I explore how we might examine commonly implemented reputation system features and their connection to Expectancy Value Theory for Help Sources as well as how a helper is selected. I pursue my research question of applying EVT-HS to improve the learning experience in online courses through the design and deployment of our Quick Helper System intended to connect helpers to students who request help. This examination in the Quick Helper field experiment is further investigated with self-report instruments in two additional survey experiments, connecting the common reputation system features with self-reported expectancies, values, and costs for help sources.

The context of these three experiments is our Quick Helper help exchange system which was designed by my collaborators to connect MOOC students who need help to peer helpers who can answer their questions. The field experiment examines how the presentation of these peers impacts whether they are invited by students to be helpers. The follow-up survey experiments examine how these peer presentations influence student expectancies, values, and costs for the helper.

What I find is that different commonly used reputation system features impact different factors of the EVT-HS model. Specifically, providing expertise information about the potential helper can positively influence anticipated values and expectancies for the help offered by the help source provided that the helper's expertise meets a particular expertise threshhold. 'Help Giver' badges reduce evaluation anxiety caused by the help source, while up/downvoting increases evaluation anxiety. Just as in the EVT Helper Survey Experiment, increases in expectancies and values yielded an increase in seeking help from the presented helper, and decreasing evaluation anxiety (a social cost) yielded a decrease in helper selection.

A final survey experiment examines how Expectancy Value Theory for the Help Source might relate to more general expectancies and values for help seeking in general.

5.1 QH MOOC Experiment

This experiment investigates student help seeking decisions in a MOOC help exchange system through the lens of Expectancy Value Theory for Help Sources. When a student in our experiment seeks help, they are given the option to select up to three potential helpers before posting their question to the course discussion board. It is through the presentation of these potential helpers that we apply our expectancy value lens. Our three main experimental dimensions consist of components of Expectancy Value Theory for Help Sources as well as evaluation anxiety (a potential cost).

To examine how reputation systems impact student expectancies, values, and costs for a help source, we selected three features that are commonly part of reputation systems: badges, helper expertise information, and up/downvoting. These features are much more ambiguous in design than the sentences derived from the EVT-HS theory in the previous survey experiment. So while it is possible to hypothesize the valence of the features' effect on help seeking, we might not be able to accurately predict the exact effect on beliefs these features may have.

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These common reputation system features were then adapted for our Quick Helper help exchange system for MOOC discussion forums. When students used our Quick Helper system, they were presented with some potential peer helpers to invite to answer their question in the course discussion forum.

We emphasized the different components of our model through methods currently employed in MOOCs and other online learning systems. Without an associated survey instrument, we can only hypothesize about whether the manipulations will have a positive or negative impact on helper selection in our help exchange system. A "Help Giver" badge system with one to four stars, which are shown in Figure 13, should have a positive impact on help seeking. If not assigned to the badge condition, potential helpers were displayed without a badge. The number of stars on the help giver badge is determined by rank ordering the three potential helpers, although we provided no explicit explanation of the stars' meaning to students. We based these badges on the visual appearance of the OLDS MOOC badges (Cross 2013), but our Help Giver badges were displayed within our Quick Helper system and not rewarded to students for display on personal pages or posts. In this way our badges were not applied in their typical way as motivational and extrinsic rewards.

Figure 13. The four different Help Giver badges that were displayed next to our recommended helpers.

By providing explicit insight into the potential helpers' knowledge, we should also elicit a positive impact on helper selection in our help exchange system. In this way, the student could evaluate the potential helpers' ability to provide accurate help. The sentence displayed was "This student has been participating in the course for <#> weeks and the matching of his/her knowledge and the topic of your query is <#>%." The numbers were provided by the system, but no further explanation of their meaning was provided to students. If not assigned to the relevant sentence condition, students were shown a control sentence about their potential helper from the following four sentences: "This colleague has a computer and is ready to go.", "This colleague is involved in the course.", "This colleague answers email on a regular basis.", and "This colleague uses Web 2.0 technologies." Figure 14 shows two examples where the top example is the positive manipulations and the bottom image exemplifies the control counterparts.
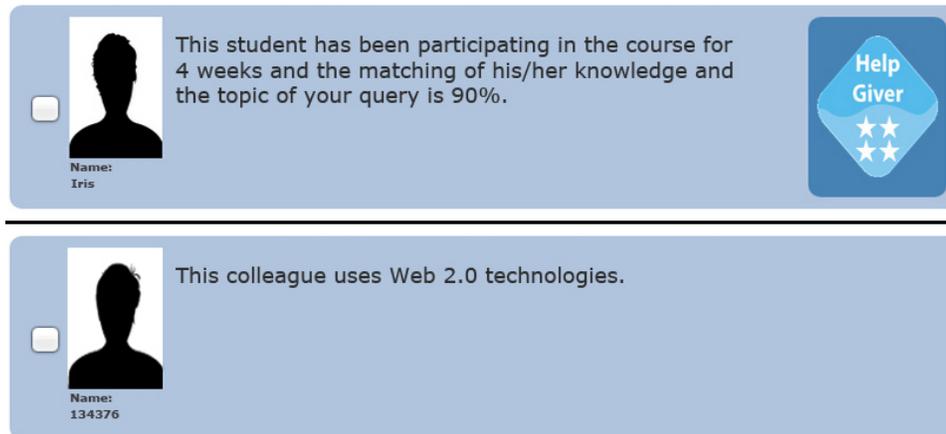
Figure 14. The top image shows badge, relevant expertise sentences, and username conditions, while the bottom image exemplifies the control version of these manipulations.

We emphasized a potential cost of seeking help by displaying to the help seeker a preview of the email selected helpers would receive. Help seekers could see from this preview email message that their selected helpers will be invited to evaluate whether the student's question was good. We did this through an exaggerated up/downvoting interactional archetype using buttons commonly used in MOOCs (Coetzee et al. 2014) and other help request discussion forums such as StackOverflow[5]. Our implementation of up/downvoting is shown in Figure 15. Knowing that one's post will explicitly be evaluated by any selected helpers should also increase public threats to self-esteem, thereby emphasizing the costs of selecting helpers. In the non-voting condition, the preview email message did not have the "Is this a good question?" with green and red buttons following.

We also manipulated whether or not students saw their potential helper's usernames. Students' selected usernames are most commonly displayed in discussion forums. However, knowing your helpers' names may impact perceived expectations and values about their help-giving abilities. And so, we included helper anonymity as a fourth dimension in our experiment, so that we might explore how Expectancy Value Theory of Help Sources lives in both a real world setting, as well as in a slightly more controlled experimental setting. However, our analyses showed no effect of this manipulation, and so it is dropped from further discussion.

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[5] http://stackoverflow.com/
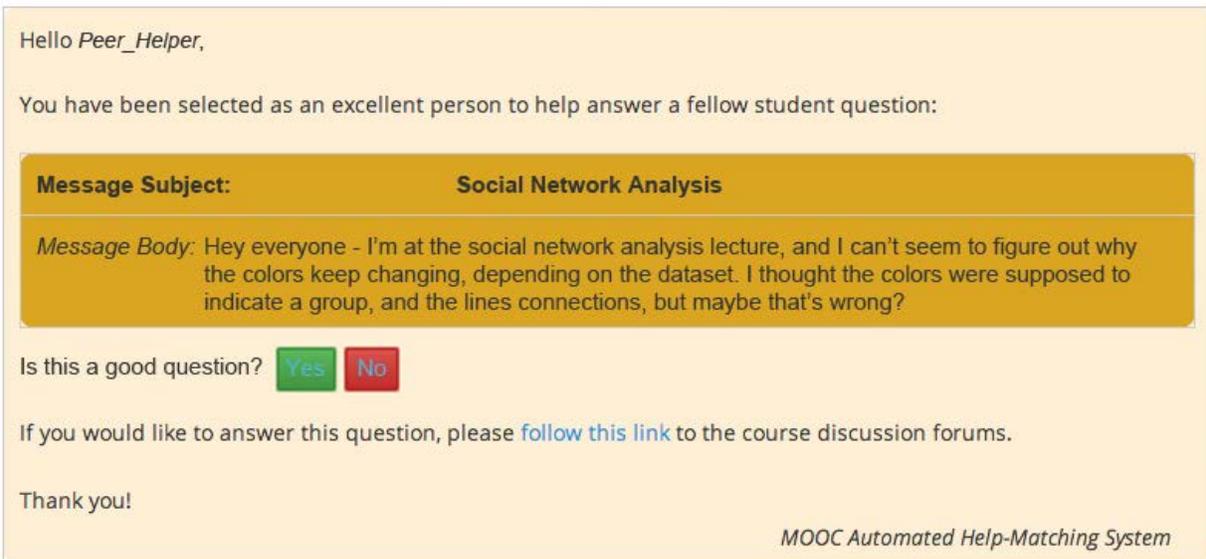
Figure 15. The preview private email message to helpers, with up/downvoting implemented. The non-voting version does not include the line "Is this a good question?" nor the green and red buttons.

5.1.1 Research Hypotheses

These three common MOOC features provide us the ability to investigate how emphasizing components of Expectancy Value Theory for Help Sources and evaluation anxiety impact helper selection in a help exchange system, yielding the following hypotheses which we test in the QH MOOC Experiment also represented in Figure 16.
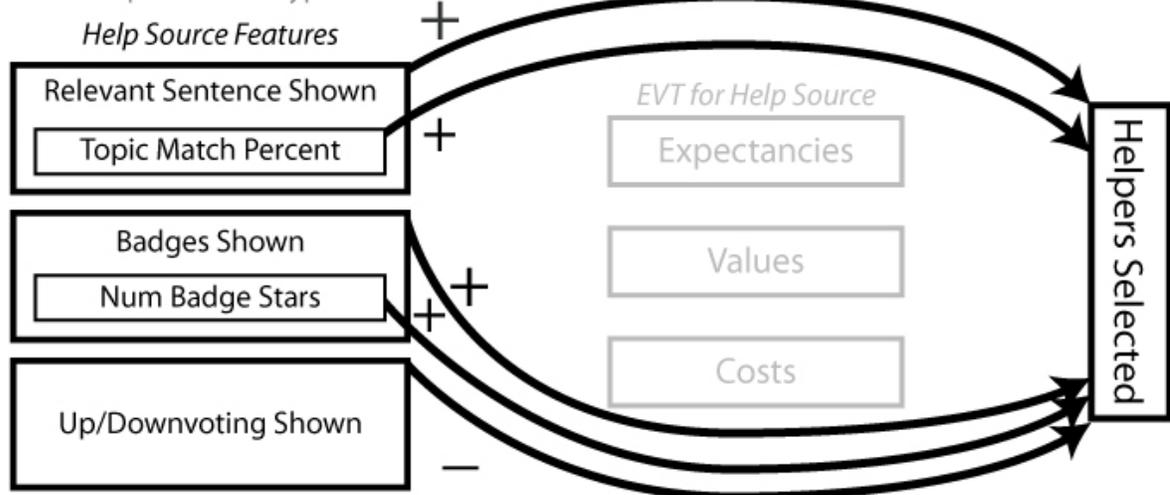
Figure 16. Hypothesized relationships between variables in the Quick Helper MOOC Experiment. No survey responses were available, and so the only outcome variable was whether the helpers were selected or not.

1. Relevant Sentences. Placing an emphasis on the helpers' knowledge and revealing their expertise on relevant topics should raise the perceived expectancies or values of the help that helper can

provide. This should be reflected by an increase in the help seeking outcomes, as compared to the non-relevant control sentences. (*Marginally supported*)

    a. An increasing number of weeks enrolled in the course should increase the number of helpers selected. (*Not supported*).

    b. An increasing topic match percentage shown should increase the number of helpers selected (*Supported*).

2. Badges. The presence of badges implying information about a peer's help giving should increase the likelihood students will seek help. In our system design, this increased likelihood will be reflected by a larger number of peers privately invited to view a public thread. (*Partially supported as an interaction with voting, see QH Theory Survey Experiment*)

    a. An increasing number of badge stars should increase the number of helpers selected (*Not supported*)

3. Voting. Being evaluated via up/downvoting increases the cost of seeking help, yielding a reduction in help seeking outcomes. (*Supported as an interaction with badges*)

To investigate how these expectations, values, and costs influence help seeking in MOOCs, we performed a 2 (badges) X 2 (relevant sentences) X 2 (voting) factorial experiment in the context of MOOC discussion forums. Our experiment manipulates how potential helpers are presented to the help-seeking student. Number of helpers selected is the main help seeking outcome we are investigating.

5.1.2 Social Recommendation for Help Seeking

Our experiment focuses on how to present and use the information returned by a social recommendation algorithm for help seeking. A collaborator implemented a context-aware Matrix Factorization model to predict students' preferences for answering a given question. In prior work, we used a similar approach designed to recommend discussion threads to students (Yang et al. 2014a), but only evaluated in corpus analysis experiments, not in a deployment study. The recommendation algorithm had not been implemented in a live system until this QH MOOC Experiment. When the student submits her question through the Quick Helper, the algorithm uses the content of the question and metadata on the student's peers to select three appropriate peer helpers. It first maps a student's question to a similar question, and then estimates students' preferences for answering that question by taking into account features from students, questions and student connections as described in Yang et al. (2014a, 2014b). The algorithm could also include load balancing to prevent any particular student from being overwhelmed by requests for help although we did not use this feature in the QH MOOC Experiment.

In the initial two weeks of the course when data on students was lacking, we used a "TA Version" of Quick Helper. Teaching Assistants were volunteers recruited by the MOOC instructors. The TA Version was different from the Student Version in the following ways: (1) the badge condition always showed four stars for the TAs, (2) the expertise topic match sentence was always "This is one of the Teaching Assistants selected for this course. All of our Teaching Assistants are highly qualified to answer student queries", (3) The TA's username was always shown. Our analyses controlled for differences in the TA and student version of the MOOC.
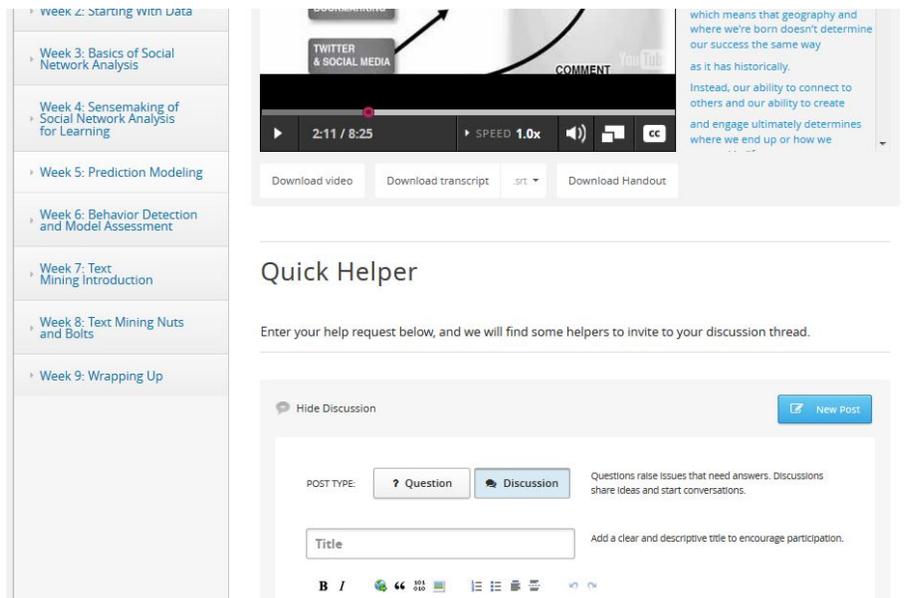
Figure 17. A screenshot of the MOOC with the Quick Helper discussion submission beneath a video lecture.

5.1.3 Course Testbed

Students in a learning analytics course hosted by edX[6] had the option to post their questions directly to the course discussion forums, or to use our "Quick Helper" as shown in Figure 17. Using the Quick Helper would still post the question to the public discussion forum, but also privately invite selected peers to view the thread's URL. Quick Helper was developed by co-authors Gaurav Singh Tomar and Diyi Yang.

The detailed process is as follows, as shown in Figure 18: *Step 1.*When the Quick Helper button is clicked, the action is logged and the student submits their question. The question is posted to the course discussion forum, sent to our Quick Helper system, and the student is randomly assigned to one of our 2^4 conditions. *Step 2.* The student's question is passed to an intelligent social recommendation algorithm which selects and recommends three potential helpers to answer the student's question. At this point, the presentation of these helpers is then manipulated such that the helpers are presented according to random condition assignment each time the Quick Helper client is accessed on the course website. *Step 3.* Information (i.e., the user name/user ID, profile image, user expertise description, and badges for user rating) about these recommended helpers is sent back to the student via a window. This window presents the user with the potential helpers. At the top of the window is a sample private message that will be sent to the selected helpers (should the student select any), as shown in Figure 15. Immediately below the preview message are the helpers from which to select, as shown in Figure 19. *Step 4.* The student selects 0-3 helpers. The system sends an email to each of the selected helpers including a hyperlink to the forum thread that was posted in Step 1, inviting a response.

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[6] https://www.edx.org/
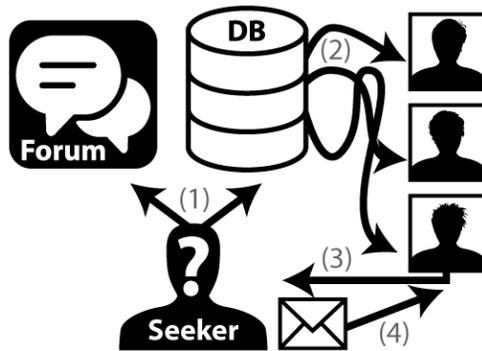
Figure 18. An illustration of the steps in our Quick Helper system. Students use Quick Helper to have potential peer helpers recommended to answer their question.

Whether or not the student selects a helper, the Quick Helper system always published the help request into the course discussion forum, and anyone in the community could respond. Our intervention added the option to explicitly invite helpers to the thread to increase likelihood of a response. I applied Expectancy Value Theory of Help Sources to test what conditions increases propensity to invite helpers.
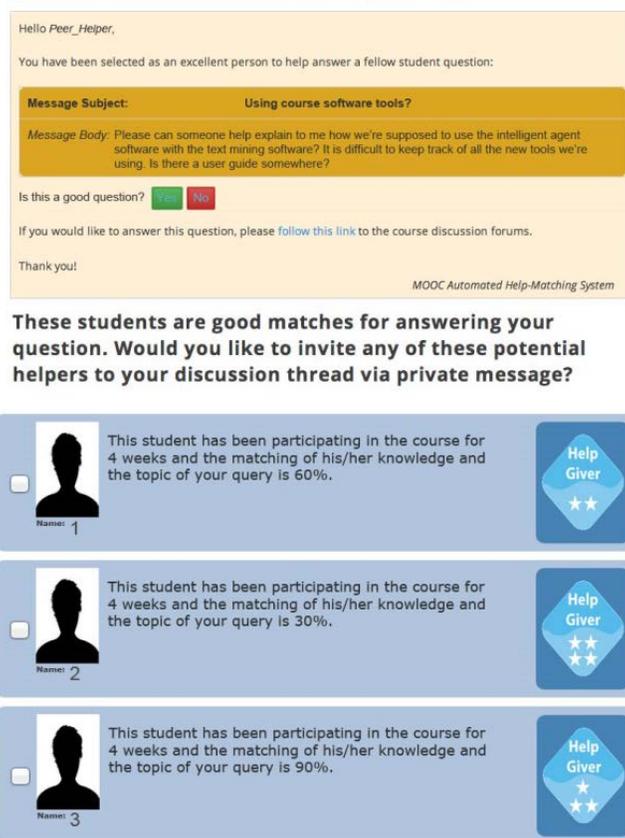
Figure 19. A screenshot of the Helper Selection Window showing the preview email message on top and the helper selection screen below. This screenshot shows the voting, badge, and relevant expertise topic match sentence conditions.

5.1.3.1 *System Evaluation*

Throughout the duration of the learning analytics MOOC, approximately 20,000 individuals were enrolled, although after the initial three weeks no more than 2,493 students were active in a given week. 285 MOOC students posted a total of 671 threads to the discussion forum throughout the entire course and 96 of these students used the Quick Helper at least once. Furthermore, use of Quick Helper relative to non-Quick Helper discussion forum posts increased over time, as shown in Figure 20.

We had numerous successful cases in which a student used the Quick Helper, invited three potential helpers to their forum post, and one of those invited peers responded, such as in the example below:

> *Student151:* I don't remember being able to participate in a hangout. In fact all I got was George in a parking lot and then some guy talking about data.

> *Student 102:* Hi Student151 The hangout you are referring to was the TONY HIRST HANGOUT from Week 2. I will usually get an email sent to me informing me of the date and time of the upcoming hangouts so if I want to participate, I will know when they are happening…
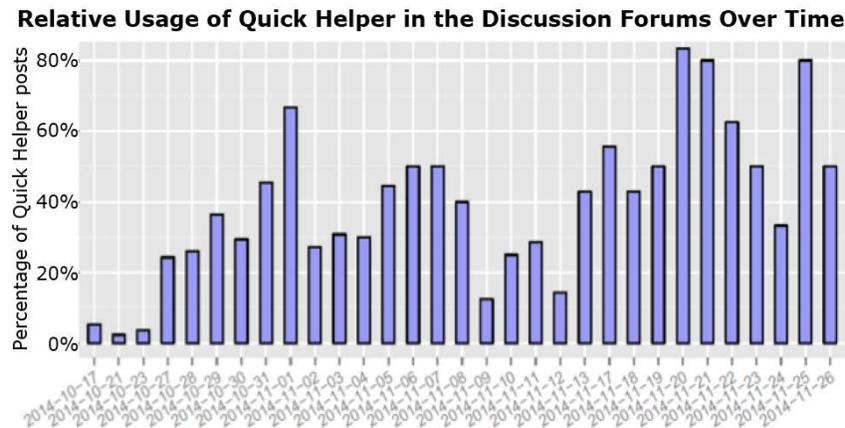
Figure 20. An increasing ratio of Quick Helper to non-Quick Helper posts in the discussion forum over time.

However, in doing a more thorough step-by-step analysis, we realized that the Quick Helper system was often inviting potential peers who may have become inactive, although they had been active in the past. This suggests that going forward our algorithm needs to incorporate students' last active date and a threshold for recent inactivity as a feature in the social recommendation algorithm.

Our analysis also revealed a few Quick Helper instances in which the student was not seeking help, but was perhaps using the Quick Helper system as more convenient access to the discussion forums. This suggests that as a new MOOC feature, students are still developing a working mental model of the purpose and benefits of using the Quick Helper. Using different introductory wording or with more widespread use, the learning curve for using the system might be reduced.

5.1.4 Results

Our dataset for testing our hypotheses includes 161 of the Quick Helper instances by 66 users, who selected a mean of 0.79 helpers ($\sigma = 1.17$). Participants were randomly assigned to 2^4 conditions. Prior to

our analysis, we removed instances that were not relevant to our hypotheses about help seeking as well as data points with a timestamp occurring after the course had officially ended.

5.1.4.1 Statistical Approach

We have two dependent variables at two levels of analysis. Our main dependent variable, 'Number of Helpers Selected', is at the Quick Helper instance level. We can use our binary badges, voting, and sentence conditions to predict number of helpers selected. Within the badges and sentence conditions, we have sub-level independent variables. These sub-level variables include the number of stars shown on the badge as well as the number of weeks enrolled and topic match percentages. These independent variables are at the helper level and 'Helper Was Selected' is the relevant dependent variable. There were three helpers shown per Quick Helper instance, so it is not possible to investigate individual helper sentence level variables with respect to instance level variables (i.e., three different sentences were displayed at once). The proportion of helpers selected with our Quick Helper system is shown in Figure 21.
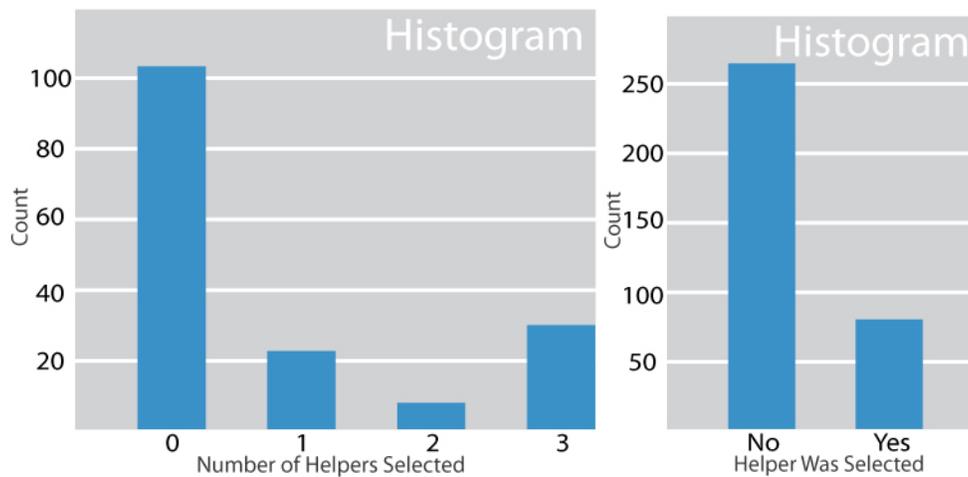
Figure 21. The histogram on the left shows how many helpers were selected per Quick Helper instance (dependent variable for the binary independent variables). The histogram on the right portrays the proportion of helpers that were selected overall (sub-level variables).

Version (i.e., student or TA) is maintained as a covariate throughout the analyses, and post-hoc analyses are performed as Student's t-test.

5.1.4.2 Hypothesis 1 – Relevant Sentence Hypotheses

An ANCOVA analysis, controlling for version showed that the relevant sentence condition had a marginal effect on number of helpers invited to the question thread, $F(2, 149) = 3.38$, $p < 0.07$ (Cohen's $d=0.21$). A Student's t-test post-hoc analysis revealed that students in the relevant sentence condition selected marginally more helpers to be invited to their help request thread. This marginal result follows the predictions of Hypothesis 1, although is described further by analysis of Hypothesis 1a.

We also investigated how the information displayed in each condition impacted whether a helper was selected. (Hypothesis 1a, 1b) Topic match percentage shown in the value emphasis condition had a significant effect on whether the helper was selected, $X^2(1, N=168) = 8.64$, $p < 0.01$ (Cramer's $V=0.009$),

as shown in Figure 22. (Hypothesis 1a) The number of weeks the helper participated in the course did not appear to have an effect on students' choices of helpers.
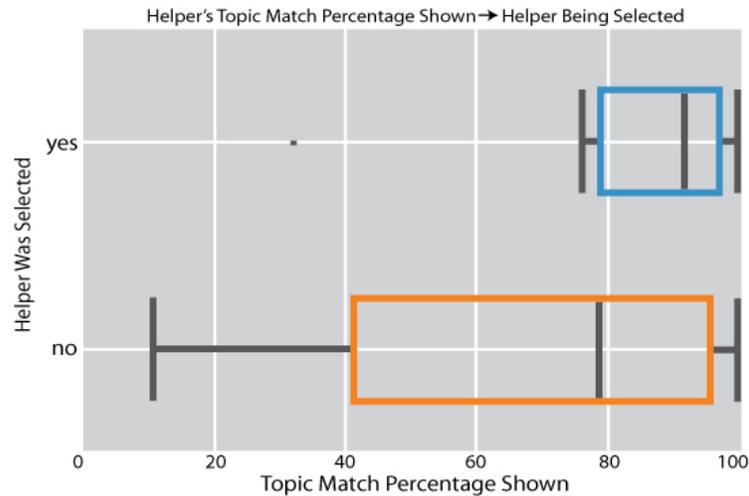
Figure 22. A comparison of the topic match percentages shown next to helpers, by whether or not the help-seeker selected them as a helper or not. If a helper had less than 80% topic match displayed, they were unlikely to be selected as a helper.

From Figure 22 we can see that helpers with topic match percentages displayed under approximately 80% were unlikely to be invited to answer the question thread. This suggests that lower topic match percentages are not emphasizing a potential helper's quality of help, but rather a complete lack of quality. This 80% threshhold is the likely reason why the effect of expertise sentences on number of helpers selected was marginal and not fully significant. Figure 23 shows that most of the potential helpers shown had a topic match above 70%, which is why we maintain some effect of relevant sentence.
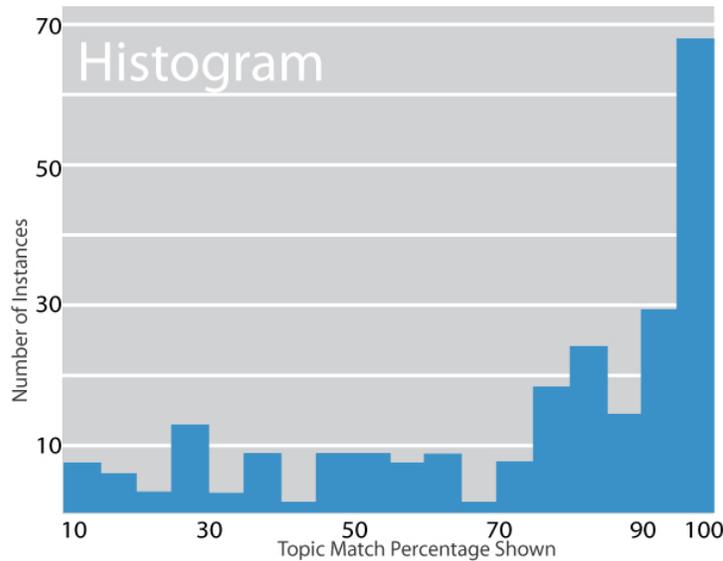
Figure 23. A histogram showing the quantity of topic match percentages shown to help-seekers. A majority of the topic match percentages shown was over 70%.

5.1.4.3 Hypotheses 2 and 3 – Badges and Voting Hypotheses

Further investigations of our usage of badges and voting revealed no statistically significant relationship, until we look at the interactions between our conditions. There was a significant interaction between badges and voting, $F(4, 129) = 4.07$, $p < 0.05$, $R^2 = 0.05$ ($\Delta R^2 = 0.025$), with a post-hoc analysis revealing that voting only appears to have an effect when no badges are present. A Student's t-test (and Figure 24) shows that in the absence of badges, significantly more helpers are selected in the non-voting condition. This interaction supports Hypothesis 3 which predicts a negative relationship between increasing the cost of help seeking, and the number of helpers selected. Hypothesis 2 is also supported as part of this interaction which also introduces the potential of using help giver badges to alleviate the negative effects brought about by the use of up/downvoting. The most number of helpers were invited on threads when prospective helpers were shown without voting and without badges, although this difference is not statistically significantly better than the conditions where badges are present.
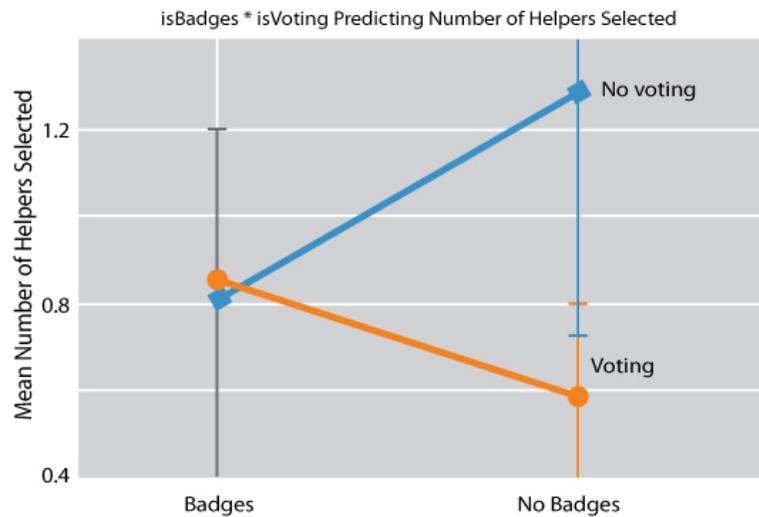
Figure 24. An interaction plot between Help Giver Badges and Up/Downvoting. Without Help Giver badges, students selected significantly fewer helpers when they knew their helper would explicitly evaluate the quality of their question.

Table 2. Results of planned statistical tests of main independent and dependent variables.

		Helper Was Selected	**Increased Being Selected**
	Badge Shown	$X^2(1, N=342) = 1.08$, $p < 0.30$	
	Badge Stars	$X^2(1, N=177) = 0.07$, $p < 0.80$	
	Sentence Shown	$X^2(1, N=342) = 5.52$, $p < 0.02$**	Relevant Expertise Sentence (i.e., Topic Match Sentence)
	Sentence Topic Match	$X^2(1, N=168) = 8.64$, $p < 0.01$**	Increased Match Percentage
	Sentence Num of Weeks	$X^2(1, N=168) = 0.05$, $p < 0.82$	
	Voting Shown	$X^2(1, N=477) = 3.15$, $p < 0.08$*	No Voting Shown (see interaction with badges)

Note: ** denotes statistically significant while * indicates marginally significant differences detected.

In investigating how the number of stars on the Help Giver badges related to whether a helper was selected, we did not find a statistically significant relationship, although the trend was in the expected direction: more badge stars shown increased the likelihood of the helper being selected. Table 2 shows more of the results of our planned statistical tests.

5.1.5   Discussion

Our results, summarized in Figure 25, suggest that two commonly applied features of reputation systems have a complex relationship with student help seeking. That is, without badges providing information about whether the help source is a help giver, up/downvoting facilities may have negative effects. The presence of the badges alleviates the potential harmful effects to public self-esteem, resulting in students inviting more helpers to their discussion threads. This suggests that our Help Giver badges and up/downvoting mechanism might be influencing the same student beliefs as part of the EVT-HS model. Designers of MOOCs and SPOCs (Small Private Online Course) need to be mindful of which features they decide to deploy in their course, and how those decisions impact student help seeking.
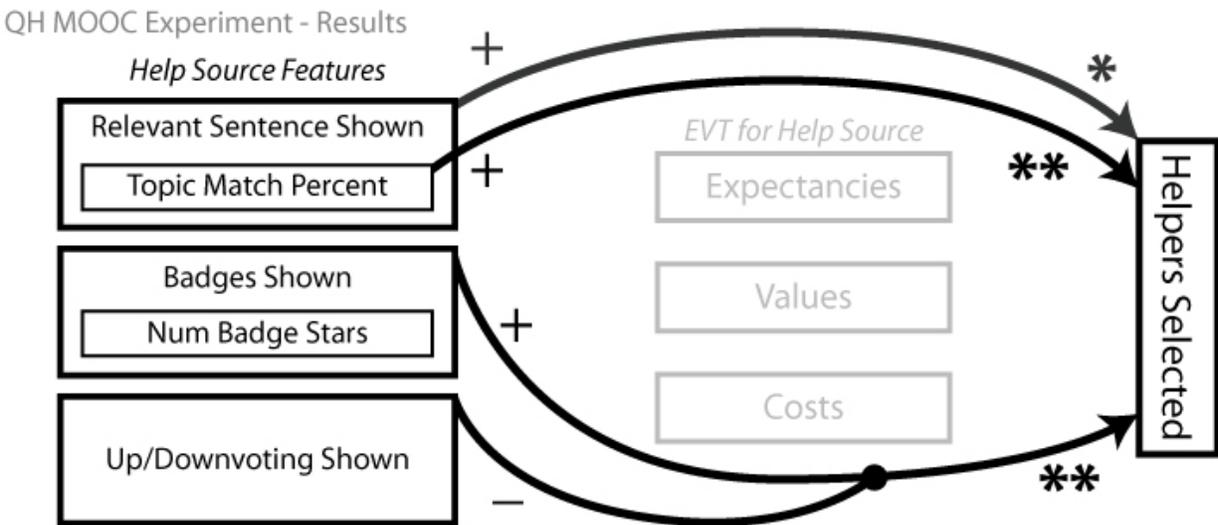
Figure 25. Statistically significant relationships between variables in the Quick Helper MOOC Experiment. No survey responses were available, and so the only outcome variable was whether the helpers were selected or not. Positive independent variables had a positive effect on helpers being invited to the thread, while voting had the hypothesized negative effect on helper selection. An interaction between badges and voting is represented by connecting lines.

The marginal effect of value emphasis on number of helpers selected supports our first hypothesis. Knowing that help sought will be high quality increases the number of helpers a student invites to their forum thread. Information about peer expertise may be important to share with help seekers. Designers of online courses may want to consider how they present the expertise of their potential helpers. In our case, a knowledge topic match below 80% had a negative effect on the number of helpers invited to a thread.

5.1.5.1   Limitations

Our Quick Helper system was designed to test our theoretical questions, and so some of our manipulations are particularly exaggerated and may not represent the design of reputation systems in more standard environments. This is possibly true for the up/downvoting manipulation. Furthermore, our

dependent variables (i.e., helper selection) were obtained immediately after exposure to the experimental manipulations. This provided ideal control over environmental variables, but 'helper selection' may not be a valid dependent variable in all MOOC discussion forum systems.

Additionally, this experiment was designed for a much larger sample size, but due to Quick Helper's novelty we did not see as much use of our system as anticipated. Due to this, we have limited statistical power to draw reliable conclusions about external validity. It might be informative for improving the help exchange system for a more in-depth analysis to examine why students clicked the Quick Helper, but then did not invite any helpers to their thread. It is possible that the Quick Helper interface was overwhelming or that inviting helpers was too effortful. It is also possible that students viewed the Quick Helper as a shortcut to using the discussion forum, and not as limited to purposes of help seeking.

5.2   QH Theory Survey Experiment

The QH Theory Survey Experiment is designed to determine if commonly used reputation system features can be mapped to Expectancy Value Theory for Help Sources through self-report. As these features are even more ambiguous in their intent than the theory-derived sentences from the EVT Helper Survey Experiment, it becomes imperative to understand how our manipulations from the QH MOOC Experiment actually related to the theoretical constructs.

Understanding the impact that common reputation system features have on expectancies, values, and costs for help sources is a novel line of research, but this survey also provides us with the opportunity to explore our control expertise sentences to ensure that they did not have unintended effects on the constructs. The more general features such as Help Giver Badges, voting, and helper expertise contribute to our understanding of EVT-HS in practice. The specific investigation of the wording of control expertise sentences may function more as a manipulation check in this particular experiment.

5.2.1   Study Design and Methodology

The QH Theory Survey Experiment is the second part of the EVT Helper Survey Experiment and the methodology is similar. The purpose of this experiment is to serve as initial empirical evidence for relationships between commonly used reputation system features and expectancy for the help source, values for the help source, and help seeking outcomes. This experiment also provides further understanding of the effect of manipulations from the QH MOOC Experiment on student expectancy, value, and evaluation anxiety beliefs for the help source.

The same dependent measures and survey items are used in both surveys: Expectancies and Values of Help Sources derived from Makara & Karabenick (2013), Intention to Seek and Avoid Help from this help source, adapted from Wolters et al. (2005) and Costs of Seeking Help in a Particular Context: Evaluation Anxiety measures from Leary et al. (1986). All of these are detailed in Appendix A. However, the two surveys differ in the independent variables. Whereas the EVT Helper Survey Experiment explored helper manipulations derived from the Expectancy Value Theory for Help Sources, the QH Theory Survey Experiment has independent variables derived from the QH MOOC Experiment. That is, the Helper Screenshots instead of being four possible sentences have several dimensions:

- No Badges or Badges (with 1, 3, or 4 stars)
- Irrelevant/Control Expertise Sentences (4 possible) or Expertise Topic Match Sentences (4 weeks participation, and 30%, 60%, or 90% topic match)
- Voting or No Voting (manipulated separately from the above two dimensions)
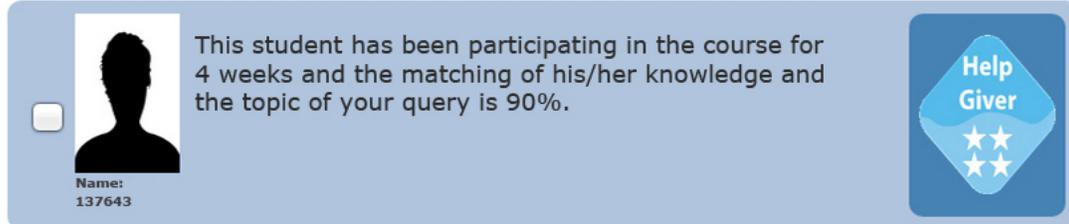
Figure 26. A Helper Screenshot from the QH Theory Survey Experiment with Badges (4 stars) and Relevant Sentences (90% topic match) conditions displayed.

A sample helper screenshot from the QH Theory Survey Experiment is shown in Figure 26, but a more in-depth discussion of the screenshots can be found in Appendix B.. The sentences shown included:

- Irrelevant Sentences: "This colleague has a computer and is ready to go.", "This colleague is involved in the course.", "This colleague answers email on a regular basis.", and "This colleague uses Web 2.0 technologies."
- Relevant Topic Match Sentences: "This student has been participating in the course for 4 weeks and the matching of his/her knowledge and the topic of your query is <#>%." where <#>% is either 30%, 60%, or 90%.
- TA Sentence: "This is one of the Teaching Assistants selected for this course. All of our Teaching Assistants are highly qualified to answer student queries."

There were over twenty different versions of the screenshot. Each of the 54 participants from the EVT Helper Survey Experiment saw three different screenshots. I recruited an additional ten participants to view eight different screenshots each. As such, this is a within-subjects experimental design. 30% topic match sentences occurred 20 times, 60% topic match had 13 instances, 90% had 27 instances, the TA sentence had 26, the Web 2.0 irrelevant sentence had 31, "involved in the course" had 26 instances, "answers email" had 36, and "has a computer" had 41 instances as shown in Figure 27.
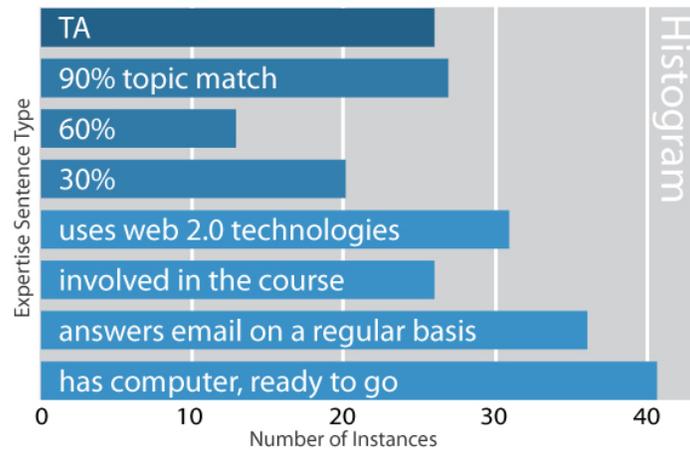
Figure 27. The number of each sentence type shown to participants. The top bar represents the TA sentence, the following three bars are topic match sentences, and the bottom four bars represent the control or irrelevant expertise sentences.

5.2.1.1   Statistical Approach

The data's structure reflected its many dimensions. There were three separate columns for the binary-level variables (i.e., `isBadges`, `isRelevantSentence`, `isVoting`), and a separate column for the type of sentence that is listed in Figure 27. Although, the `isRelevantSentence` condition technically had three levels: `isRelevantSentence`, `isIrrelevantSentece`, and `TAsentence`. 73 badges with 1 star were shown, while 74 badges with 4 stars were shown, and 93 screenshots shown did not have any badge. Topic match percentage and number of badge stars were each treated as continuous variables.

All analyses connecting categorical experimental manipulations to numerical beliefs scales were performed as an ANOVA with `RespondentID` as a random effect to account for the within-subjects experimental design. Analyses connecting the theory beliefs scales to intention to seek help were performed as a linear regression with `RespondentID` as a random effect as well. Post-hoc analyses were performed via Student's t-tests.

5.2.2   Research Hypotheses

Based on Expectancy Value Theory of Help Sources and the experimental manipulations from the Quick Helper experiment, we generate the following hypotheses, as shown in Figure 28. The QH MOOC Experiment suggested that badges and increasing expertise have a positive effect on help seeking, which could be achieved through many paths: increasing expectancies and values, or decreasing costs. These hypotheses linking manipulation to belief are tentative as badges and sentences were adapted from commonly used reputation system features and not necessarily designed to target EVT-HS specifically.

5.2.2.1   Badge Manipulations

Help Giver Badges might increase student expectations that there will be help, and so:
1. The presence of badges will increase perceived expectancies for the help source. The presence of badges may also increase self-reported intentions to seek help from that source. (*Unsupported*)
2. An increasing number of stars on the badge will result in an increase in the perceived expectancies for that help source. More badge stars should also result in more self-reported

intentions to seek help from that help source. (*Unsupported, except for a significant negative effect on evaluation anxiety,* , F(1,81)=8,19, p=0.005, R^2=0.83)

5.2.2.2 *Expertise Sentence Manipulations*

The expertise sentences from Quick Helper might increase student's perceived value of help from that help source. As the expertise sentences might manipulate values for the help source, prior work suggests the sentences will also manipulate expectancies.

3. Teaching Assistant and Relevant expertise sentences will predict significantly higher value for the help source than Irrelevant Sentences. (*Supported* F(2,172)=16.08, p<.0001, R^2=0.68)
4. Teaching Assistant and Relevant expertise sentences will predict significantly higher expectancies for the help source than the control sentences. (*Supported,* F(2,170)=10.91, p<.0001, R^2=0.68)
5. Teaching Assistant and Relevant expertise sentences will predict significantly higher Intention to Seek Help than the control sentences. (*Supported,* F(2,176)=11.76, p<.0001, R^2=0.64)
6. Increasing Topic Match Percentages in the Relevant Expertise Sentences will result in significantly higher value for the help source (*Supported,* F(1,34)=17.26, p=0.0002, R^2=0.91) as well as significantly higher Intention to Seek Help (*Supported,* F(1,51)=6.3, p=0.02, R^2=0.66). Increasing Topic Match Percentage may also result in increased expectancy beliefs for the help source (*Supported,* F(1,27)=9.56, p=.05, R^2=0.94).

5.2.2.3 *Connecting Beliefs to Intention to Seek Help*

Standard hypotheses relating Expectancy Value Theory for Help Sources to self-reported Intention to Seek Help and Intention to Avoid Help:

7. Self-reported expectancies will significantly predict intentions to seek help from the shown help source. (*Supported*, F(1,195)=297.00, p<.0001, R^2=0.75)
8. Self-reported values will significantly predict intentions to seek help from the shown help source. (*Supported*, F(1,190)=441.66, p<.0001, R^2=0.85)
9. Self-reported costs (i.e., evaluation anxiety) will significantly [negatively] predict intentions to seek help from the shown help source. (*Supported*, F(1,222)=28.94, p<0.0001, R^2=0.66)

5.2.2.4 *Irrelevant/Control Sentence Hypotheses*

Hypotheses related to the four different irrelevant sentences.

10. TA and 90% topic match sentences will predict significantly more perceived values for the help source, followed by the irrelevant/control sentences followed by 60% and 30% topic match sentences (due to how they emphasized a lack of value in the Quick Helper experiment). (*Supported*, F(7,168)=10.55, p<.0001, R^2=0.74)
11. Sentence Type may have a significant effect on Intention to Seek Help, in the ordering described by Hypothesis 10. (*Supported*, F(7,170)=9.13, p<.0001, R^2=0.71)
12. Sentence Type may have a significant effect on expectancies for the help source, in the ordering described by Hypothesis 10. (*Supported, although the "email" sentence performs significantly better than the 90% topic match sentence on expectancies*, F(7,166)=7.10, p<.0001, R^2=0.73)

5.2.3 Results

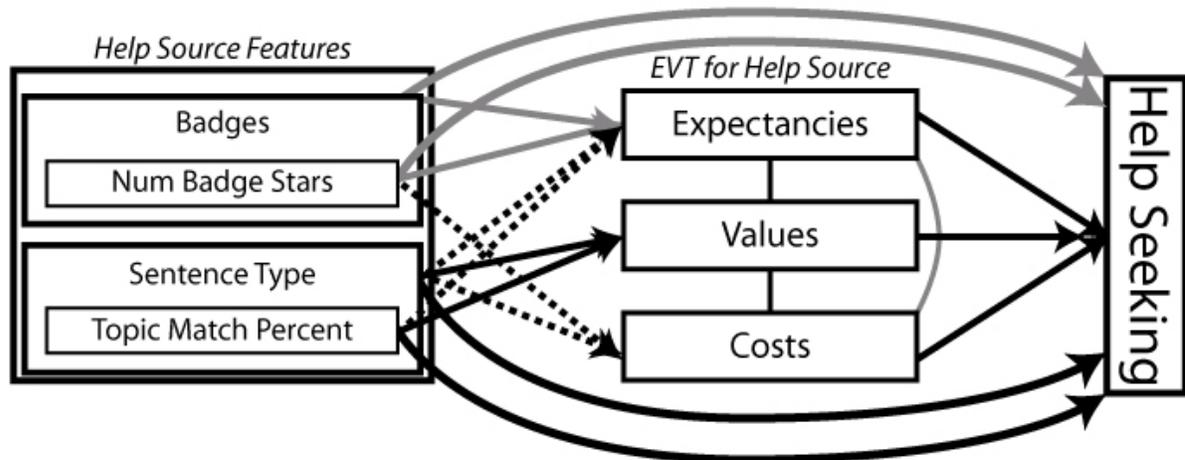Results can be seen in the hypotheses results model in Figure 28 and statistical information is provided under the Research Hypotheses. Overall, we see the majority of our hypotheses supported.

What we see is that the badges did not have the hypothesized effect on expectancies, but number of badge stars did have a significant inverse relationship with our measures of evaluation anxiety. The value

manipulation, expertise sentence condition, had a significant relationship with value beliefs and expectancy beliefs, as anticipated. The relationship between expectancies, values, and evaluation anxiety with intention to seek help was once again repeated in the hypothesized directions.

Figure 28. The hypotheses results model for the QH Theory Survey Experiment. Solid black lines indicate hypothesized relationships, solid grey lines indicate unsupported hypotheses, and dotted black lines indicate unhypothesized relationships. Badges potentially reduce costs to seeking help, and relevant sentences increase values and expectancies for the help source. These results further explain those relationships we saw in the Quick Helper MOOC experiment.

The irrelevant/control sentence hypotheses can be further explored as a manipulation check to ensure that the control sentences were neutral. These hypotheses generally predicted that the TA and 90% topic match sentences would perform better on the positive dependent variables (expectancies and values for the help source, intention to seek help) than the control sentences, with the 60% and 30% topic match sentences following at the end. As shown in Figure 29, this relationship generally held through all three of the positive outcomes, except the "This colleague answers email on a regular basis" sentence performs consistently higher than all the other control sentences. In results for the expectancies for the help source, this email sentence actually performs statistically significantly better than the 90% topic match sentence and statistically indistinguishable from the TA sentence.

Expectancy for Help Source by Sentence

Value for Help Source by Sentence

Intention to Seek Help from Source By Sentence

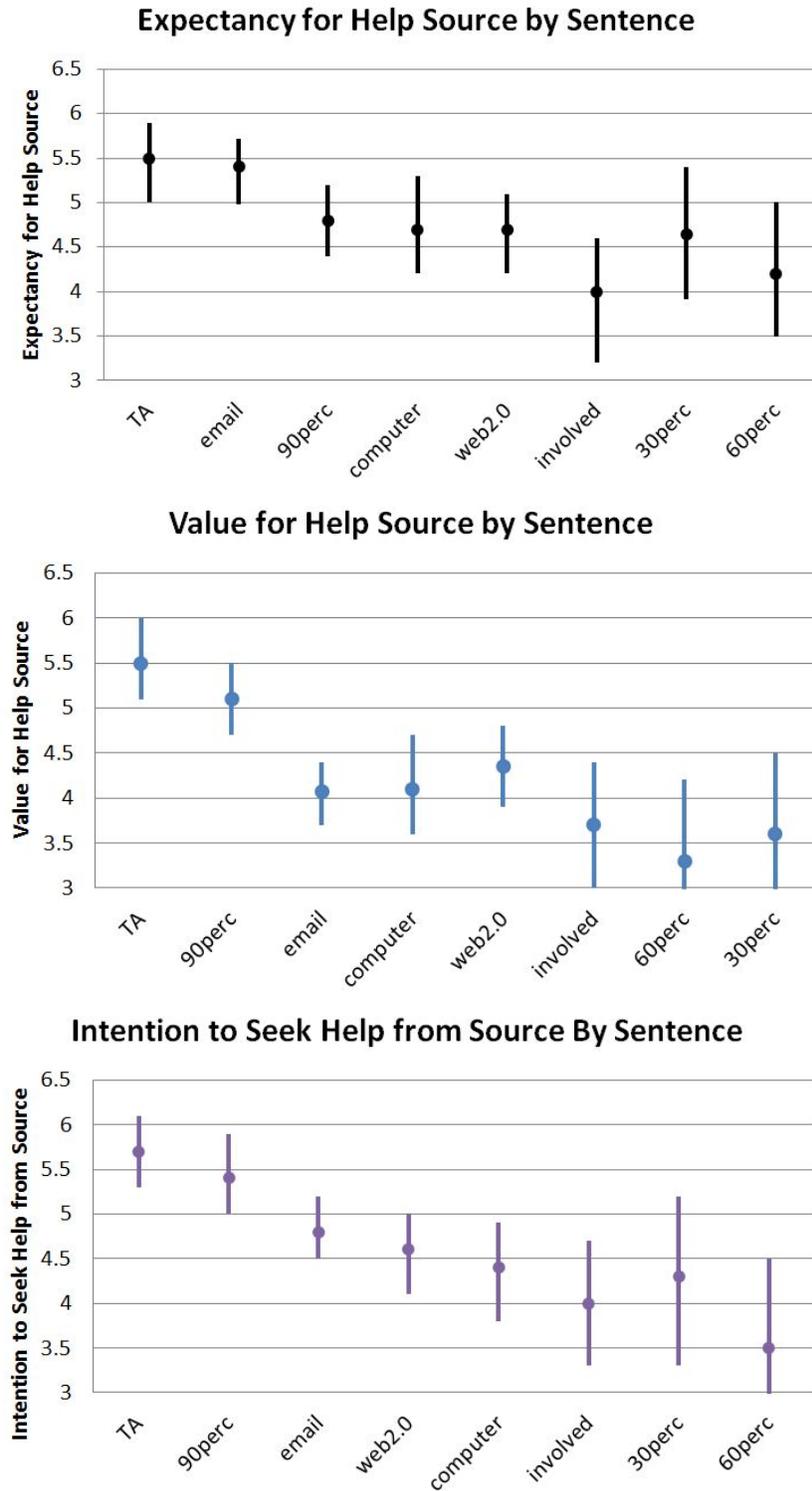**Figure 29. Mean point plots with 95% confidence intervals for the effect of the different sentences on expectancies for the help source, values for the help source, and intention to seek help. In general, the TA and 90% topic match relevant expertise sentences had the hypothesized effect on student beliefs. The "email" control sentence had unexpectedly high impact on expectancies for the help source.**

5.2.4   Discussion

The results of this survey are three-fold:

(1) *Help Giver badges do not manipulate expectancy for the help source beliefs, but they might manipulate evaluation anxiety*. This result better explains the interaction between badges and voting we saw in the QH MOOC Experiment. Quite possibly, the negative effect of voting was reduced due to a direct manipulation of evaluation anxiety via the badges, although we did not see any relationship between number of badge stars shown and whether or not the helper was selected in the Quick Helper Experiment. Further exploration of why a Help Giver badge reduces evaluation anxiety might be necessary. Perhaps when participants see a helper listed as a "Help Giver" they assume that this peer is more altruistic and less likely to negatively evaluate their help seeking.

(2) *The value manipulation once again manipulated both value and expectancy beliefs for the help source*. This supports earlier results from the EVT Helper Survey in which expectancy and value beliefs for the help source are difficult to manipulate separately, although increasing both expectancies and values has a positive effect on help seeking.

(3) *One of the control expertise sentences did not function as a control sentence for expectancy beliefs for the help source*. While the "email" sentence performed better than expected for one outcome (expectancy beliefs for the help source), overall the control sentences performed at the hypothesized levels. Any information provided has the potential to impact student beliefs for the help source, and so from a theoretical standpoint minimizing that effect for control sentences is important.

5.2.4.1   *Empirical Validation of Voting Increasing Evaluation Anxiety*

Currently missing from this section is an analysis of the connection of our cost manipulation with evaluation anxiety (i.e., cost beliefs). Hypotheses would have predicted a positive relationship between up/downvoting and evaluation anxiety, but it was not possible to implement the Quick Helper preview email message screenshots in an interpretable format for survey participants. Pilot testing revealed a general failure of participants to (1) read the content of the messages included in the email preview screenshots, (2) understand that the screenshot was a preview for a peer helper that was not the participant, and (3) realize that the peer helpers were requested to evaluate the quality of the question. Much of this confusion was likely due to the question in the email preview screenshot being arbitrary and not specifically written by the survey participant, as was the case in the actual Quick Helper system. However, due to the explicit evaluative nature of up/downvoting and the results of the EVT Helper Survey Experiment, confidence in up/downvoting manipulating evaluation anxiety is relatively high.

Initial pilot testing of this portion of the survey revealed that outside of the MOOC with the Quick Helper system, survey participants were unsure what the preview email screen actually represents. As an example, the screenshot shown in Figure 30 was shown to participants along with the instructions, "*You are enrolled in an online course and having difficulty with one of the assignments. Your question begins: 'Please can someone help explain to me how we're supposed to use the intelligent agent software with the text mining software?...' You decide to seek assistance from some of your peers. The online course system recommends qualified fellow students as shown below.*"
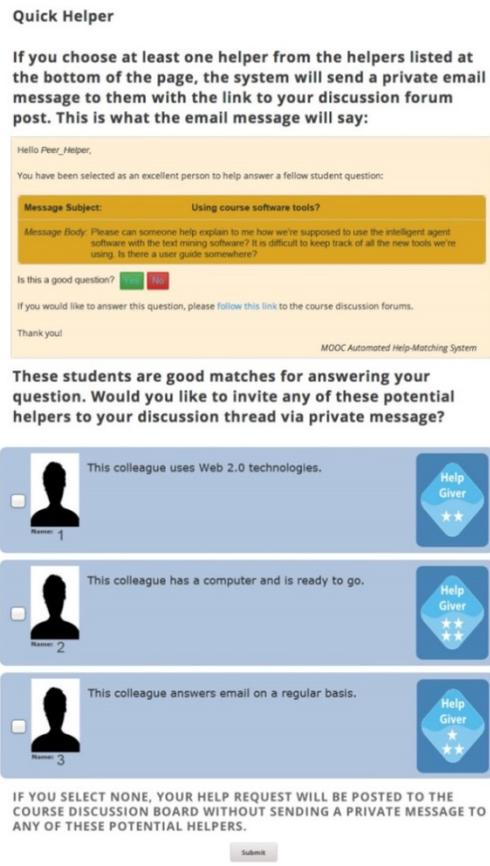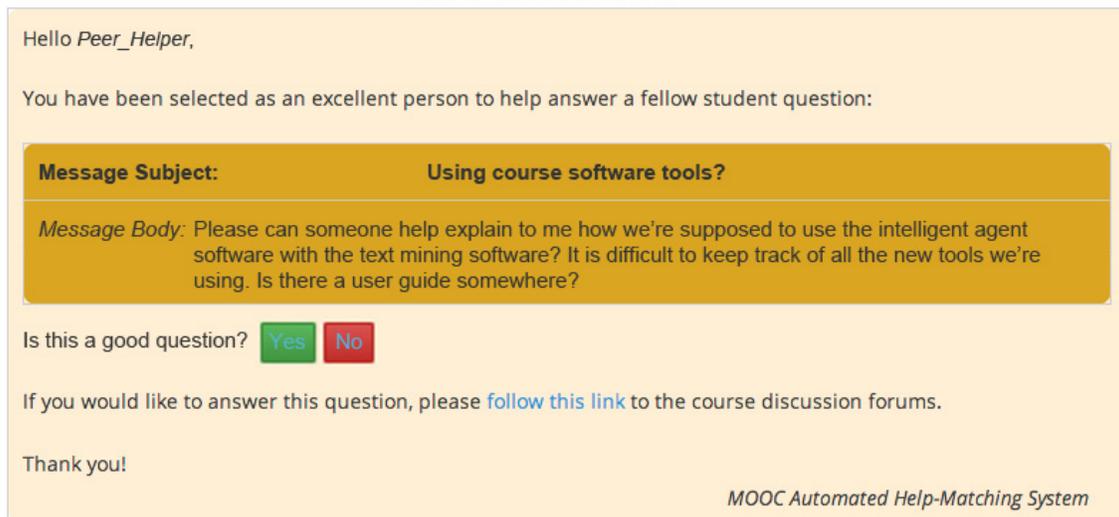
Figure 30. A sample screenshot shown to participants during pilot testing of the QH Theory Survey Experiment (top). And a zoomed-in view of the preview email screenshot that was shown (bottom). Participants were only shown a larger, more readable version of the top image.

The 10 respondents who were recruited through Carnegie Mellon's Center for Behavioral and Decision Research participation pool provided the responses to our manipulation check items contained in Table 3, in response to the top screenshot in Figure 30. All of the manipulation check questions appear to have widely varying responses, indicating unsuccessful interpretation of the screenshot shown.

Table 3. Descriptive statistics for participant responses to the manipulation check questions during pilot testing of the voting manipulation showing that participants either did not read or did not understand the preview email screenshot shown to them.

Please read each question and then select the number on the scale that best indicates the extent to which you agree. '1' corresponds to "Strongly Disagree" and '7' corresponds to "Strongly Agree.'			
Question	**Mean**	**S.D.**	**Expected Answer**
The peer helpers will evaluate the quality of my question.	**5.1**	1.9	7
My question asks about using Weka in the homework assignment.	**2.3**	2.2	1
I have been selected as a peer helper.	**2.6**	2.6	1
My question includes a request for a user guide.	**5.6**	2.1	7

After seeing an additional survey item that included the full Helper Selection screen (preview email message and 3 suggested peer helpers) in the survey, an additional screenshot was shown of just the preview email screenshot shown in Figure 31. 7 pilot test participants saw the "no voting" version of the screenshot and 3 saw the "voting" version. The accompanying instructions were: *"While enrolled in an online course, you encounter difficulty with one of the concepts from the video lectures. You decide to seek assistance from some of your fellow students. The online course system provides you with a preview of an email invitation it will send to your peer helpers as shown below:"*
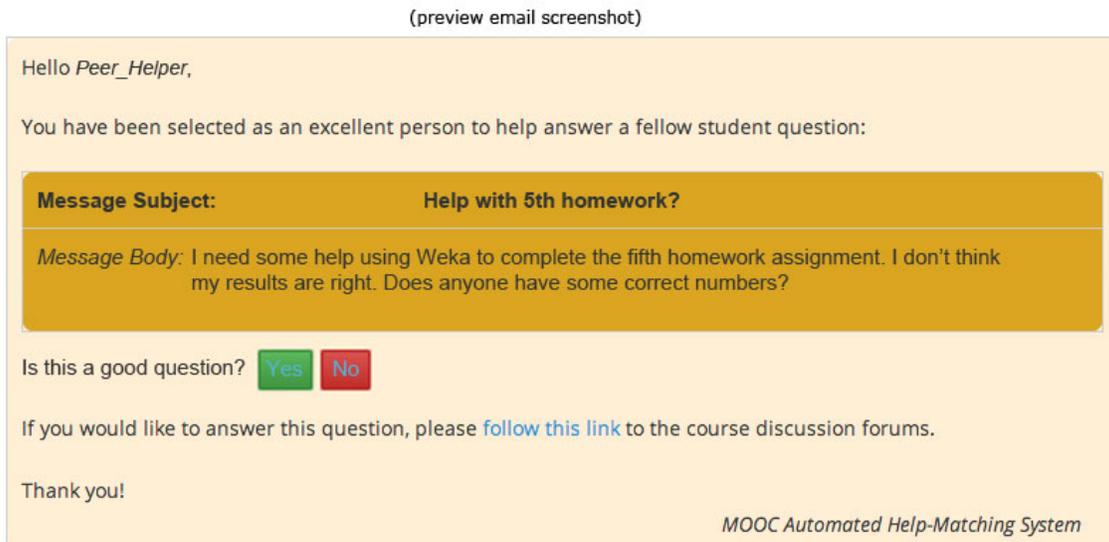
Figure 31. A preview email screenshot shown to participants during the pilot testing phase of the QH Theory Survey.

Responses to the same manipulation check question were equally mixed, regardless of whether the voting or no voting screenshot was shown, displayed in Table 4. The mean response values for the first question,

"The peer helpers will evaluate the quality of my question" should be on opposite ends of the 7-point Likert scale. Instead, they are only two points apart. The "I have been selected as a peer helper" response should be very low or 1, instead it is at 2.7 and 5.

Table 4. Descriptive statistics for participant responses to voting and no voting manipulation check questions during pilot testing of the voting manipulation. Participants continued to be confused about whether they were selected to be a helper, or if a helper would be evaluating their question.

Please read each question and then select the number on the scale that best indicates the extent to which you agree. '1' corresponds to "Strongly Disagree" and '7' corresponds to "Strongly Agree.'				
Question	**Mean-Vote**	**S.D.-Vote**	**Mean-NoVote**	**S.D.-NoVote**
The peer helpers will evaluate the quality of my question. (7 or 1)	**4.3**	3.1	**2.3**	2.3
My question asks about using Weka in the…assignment. (7)	**6.9**	0.4	**6.3**	1.2
I have been selected as a peer helper. (1)	**2.7**	2.6	**5**	3.5
My question includes a request for a user guide. (1)	**2.9**	2.5	**1**	0

Additionally, the comments text box in the pilot test survey had complaints about this same issue: "I think it would help to clarify either in the first slide at the beginning or after every message image that we, the participant, are the student asking for help and that getting help from "this person" refers to whomever we selected as a peer helper. I reread to make sure I was still the one asking the question versus the helper," so even some of the survey participants knew they were experiencing difficulties with this portion of the survey.

The issues encountered during this pilot test of the cost manipulation and beliefs stem from numerous directions. Presenting a rather complex user interface in an online survey experiment that lacks context will lead to misunderstandings of the interface screenshots. Without writing your own question and seeing that question appear in the preview message screenshot, it appears incredibly difficult for users to make that connection. Adding to the issue of lacking context is the common obstacle of online survey participants not reading items or screenshot manipulatives carefully.

We know from the EVT Helper Survey Experiment that it is possible to manipulate evaluation anxiety through a "This person will evaluate the quality of your question" sentence. However, it is uncertain if it is possible to manipulate those same beliefs with a screenshot of an email preview in the context of an online survey experiment removed from the live system for which it was designed.

5.2.5   Limitations
This QH Theory Survey Experiment shares many limitations in common with the EVT Helper Survey Experiment previously described. Specifically, the nature of introducing the hypothetical context might introduce validity questions which are the case for the up/downvoting manipulation. Additionally, the survey relies on the specifically selected design features of the Quick Helper system which may not be valid outside of our helper recommendation system, although this concern is most relevant for the design of the control expertise sentences which serve a theory-purpose in the experiments in this chapter.

5.3   QH Contrast Survey Experiment

The Quick Helper Contrast Survey is designed to examine the relationship between Expectancy Value Theory for Help Sources and Expectancy Value Theory for help seeking in general. As expectancies and values have been relatively empirically unexplored at the help sources level, it is unknown whether increases in expectancies and values for a help source results in impact at the more general help seeking level. We have seen that our manipulations designed to increase the expected quality of help from particular help source increases expectancies and values for the help source, but do the manipulations impact general attitudes about help seeking in the same way? Furthermore, if general attitudes about help seeking are more trait-based, and not significantly impacted by help source manipulations, how might these help seeking traits interact with more state-based help source beliefs to impact student help seeking?

The QH Contrast Survey Experiment is similar to the previous two survey experiments described, as it shares the same dependent variables, but the independent variables are different and it also contains an additional Help Seeking Beliefs measurements section. This portion of the survey connects two contrasting versions of the Quick Helper interface with participant expectancy value beliefs towards the potential helper and toward help seeking in general. This section is meant to determine if the most costly and most accessible versions of our potential helpers can have any impact on self-reported expectancy value beliefs about help seeking. As the only survey section that contains items about general help seeking beliefs, I investigated if these most extreme versions of our Quick Helper screenshots have any effect on participant self-reports of more high-level help seeking beliefs.

5.3.1   Study Design and Methodology

I investigated whether the most extreme versions of our Quick Helper experimental manipulations had an impact on self-reported expectancies, values, costs, and more general attitudes about help seeking. This particular investigation was a within-subjects experimental design where students saw both the least EVT emphasized and most EVT emphasized versions of the interface, as defined below:

- *Most EVT Emphasized*: A screenshot containing a preview email message followed by a single helper profile image. The proposed helper was shown with a high topic match percentage (90%), and the maximum number of badge stars (4), as in Figure 32. Additionally, this image would be accompanied by an email preview message without any up/downvoting.
- *Least EVT Emphasized*: The most costly screenshot included a single peer helper with an irrelevant expertise sentence, no badge, and up/downvoting in the preview email message. Essentially, this screenshot manipulation de-emphasized the potential helper's perceived expectancy and values while maximizing the costs.
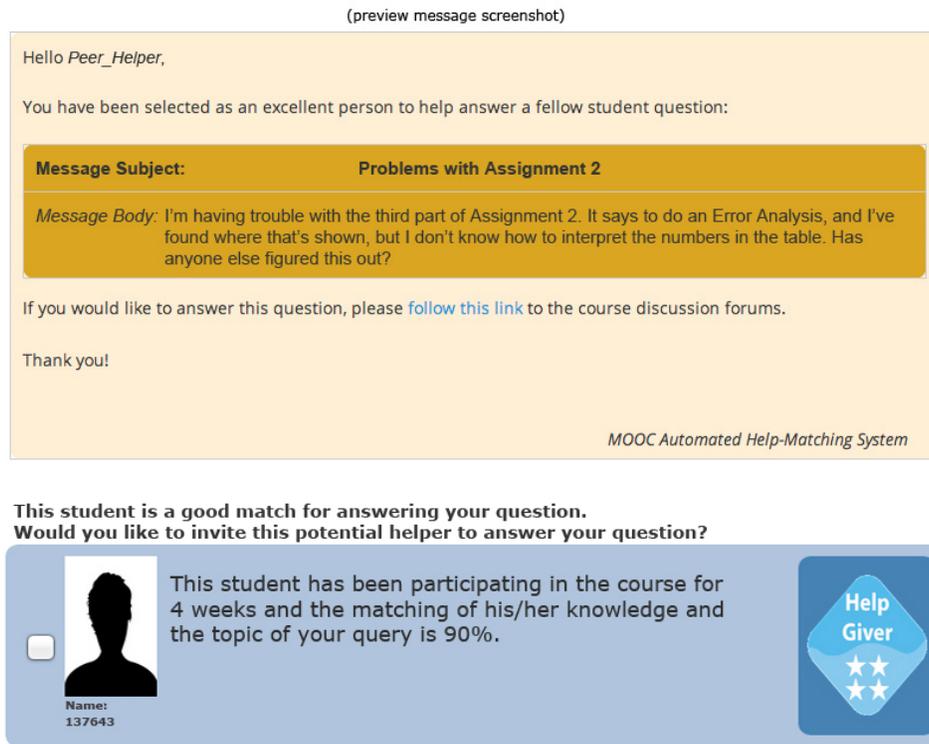
Figure 32. The "most EVT emphasized" screenshot of a potential peer helper with 4 badge stars, a 90% topic match and a rather high number of weeks enrolled in the course. This was accompanied by an email preview message without up/downvoting. The "least EVT emphasized" screenshot had no badge shown, an irrelevant control sentence, and an email preview message with up/downvoting.

Measurement items for this experiment included identical measures to those used in the previous survey experiments, but also Expectancy Value Theory of General Help Seeking items and Outcomes of Seeking Help items, as described below (and found in Appendix A.):

- Expectancies and Values of Help Sources derived from Makara & Karabenick (2013): Expectancies of the help source, Values of the help source
- Intention to Seek and Avoid Help from this help source, adapted from Wolters et al. (2005).
- Costs of Seeking Help in a Particular Context: Evaluation Anxiety measures from Leary et al. (1986).
- Expectancy Value Theory of General Help Seeking adapted from Wigfield & Eccles (2002): Ability beliefs of seeking help, Expectations for success in help seeking, Utility value of seeking help
- Outcomes of Seeking Help adapted from Wolters et al. (2005): Likelihood/Expectancy of instrumental help seeking goals; Importance/Value of instrumental help seeking goals; Likelihood of expediency in help seeking; Importance of expediency in help seeking; Public, Private, and Face threatening likelihoods of help seeking (costs); Public, Private, and Face threatening values of help seeking (costs); and Likelihood & Importance of benefits of help seeking.

For the general Expectancy Value Theory of help seeking, I attempted to adapt Expectancy Value Theory items from Eccles & Wigfield (2002), however, these items were intended for investigating anticipated perceptions around a particular task or domain, which did not always adapt to the process of help seeking. In rethinking my approach, I generated new items based upon the initial Expectancy Value Theory ideals: "A learner's *decision* to pursue a goal is determined by the learner's estimated *likelihood* of successfully achieving an outcome, and the estimated *values* and *costs* placed on that outcome." With a renewed focus on measuring students' perceived likelihood of success, value of achieving that success, and costs of achieving that success, we were able to generate new survey items, in Appendix A.

5.3.1.1   *Statistical Approach*

All analyses connecting categorical experimental manipulations to numerical beliefs scales were performed as an ANOVA with `RespondentID` as a random effect to account for the within-subjects experimental design. These analyses were generally simpler than the previous two survey experiments, as participants only saw two different screenshots, and the experimental manipulation was a categorical variable that was either "most EVT emphasized" or "least EVT emphasized" (i.e., two levels). Analyses connecting the theory beliefs scales to intention to seek help were performed as a linear regression with `RespondentID` as a random effect as well. Post-hoc analyses were performed via Student's t-tests.

5.3.2   **Research Hypotheses**

Our hypotheses for this data are founded in our theoretical understanding of Expectancy Value Theory on which the Quick Helper MOOC Experiment was designed. And so, for this portion of the survey experiment we have the following hypotheses which are also illustrated in Figure 33:

5.3.2.1   *Connecting Manipulations to EVT-HS Beliefs*

1. (local) Peer helpers shown with the highest expectancies and values and lowest costs (i.e., the most EVT emphasized) will predict higher self-reported intention to seek help from that source. (*Supported*, $F(1,56)=17.20$, $p<.0001$, $R^2=0.52$).
2. (local) Peer helpers shown with the highest expectancies and values, and lowest costs (i.e., the most EVT emphasized) will predict higher self-reported expectancies & values of the help source than the lesser EVT emphasizing screenshots (*Supported*, $F(1, 56)=17.20$, $p<.0001$, $R^2=0.71$ & $F(1,56)=8.31$, $p<.006$, $R^2=0.51$).
3. (local) Peer helpers shown with the highest expectancies and values, and lowest costs (i.e., the most EVT emphasized) will predict lower self-reported costs for this help source than the lesser EVT emphasizing screenshots (*Unsupported*).

5.3.2.2   *Connecting Beliefs to Intention to Seek Help*

4. (local) Expectancy and value beliefs of the help source will be positively correlated with intention to seek help (*Supported*, $F(1,108)=104.41$, $p <.0001$, $R^2=0.72$ & $F(1,105)=333.13$, $p<.0001$, $R^2=0.90$).
5. (local) Cost beliefs will be negatively correlated with intention to seek help. (*Supported*, $F(1,84)=3.75$, $p=0.56$, $R^2=0.43$)

5.3.2.3   *Global Help Seeking Beliefs*

6. (global) Peer helpers shown with the highest expectancies and values, and lowest costs (i.e., the most EVT emphasized) might predict higher Expectations for success in help seeking and Utility value of seeking help. (*Unsupported*, but there was a significant effect on perceived value of pursuing help, $F(1,55)=15.4$, $p<.0001$, $R^2=0.70$)

7. (global) Peer helpers shown with the highest expectancies and values, and lowest costs (i.e., the most EVT emphasized) might predict higher likelihoods and importance of instrumental help seeking, lower values for expediency, and lower values for public/private/face threatening costs of help seeking. (*Unsupported*, although easier screenshots predicted significantly more expectations of expedient help seeking, $F(1,55)=6.35$, $p<0.02$, $R^2=0.87$. There was an effect of the less EVT emphasized screenshot predicting marginally more importance of costs in help seeking in general, $F(1,53)=3.25$, $p<0.08$, $R^2=0.91$)

Of special note is that our first three "local" hypotheses indicate what effect our helper presentation manipulations were intended to have on perceptions of help sources. We manipulated how the help source was presented, and so that should have a direct effect on attitudes about seeking help from that help source. The last two "global" hypotheses are intended to determine whether our small, local manipulation can have a larger effect on student help seeking attitudes, not just from this particular help source, but from help sources in general. Since our experimental manipulations were not designed with this effect in mind, it would not be surprising to see Hypotheses 6 and 7 unfulfilled.

5.3.3   Results

59 participants saw both the most and least EVT emphasized screenshot in this within-subjects survey. Results of this initial section of the survey experiment provide evidence for our three local hypotheses (also illustrated in Figure 33), and less support for the global hypotheses, as expected.
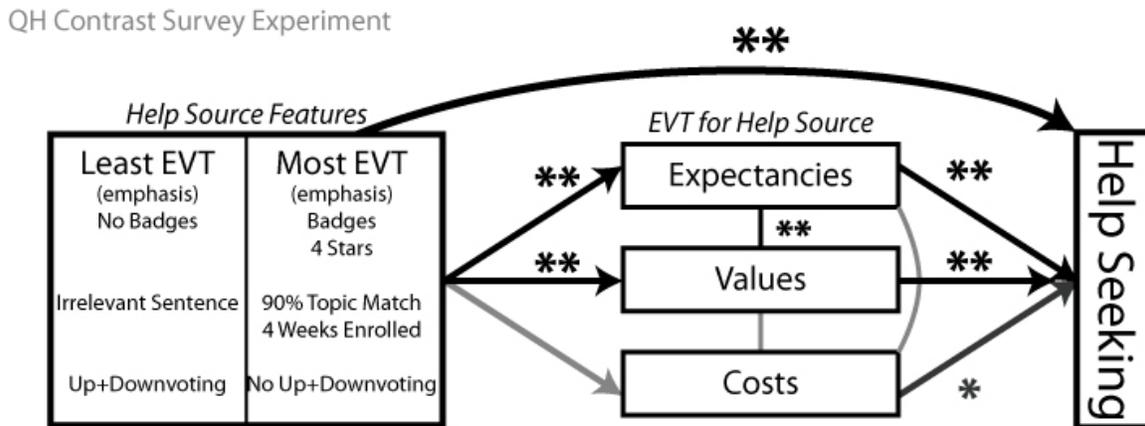
Figure 33. The hypotheses results model for the QH Contrast Survey Experiment. Black solid lines indicate supported hypotheses, grey solid lines indicate unsupported hypotheses. Arrow-less lines indicate correlations. We see our previous hypotheses generally supported, except for the relationship with costs. This is likely due to the same screenshot misunderstanding experiences in the QH Theory Survey Experiment.

5.3.4 Discussion

These results show that our screenshots of peer helper descriptors can impact more local perceptions of expectancies and values for a help source, but the manipulation is not strong enough to impact many of the more general attitudes about help seeking. While the easier emphasized screenshots were able to positively impact perceived values of help seeking in general, the same effect did not exist on perceived expectancies of successfully achieving that help. The design of these screenshots were intended to impact perceptions of the help source, and not of help seeking in general, and so this survey shows our manipulations to be mostly effective in that effort.

For only this portion of the survey experiment, the evaluation anxiety manipulations and measures appear to have none of the hypothesized relationships. None of the correlations between costs and the rest of the "EVT for Help Source" model exist in this portion of the survey, either. Even the relationship between costs and Intention to Seek Help is marginal. The most likely explanation for this is that our cost manipulation is not intuitive. This portion of the survey appeared first, and so it may have taken users several exposures to the "email preview message" in order to fully understand what it represented and notice the nuances of the screenshot. Furthermore, the discussion of difficulties implementing the preview email message screenshot described in 'Empirical Validation of Voting Increasing Evaluation Anxiety' likely applies to this situation as well. It is probable that survey participants do not understand the connection between their hypothetical question and questions shown in the email message screenshots. If pilot test participants view those screenshots and believe it communicates that they are the helper, then it is not surprising no relationship exists between the voting manipulation and other measures.

5.3.4.1 Path Analysis

In the QH Contrast Survey Experiment, unlike the other survey experiments described in this dissertation, additional expectancies, values, and costs of the more general help seeking process were measured in addition to the EVT-HS beliefs. In order to investigate how all these different factors of both EVT of help sources and help seeking are connected, I performed an initial path analysis. Our previously discussed results suggest a minimal effect of our manipulations on more general help seeking beliefs, but these more general EVT help seeking beliefs have not yet been connected to EVT-HS beliefs. A structural equation model analysis is an appropriate method for investigating the causal relationship of the many factors in the model. Just as in the previous path analysis in this document, the GES search algorithm is combined with prior background knowledge to constrain the space of the models that are searched. A low p-value suggests that the model can be rejected and a high p-value means that it cannot.

For the QH Contrast Survey experiment, I assume that the independent variables are exogenous and causally independent. The contrasting emphasis condition and student beliefs about their help seeking ability precede all other factors in this model. The EVT for Help Seeking beliefs are prior to the EVT-HS beliefs which are prior to intention to seek or avoid help. I set required relationships on the causal model represented by the hypotheses as shown in Figure 34. By forbidding a direct relationship between the experimental manipulation and intention to seek help the EVT-HS beliefs variables are forced to be mediators of that relationship. The directed edges in the graph represent a direct causal relationship. No restrictions were set on the relationship between the EVT-HS beliefs variables, and so the GES algorithm searched pattern space for an optimal model to fit within other given constraints.
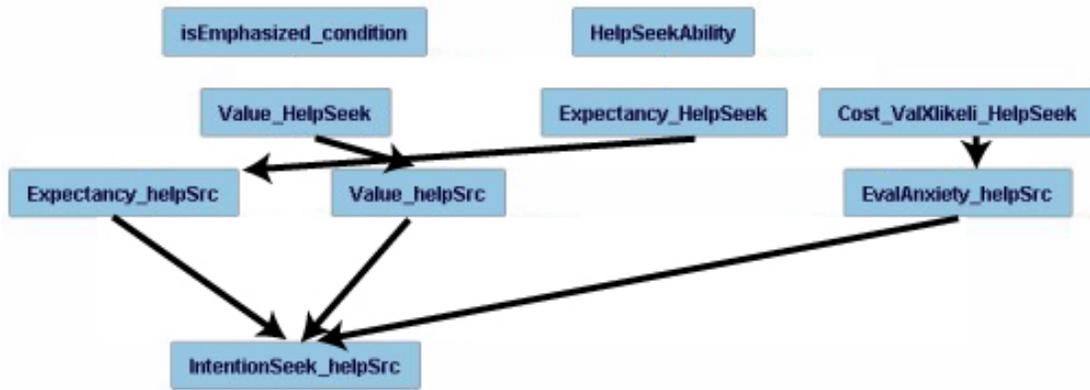
Figure 34. The prior knowledge model for the QH Contrast Survey Experiment with four causal levels. Required relationships to constrain the GES search were only those illustrated via directed lines. The prior knowledge model reflects our constraints on the causal model, to be discovered and tested.

We see in Figure 35 a model discovered by a GES search that fits the data well (X^2=20.9, df=20, BIC=-82.7, p=0.52). This model is reflective of relationships in prior work. In particular, student self-reported beliefs about help seeking ability is a causal predictor of expectancy for the help seeking process. Similar to prior survey experiments, we see that value beliefs about help seeking in general is a causal predictor of both value for the help source (0.55) and expectancy for the help source (0.71). We also see that the required relationships between help seeking and help sources EVT beliefs are generally maintained as part of the model. Although, the correlation coefficients originating from expectancies about help seeking in general are relatively low as compared to those originating from values related to help seeking. Additionally, only values for help seeking, and not expectancy nor costs, appear to have a causal effect with intention to seek help. This suggests that student perceived importance or value in the help seeking process can be an important factor in whether students seek help from a particular help source, alongside beliefs specifically related to the help source.

The required relationship between expectancies for the help source and intention to seek help from the help source in this model shows a negative coefficient, which conflicts with our previously performed ANOVA. This suggests that the preliminary path analysis may require additional covariates to properly represent the positive relationship between expectancies for the help source and intention to seek help from the help source that was observed in all previous analyses.

Overall, this model suggests that general beliefs about help seeking can influence beliefs about seeking help from a particular source. The causal relationship between the condition variable (whether the most EVT emphasized condition was shown or not) had on values for help seeking, is reflective of the results seen in Hypothesis 6. In general, our manipulations related to the help source only impacted perceived values for help seeking, and not expectancies or costs at the more general level.
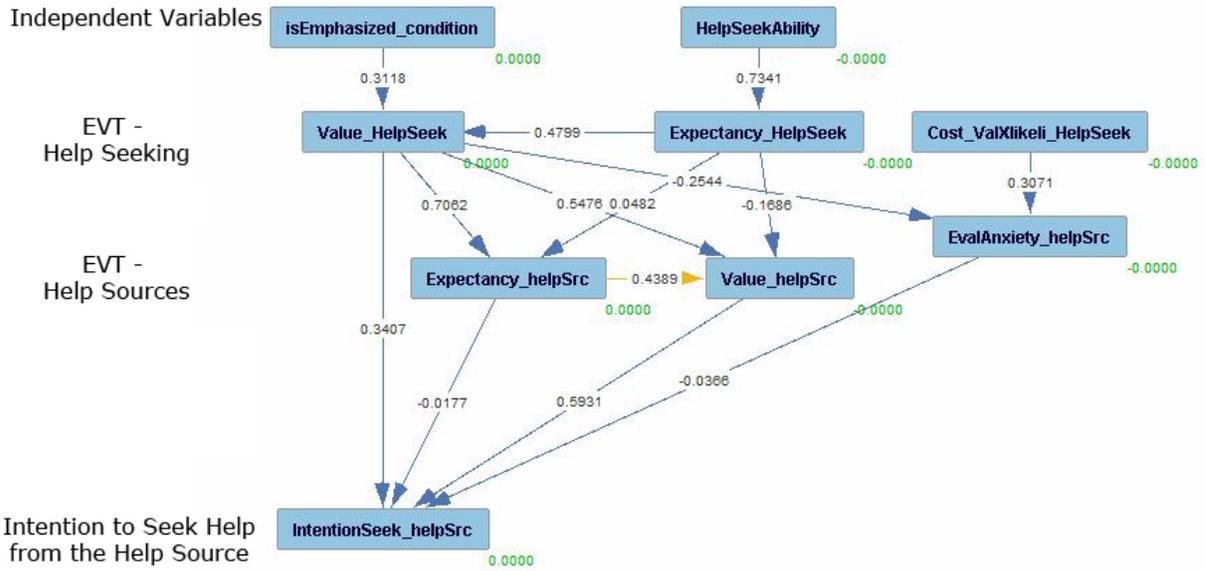
Figure 35. A structural equation model showing the causal connections between various factors of EVT-HS and Expectancy Value Theory of general help seeking. Orange arrows indicate an unknown direction relationship.

5.3.5 Limitations

This portion of the survey shares limitations with many of the other portions of the same survey. However, what is unique to the QH Contrast Survey is that it includes Expectancy Value items for the help seeking process. Discussion in this section has noted that we did not design our manipulations for a global effect on help seeking, just a local effect for help sources. Better Expectancy Value items for comparison to Expectancy Value Theory for Help Sources might require considering "Getting accessible/any help from this person" (i.e., EVT-HS expectancy) as an outcome determined by the product of the likelihood of receiving any help from this person and the importance of receiving any help from this person. Likewise, "Getting quality help from this person" (i.e., EVT-HS value) might be another outcome determined by the likelihood of receiving quality help from this person and the importance of receiving quality help from this person. In this model, costs for help seeking might be the outcome "People will judge me for asking this question" determined by the perceived likelihood that people will judge, and the importance of not being judged. This representation would easily allow for other outcomes in the calculation of whether or not to seek help.

5.4 Chapter Discussion

In this chapter I have shown that portions of Expectancy Value Theory for Help Sources can be used to explain actual student behavior in a help exchange system. However, much like in the EVT Helper Survey Experiment, Value Beliefs are difficult to manipulate separately from Expectancy Beliefs for the help source. However, the expected relationship between EVT-HS beliefs and help seeking outcomes was observed in our analyses. From a practical perspective, aiming for a positive effect on expectancies or values, and a negative effect on evaluation anxiety should result in increased help seeking. It may be difficult to design manipulation to specifically impact only one EVT-HS belief independently.

Figure 36 shows a synthesis of the results from the MOOC field experiment and the QH Theory Survey Experiment. We see that our hypotheses were essentially supported: expectancies and values can be increased through the use of expertise sentences, and perceived costs for a help source can be impacted by Help Giver Badges and up/downvoting. The figure also shows that the expertise sentences, due to their ambiguous design, influenced expectancies, values, and costs in consistent directions. An interaction between Help Giver Badges and up/downvoting is interpreted as two separate and opposing manipulations of perceived costs of seeking help from the help source.
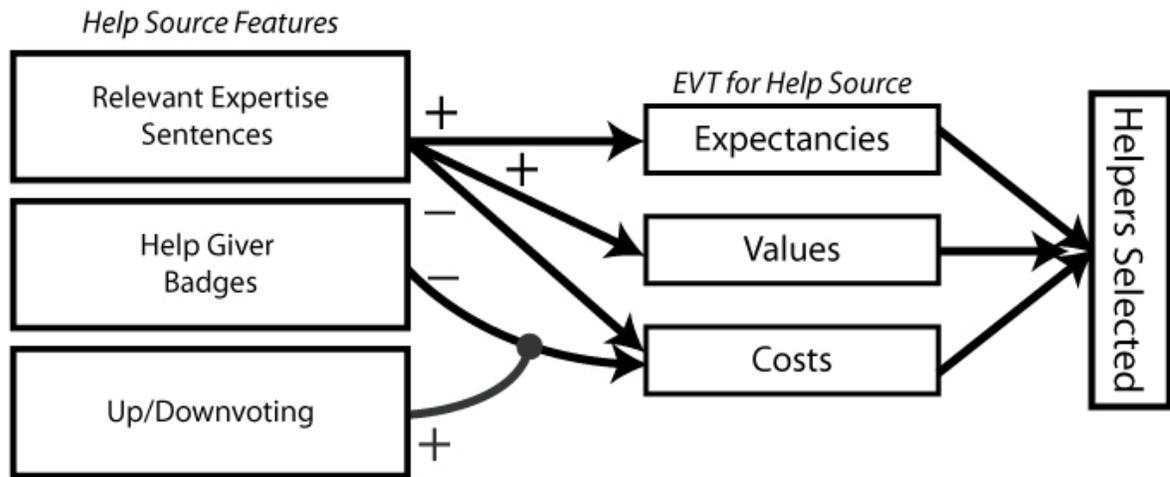
Figure 36. A synthesis of the QH MOOC Experiment and QH Theory Survey Experiment results. Not that the connection between Up/Downvoting and EVT-HS costs was unable to be empirically examined.

The Quick Helper MOOC experiment and associated survey experiments have generated some design recommendations. Specifically, up/downvoting impacts the helper selection process negatively, but this can be mitigated through the use of Help Giver badges which reduce self-reported evaluation anxiety. If your reputation system has a representation for student expertise, if that representation is not high then students will be unlikely to seek help from that person.

The Quick Helper system is useful as a theory proving ground, and also potentially as a way to connect more students to the help that they need. However, there is a considerable amount of future directions for this research that remain unexplored. A better understanding of whether the peer helpers from the Quick Helper system actually answer the student in need is necessary, as well as better approaches for encouraging the peer helpers to provide help when requested. It is also unclear how Quick Helper might affect non-Quick Helper help seeking in the discussion forums and whether our manipulations of common reputation system features might have some effect outside of Quick Helper.

6   Applying Expectancy Value Theory to a Discussion Forum

Throughout this dissertation I have focused on applying Expectancy Value Theory of Help Sources to explain help seeking behavior, and added evaluation anxiety as an important factor impacting student help seeking. Evaluation anxiety can impact other behaviors that render people vulnerable as well, such as in the disclosure of personal information as in Powers et al., (2007). It is quite possible that evaluation anxiety might have an effect on help seeking in discussion forums, and on other discussion forum behavior as well. In the previous chapters, the Quick Helper system allowed significant control over the independent and dependent measures, especially since the responses were gathered immediately after exposure to the manipulations. However, most course discussion forums do not have a Quick Helper help exchange system and the factors impacting evaluation anxiety, expectancies, and values for the help source might not be as tightly timed for affecting help seeking.

In this chapter I explore how we might leverage Expectancy Value Theory more generally to understand help seeking and other, less controllable behaviors in a more standard online course discussion forum where evaluation anxiety is still a factor in student learning-relevant behaviors. I do this first by describing a Vignette Survey Experiment that determines that the adoption of learning-oriented classroom goals has a positive effect on evaluation anxiety. This result using the endorsement of goals is then adapted and applied to an experiment in a small private online course that also examines upvoting only separately from up/downvoting. Learning is added as an additional outcome variable, along with other forum behaviors such as number of contributions. Figure 37 presents an overview of the factors investigated in this chapter. The Vignette Survey Experiment suggests a connection between mastery achievement goals and a reduction in evaluation anxiety. My prior work suggests an increase in evaluation anxiety with increasing up/downvoting. In this chapter, we will combine the results of these two threads of research to explore methods of decreasing evaluation anxiety and increasing help seeking in a more naturalistic online course discussion forum setting.

My results show email prompts and up/downvoting can impact student help seeking and learning. Implementing either learning-expectancy or neutral (i.e., control) email prompts had a negative impact on help seeking in course discussion forums. However, upvoting (without downvoting) might be leveraged to make help seeking more accessible to students as compared to baseline set-ups of discussion forums. Up/downvoting in this context appeared to have a positive effect on learning.

Chapter 6 - Hypotheses
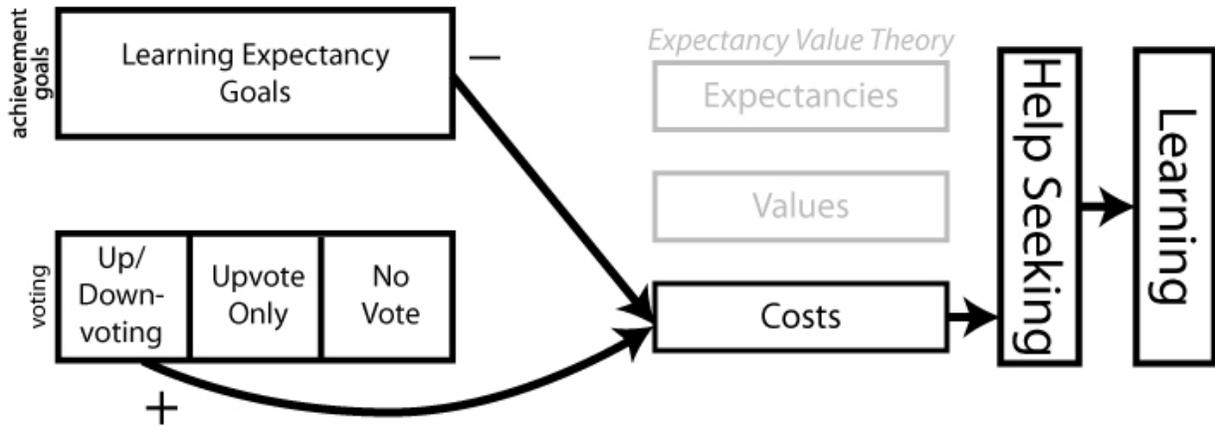
Figure 37. An overview of the hypothesized factors impacting evaluation anxiety that will be explored in Chapter 6. Increasing learning expectancy goals (i.e., mastery achievement goals) and decreasing the amount of up/downvoting should have positive effects on perceived costs of help seeking, leading to increase help seeking and learning.

6.1 Vignette Survey Experiment

The Vignette Survey was part of my earlier work on designing dialogue tutors for a maximum benefit on student evaluation anxiety with regards to help seeking, but the results can help inform our design of reputation system features in online courses as well. As part of its initial goals, the Vignette Survey was designed to determine the largest obstacles students experience in help seeking in a one-on-one tutoring situation that may drive them to seek help from a computer rather than a human. This method was intended to be a more expedient version of a fully developed experiment by providing participants with several hypothetical situations with a variety of tutor features manipulated. Survey items focused on features that can be purposely developed in intelligent tutoring systems so that I could extract practical implications for automated tutor design. This vignette survey approach allows us to examine students' pressing concerns in regards to help seeking, ensuring the research is relevant to actual students' needs.

The vignette survey's purpose was to quickly pilot test some potential interventions that have practical implications for intelligent tutor design. This survey was also intended to be an initial test of the evaluation anxiety measures that are used throughout this thesis (placing this Vignette Survey Experiment, chronologically, before all the other work included in this document). While many potential dialogue tutor designs were tested and contrasted (as seen by the full survey items in Appendix D.- Vignette Survey Experiment), for the purposes of this dissertation document I will be discussing only one set of independent variables: mastery and performance goals. Mastery goals might be considered from an Expectancy Value Theory perspective as increasing the likelihood of learning from a particular action. Performance goals might be considered from an Expectancy Value Theory as increasing the importance of not being judged as less competent than others.

6.1.1   Study Design and Methodology

This survey is adapted from Vaux et al.'s (1987) Social Support Behaviors Scale to measure our questions about the effect of emphasizing the likelihood of learning on evaluation anxiety and help seeking. Vaux et al. (1987) presented participants with a vignette in which the character experienced varying levels of supportive friends: (1) adequate support, (2) lacking in emotional support, (3) lacking in social support, (4) lacking in practical support, (5) lacking financial support, or (6) lacking advice/guidance. Scales were constructed for participants to report to what extent the character received the varying levels of support. My approach is similar. Each participant reads a short hypothetical story about a character with an androgynous name interacting with an intelligent dialogue tutor. This story is followed by survey items measuring evaluation anxiety (Leary et al., 1986) and intention to seek help (Wolters et al., 2005).

The experimental manipulation occurs in the vignette story, which in this case a student, Morgan, is learning about the human circulatory system from a tutor. The contrasting conditions are Mastery or learning emphasis versus Performance goals, derived from work on achievement goals endorsed by teachers in the classroom. Meece (1991) combined survey and observational data in 10 elementary school science classrooms in order to study differences in students' achievement goals. By comparing classroom mastery goal responses to observational records, the results revealed that teachers of low- and high-mastery-oriented students differed in the degree to which they (a) promoted meaningful learning and understanding, (b) adapted instruction to the developmental levels and personal interests of their students, (c) established learning structures supportive of student autonomy and peer collaboration, and (d) emphasized the intrinsic value of learning. The experimental manipulation for the Vignette Survey adapts these results to a one-on-one tutoring situation in which the tutor endorses the intrinsic value of learning, and adapts instruction to the personal interests of the student, as seen in Table 5. More of these vignettes and the associated survey items can be located in Appendix D.

Each participant saw only one of these vignettes, out of a total possible of six (3 mastery vignettes and 3 performance vignettes), creating a between-subjects experimental design. Dependent measures included evaluation anxiety (Leary et al., 1986) and intention to seek help (Wolters et al., 2005) among others, but we will focus our analysis on evaluation apprehension and help seeking outcomes.

Table 5. The top dialogue represents a sample (out of three) mastery vignettes, while the bottom represents a sample performance goals vignette as noted in bold emphasis. The square brackets indicate a second manipulation, that of a tutor expertise which was used as a control variable throughout analysis.

6.1.1.1   *Mastery Emphasis Vignette #1*

Tutor: Hello, I will be your tutor today.
Morgan: hi.
Tutor: This is my [third semester] [one of my first times] tutoring for this class. I hope we'll be able to learn **and have a bit of fun**. All my past students felt this was **a valuable experience**. Are you ready to get started?
Morgan: Sure.
Tutor: I've looked through your assigned readings about the circulatory system. **I think it's great to learn about a topic that is so relevant to current events like rising rates of heart disease**. How has this new knowledge of bloodflow in the human circulatory system

---

changed your understanding of how the body works...like with the heartbeat?

...

Tutor: Where does the deoxygenated blood go when it is returning from the body?

Morgan: The atrium? I can't remember if it's the left or the right.

Tutor: **Good try. Maybe if we review a bit you'll remember**. **What's important is that we're working at it.** Maybe you can recall how blood gets into the left atrium?

Morgan: It comes in through a valve.

Tutor: Almost. **Let's take some time to really understand** the differences between the two atria.

6.1.1.2   *Performance –Emphasis Vignette #1*

Tutor: Hello, I will be your tutor today.

Morgan: hi.

Tutor: This is my [third semester] [one of my first times] tutoring for this class. I hope we'll be able to learn some. All my past students were **really smart and did really well** on this assignment. Are you ready to get started?

Morgan: Sure.

Tutor: I've looked through your assigned readings about the circulatory system. How has this new knowledge of bloodflow in the human circulatory system changed your understanding of how the body works...like with the heartbeat?

...

Tutor: Where does the deoxygenated blood go when it is returning from the body?

Morgan: The atrium? I can't remember if it's the left or the right.

Tutor: **Um, okay**. Can you recall how blood gets into the left atrium?

Morgan: It comes in through a valve.

Tutor: Incorrect. The left atrium takes in oxygenated blood. The right atrium handles deoxygentated blood.

6.1.2   Research Hypotheses

The hypothesis for this portion of the Vignette Survey Experiment is that a tutor that endorses mastery learning goals will reduce evaluation anxiety and increase help seeking outcomes more than a tutor that endorses performance-oriented achievement goals (*Supported*).

6.1.2.1   *Statistical Approach*

The Vignette Survey was essentially four separate 2X2 survey experiments in which participants only saw one version of each condition, yielding a between-subjects design. When the mastery/performance classroom goals are an independent variable, the second dimension of the experiment is used as a covariate. Post-hoc analyses are performed as a Student's t-test.

6.1.3   Results

66 participants were recruited through Carnegie Mellon University's Center for Behavioral and Decision Research Participation Pool, as these participants are of approximately the same age and educational level as many online course students. The population included 46 females and 20 males with a mean age of

20.4 years (1.64σ). 31 students were in the Performance Goals Tutor, 39 students in the Mastery Goals Tutor condition. An overview of results can be found in Figure 38.
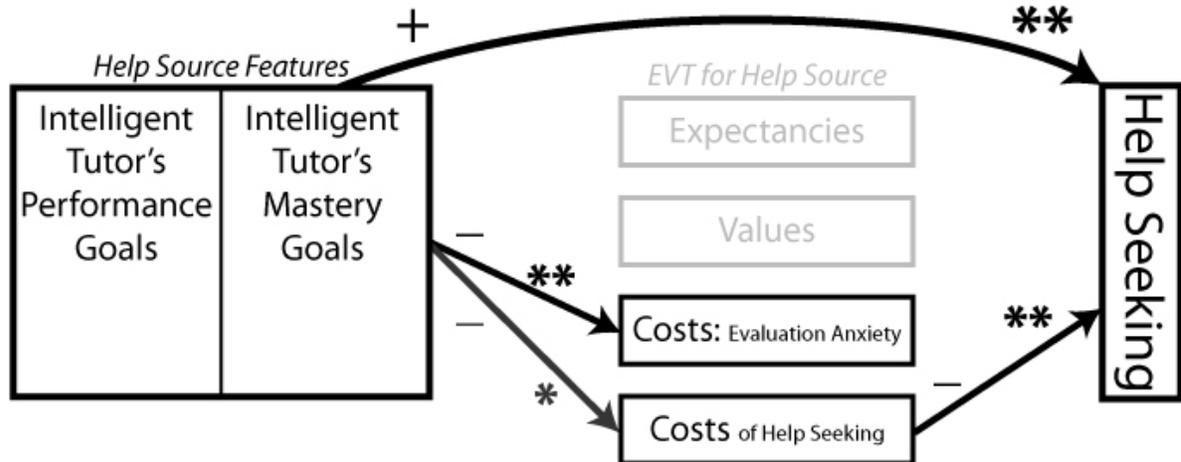
Figure 38. A diagram of the significant and marginal results from the Vignette Survey Experiment. Mastery classroom goals decreased perceived costs. Evaluation anxiety did not appear to be connected to intention to seek help, likely due to the wording and scope of the two scales' items.

Achievement goals is a statistically significant predictor of evaluation anxiety with a post-hoc analysis revealing that students with a tutor that endorses Performance Goals report significantly more evaluation anxiety, $F(2, 64)=4.20$, $p<0.02$, $R^2=0.12$. These results are displayed in Figure 39.
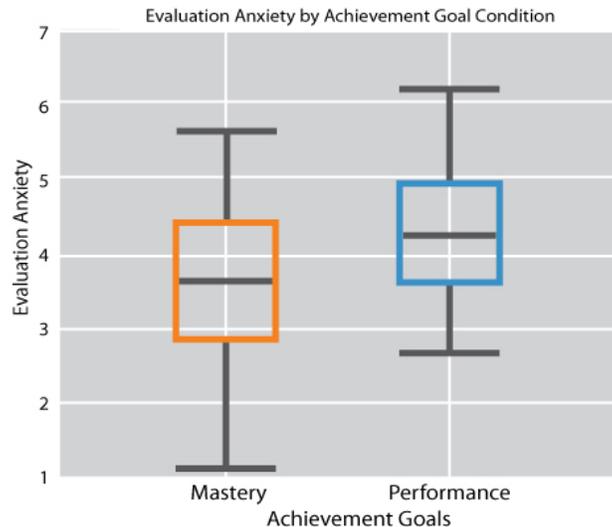
Figure 39. Mastery goals endorsed by a vignette dialogue tutor significantly reduces evaluation anxiety as compared to performance goals endorsement.

There was also a significant result on tutor achievement goals and student reports of seeking help with students in the Mastery Goals condition reporting more help seeking, $F(2, 64)=4.58$, $p=0.014$, $R^2=0.13$. A supporting result is found on help avoidance, with students in the Mastery Goals condition reporting significantly less help avoidance, $F(2,64)=5.23$, $p<0.008$, $R^2=0.14$. Students in the Performance condition also report marginally more costs of help seeking, $F(2,64)=3.26$, $p=0.08$, $R^2=0.06$. There was also a significant relationship between perceived costs of help seeking and self-reported intention to seek help.

6.1.4   Discussion

These results show that we can directly lower evaluation anxiety through the use of a one-on-one tutor that endorses learning goals. This may be achieved by shifting the focus away from performance and more toward learning. It might be possible to extend these results to online course discussion forums by having the course instructor or the discussion forum itself endorse these learning goals as a means of reducing evaluation anxiety. We might hypothesize that endorsing mastery goals in the classroom will reduce evaluation anxiety, as suggested by the Vignette Survey. Further hypotheses based on my prior work in MOOC help exchange systems suggests that a decrease in evaluation anxiety should increase help seeking. Therefore, endorsing mastery goals in the classroom should also increase help seeking.

From a theoretical perspective, endorsing learning goals can possibly be viewed from an Expectancy Value Theory perspective as emphasizing the connection between a particular learning activity (such as posting to a course discussion forum) and learning. We might be able to raise expectations that performing that activity will increase learning. This raise in expectations for learning might only be meaningful for students who also highly value learning. Essentially, what we might expect to see is an increase in the activity for participants that value learning.

In these particular results we also see that evaluation anxiety does not appear to have a negative impact on intention to seek help. This is interesting, as all prior survey experiments examining EVT for Help Sources and intention to seek help from a particular source have supported this relationship. In this survey experiment, self-reported intention to seek help is not measured at the help sources level but at the help seeking process level (i.e., "If <Character's name> needed help with the readings for the assignment, <name> would ask for help."), which might explain the difference in results. This is further supported by a lack of correlation between the two measures of cost. Possibly, evaluation anxiety works mostly at the local, help sources level. The help seeking process level incorporates many additional attitudes and beliefs which might obstruct the impact of evaluation anxiety in this Vignette Survey.

6.2   SPOC Experiment

Where the Vignette Survey suggests endorsing learning-oriented goals as a means of reducing evaluation anxiety, my previous work on Quick Helper has shown how up/downvoting can have a negative effect on help seeking in online courses. Combining the results of these two threads of research would suggest emphasizing the discussion forum's learning benefits as a means of reducing evaluation anxiety in the presence of up/downvoting. However, it may also be possible to reduce the evaluation anxiety from voting by manipulating the type of voting. Up/downvoting should cause considerably more evaluation anxiety than up-voting alone. In this experiment, I seek to investigate both the effect of message prompts and types of voting on help seeking and other learning-relevant behaviors in a course discussion forum.

The context of this experiment is in a Small Private Online Course (SPOC) discussion forum that has been in use in an undergraduate parallel computing course for multiple years. Student behaviors and other outcome variables will not be as strongly controlled as in the Quick Helper experiments.

Furthermore, up until this point I have been focusing solely on helper selection as the vulnerable behavior being affected by evaluation anxiety, but it is quite possible that other behaviors that render the student more likely to be evaluated will also be impacted by manipulations of evaluation anxiety. These behaviors might include the quality or types of student contributions to the forum. Students access course discussion forums for many reasons, possibly because they are required for participation grades or because the student needs help or because the student enjoys discussion. The multiple motivations of students for contributing to the course discussion forum may reduce the salience of the connection between experimental manipulations and help seeking.

6.2.1 Research Hypotheses

My research hypotheses for this experiment explore the impact of evaluation anxiety and features commonly used in a course discussion forum to predict student help seeking, quantity of contributions, and quality of that contribution (here measured as number of characters in a contribution).

6.2.1.1 Voting Hypotheses

1. Up/downvoting (more so than Upvoting Only) may decrease…
    a. …student help seeking. (*Marginal Interaction*, $X^2(4, N=429) = 7.43$, $p = 0.1$, $R^2=0.02$ ($\Delta R^2=0.01$))
    b. …student contributions. (*Not Supported*)
    c. …quality of student contributions. (*Not Supported*)
    d. …learning. (*Supported*, $F(2,62)=4.1$, $p=0.02$, $R^2 = 0.41$ ($\Delta R^2 = 0.30$))

6.2.1.2 Email Prompt Hypotheses

2. Learning Emphasis prompts may increase…
    a. …student help seeking. (*Interaction,* $X^2(4, N=429) = 6.04$, $p = 0.05$, $R^2=0.02$ ($\Delta R^2=0.01$)
    b. …student contributions. (*Not Supported*)
    c. …quality of student contributions. (*Not Supported*)
    d. …learning. (*Not Supported*)

6.2.1.3 Learning Hypothesis

3. Help seeking may increase learning. (*Not Supported*)

My hypotheses for voting's effect on help seeking and contributions are related to previous work on increasing evaluation anxiety's effect on behaviors that render a student more vulnerable to evaluation.

Hypotheses pertaining to learning emphasis prompts originate from the Vignette Survey in which similar messages were used to successfully reduce evaluation anxiety. However, emphasizing the likelihood of learning in the course discussion forum may rely on a relatively high value for learning to be effective in increasing student contributions. That is, if a student knows that the forum will increase the likelihood of learning because of the experimental manipulation prompts, the student will only change his behavior and

post on the forum if he highly prioritizes learning. If, however, he highly prioritizes spending little effort or time on the course, this manipulation may not have significant impact.

All hypotheses predicting a relationship between experimental manipulations and help seeking may suffer from conflicting motives for student usage of the discussion forum. The course requirement to participate in the forum for a participation grade may de-emphasize the forum's utility as a help source and instead of emphasize the necessity of posting for an extrinsic reward. Furthermore, students may be participating in the discussion forum for increased social interaction and discussion. The usage of the Quick Helper system was limited to help requests, but this more baseline discussion forum elicits multiple strong motivations for the use and intent of the forum.

Furthermore, help seeking is just one of many sources of learning in an online course. Help seeking is considered a key self-regulatory skill for learning, resulting in more effective learning both in face-to-face classrooms (Nelson-Le Gall, 1981; Karabenick & Newman, 2009) and with educational technologies (Aleven et al., 2006). My hypothesis about the connection between help seeking in the discussion forum and learning reflects the research on this topic. As an example, in Howley et al. (2014) we found no relationship between help seeking and learning on the topics that were covered by the reading materials. On topics which were not included as part of the reading material, help seeking did have an impact on learning. This suggests that quality learning materials may reduce the relationship between help seeking and learning for most students. In the SPOC described in this section there is a variety of learning materials, as well as a variety of sources from which to seek help. Students may choose to seek help from a peer or another Internet resource, outside of the discussion forum, and so it is plausible to see a different relationship between help seeking and learning in this case as well. We may not anticipate a relationship between the email prompts and help seeking, as the prompts do not emphasize the discussion forum's utility for help seeking, but rather for learning.

The SPOC experiment occurs in a very different environment than the previous Quick Helper MOOC experiments, and as such, these hypotheses pertain more to what we might expect to see in a more tightly controlled Quick Helper MOOC follow up experiment.

6.2.2 Study Design and Methodology

This experiment took place in an undergraduate parallel computing course that met twice per week in a face-to-face classroom, but the class lectures were posted online each week. Students were required to post on each set of lectures (i.e., twice per week) for a participation grade. A screenshot of the course discussion board is shown in Figure 40, which shows that there was a discussion forum underneath each lecture slide. The discussions were not threaded, and so which contribution was a response to which prior contribution was not inherently obvious.

Figure 40. A screenshot of one of the SPOC discussion forums appearing under a single lecture slide.

65 consenting students were randomly assigned to voting conditions at the beginning of the course, and were randomly assigned to prompting conditions five weeks later when the prompting condition was deployed, as visualized in Figure 41. Conditions were assigned per student, so each student only saw one prompting condition and one voting condition. Due to the distributed nature of the experiment, I am limiting the investigation of behavioral variables and learning to be between the midterm and final exams.
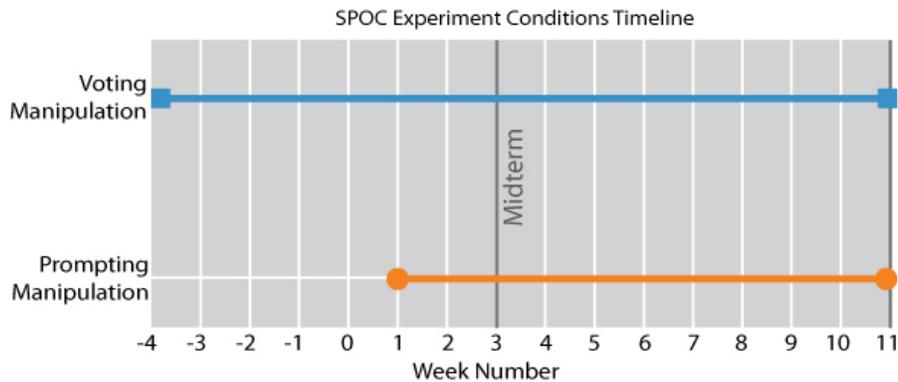
Figure 41. The timeline for the SPOC Experiment manipulations, showing the duration of each manipulation.

6.2.2.1 Voting

The voting manipulation appeared in the discussion forums underneath each lecture slide. Figure 42 shows the three different experimental manipulations for the voting condition. We see that a student in the 'no vote' condition does not see any mention of voting links on discussion board comments. The 'upvote only' condition sees only the potential for upvoting, and the 'up/downvoting' condition see both upvoting and downvoting links.

No students downvoted others' contributions, however, this should not minimize the impact of evaluation anxiety influenced by these conditions. The potential to be downvoted still remains and students are not explicitly informed of the rarity of downvotes. Students did upvote a mean of 1.6 posts ($\sigma = 4.6$). Furthermore, upvoting still introduces evaluation, although the negative possibility for evaluation is removed. For this reason, upvoting should still induce evaluation anxiety.
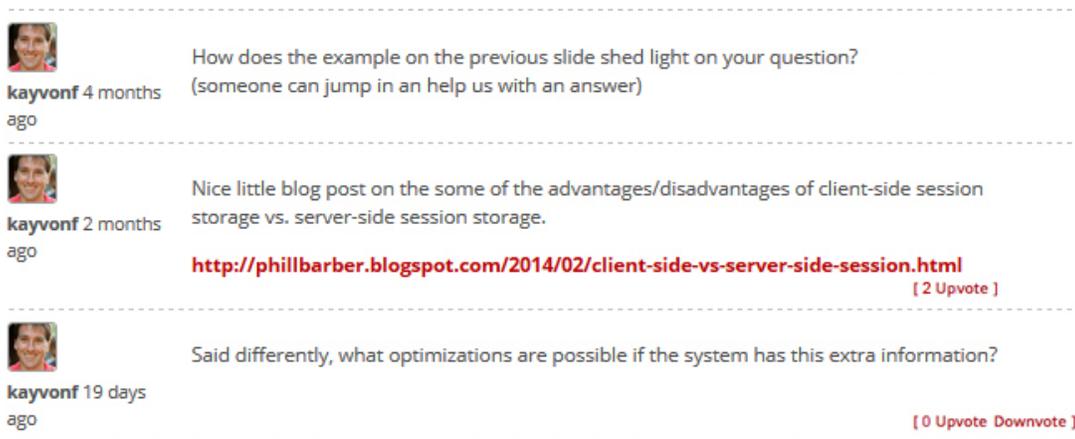
Figure 42. A screenshot of three different forum contributions showing three different voting experimental manipulations. The top contribution is from the perspective of a student in the 'no voting' condition, the middle contribution is from the 'upvote only' condition, and the bottom contribution is from the 'up/downvoting' condition.

6.2.2.2 Email Prompts

Email prompts were designed with the intention to reduce evaluation anxiety by increasing the expectancy of learning from contributing to the forum. The messages were implemented as email prompts

with a format as shown in Figure 43. The first line informs the student that she has been prompted, followed by a second line that resembles a salutation (what is called a "welcome prompt"), but is where the experimental manipulation occurs. This line is followed by a contextual instruction (or "context prompt") which is editable by the instructor sending the prompts. Then a quotation from the discussion forum is included, followed by (in grey) an explanation from which course the prompt originated.
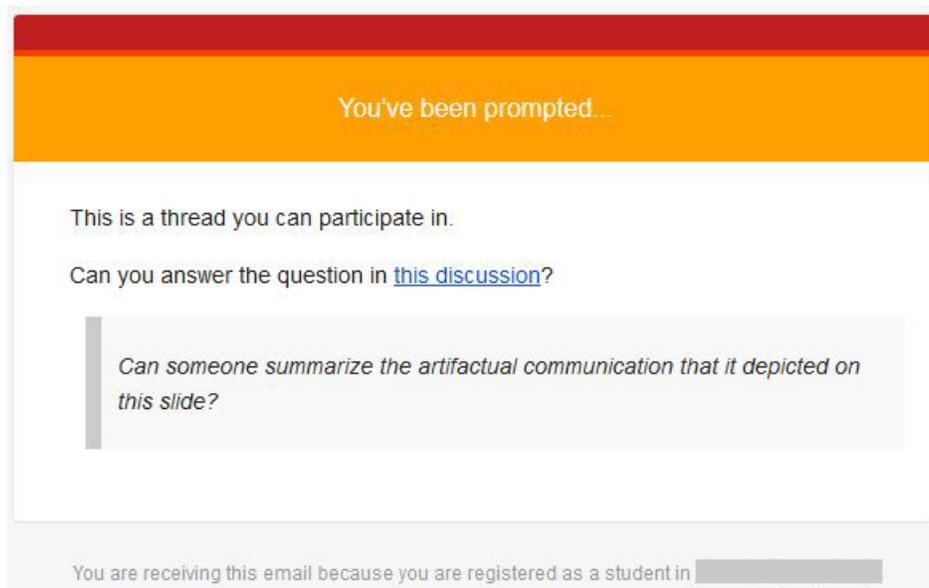
Figure 43. A screenshot of an email prompt with a heading, a neutral welcome prompt (experimental manipulation) , a contextual prompt relating to a question, and an excerpt of a comment in the forum.

A complete list of the email prompts can be found in Appendix C.-Small Private Online Course Email Prompts, but below is a sample of the 16 learning emphasis welcome prompts:

1. Participating in class discussions increases exposure to new ideas.
2. Writing down your thoughts will help you think through complex ideas.
3. Class discussions help you understand concepts, not just memorize them.
4. Contributing to the course discussion forums is a good way to learn new things.
5. Expanding on others' ideas is a great way to learn new things.
6. Participating in the class discussions online will help you learn the concepts better.

The control welcome prompts also had 16 different phrasings which all essentially said different versions of "Here is a discussion forum." When an instructor decided to prompt a student through their administrator account, the system would randomly select two students, select the appropriate welcome prompt according to their condition assignment, and suggest a context prompt but allow the instructor to edit it. The welcome prompts were not editable by instructors.

There were 5 Teaching Assistants and 1 instructor, who were advised to prompt twice per week. Since prompts were sent to two students at once, we would expect to see 24 prompts sent per week. Although,

since we are only looking at consenting students, we might only see up to about 8 prompts per week. Instead, instructors sent most of their prompts after the fourth week of the prompting manipulation (i.e., ninth week of classes), as shown in Figure 44. We also see that 26 students did not receive their first email prompt until after week four, and 16 saw their first prompt in the first week of the prompting experiment. 18 students never received any prompt due to the random selection approach of the system, and so they are assigned to a "no prompt" condition. The dilution of this experimental manipulation and its time sensitive orientation produce some constraints and complications in the analysis of these results.
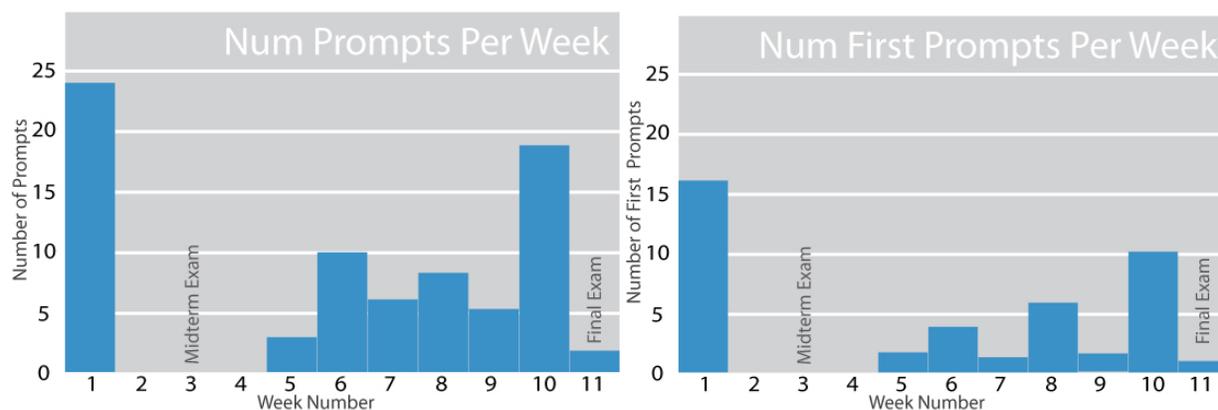
Figure 44. A histogram showing when consenting students received email prompts, by week (left) and when consenting students received their first prompt (right). Most students did not receive any prompts until after the midterm exam.

6.2.2.3 Statistical Approach

Student-level analyses (i.e., condition assignment, learning, behavioral counts) are performed as a between-subjects analysis, with both prompting and voting conditions included. Comment-level analyses (i.e., comment length, is a help request) are performed as a within-subjects analysis including the student ID as a random effect. Post-hoc analyses are performed as a Student's t-test.

6.2.3 Results

53 students posted a total of 655 comments to the forum over a thirteen week period, with a mean of 19.58 posts ($\sigma = 16.5$) per student, and on average 4.2 help requests ($\sigma = 4.5$) as determined by a simple algorithm that searched each comment for "question", "dunno", "n't know", "?", "confus", "struggl", "lost", "stuck", and "know how". A summary of the results is represented in Figure 45.
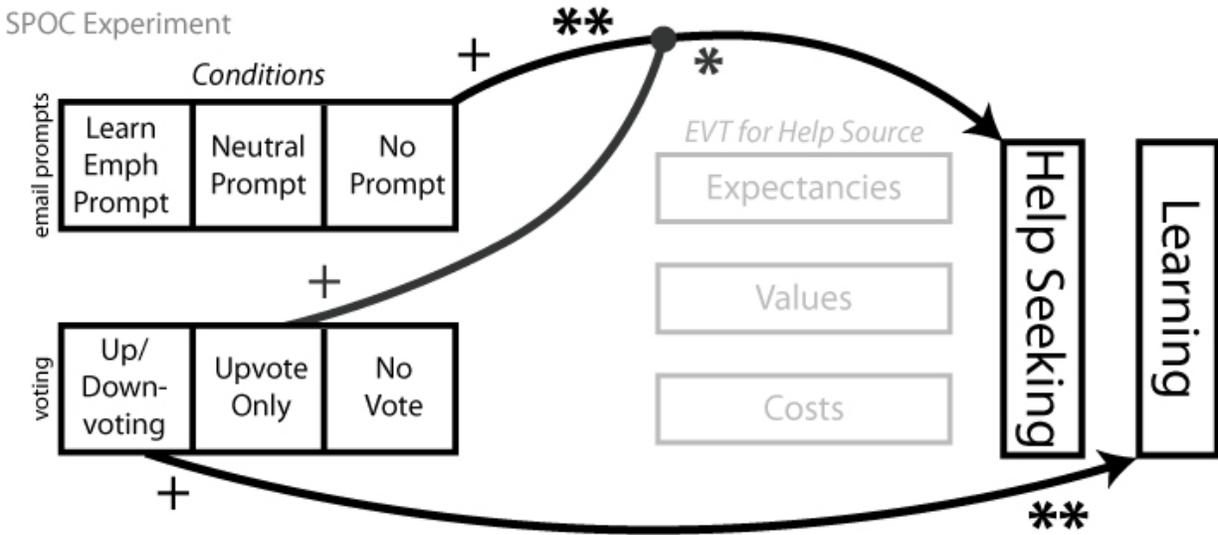
Figure 45. A diagram representing the statistically significant relationships in the Small Private Online Course model. Email prompts generally had a neutral and negative impact on commenting and help seeking, respectively. Upvoting only might have a positive effect on help seeking, but students in the up/down voting condition learned more overall.

6.2.3.1 Commenting

Figure 46 shows the number of comments per week from consenting students. Comments appearing on a lecture slide more than three weeks old were removed from the dataset. Commenting on a lecture since approximately six additional lectures were posted was interpreted as not contributing to the ongoing (now expired) conversation. Results showed that my hypotheses related to help seeking and overall number of contributions to the forum were not supported by this data.
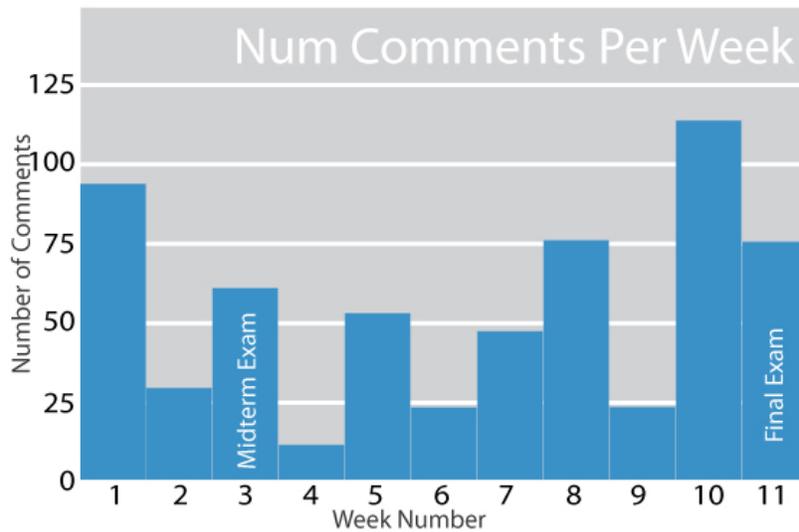
Figure 46. Total number of comments from consenting students per week.

Diving more into the time-oriented nature of the prompting conditions, I performed an ANCOVA examining the relationship between prompting condition, voting condition, and number of comments one

week after a student's first received prompt, controlling for number of comments posted one week before that prompt and the date of the first prompt received. There was no effect of the number of comments one week after receiving the first prompt, as shown in Figure 47. The trend was in the hypothesized directions, but not statistically significant. I also examined the number of comments three days after the first prompt, for the possibility that the email prompt had a very short and immediate effect but there was also no significant relationship. However, these results align with the findings from Kizelcec et al. (2014) and Zhu et al. (2013) in which the email prompts had no effect on forum contributions.
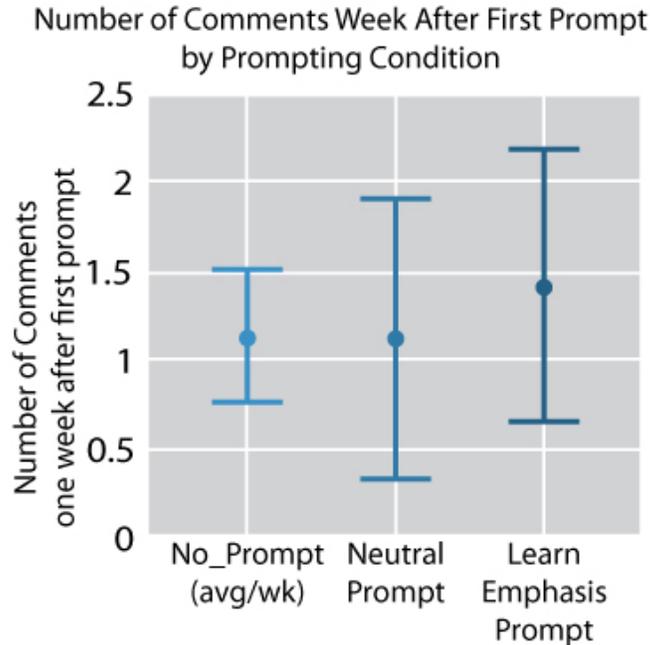
Figure 47. Mean point plot with 95% confidence intervals for the number of comments one week after receiving the first email prompt. There was no significant difference between email prompting conditions, although students receiving learning emphasis prompts commented slightly more than those in other conditions. This was not significant.

6.2.3.2 Help Seeking

However, there was an interesting interaction between the prompting and voting conditions on whether a comment was a help request or not. Specifically, the interaction itself was marginal, but the prompting term was significant, $X^2(4, N=429) = 6.04$, $p = 0.05$. We see in Figure 48 that participants in the No Prompt condition had significantly more help requests. This suggests that not only did email prompts have no effect on overall contributions, email prompts may have a negative impact on help seeking. Even a no prompting up/downvoting condition which is status quo in many course discussion forums does not perform better than the baseline control condition (i.e., no voting and no prompting). The only condition that does perform better than baseline on help seeking is the no prompting, upvote only condition.
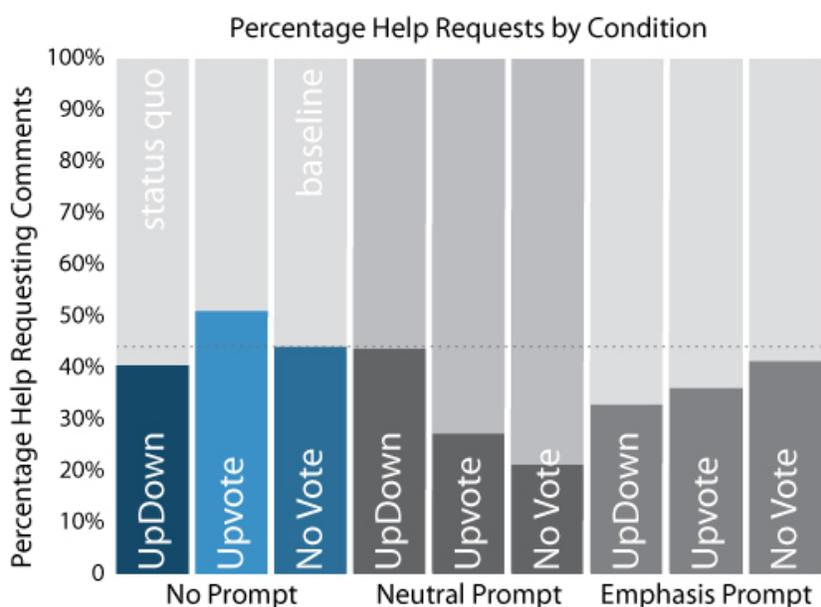
Figure 48. The percentage of help requests by condition. "No Vote/No Prompt" can be considered a baseline, and "Up/downvoting & No Prompt" might be considered status quo. Email prompts generally had a negative impact on the measure of help seeking, and it is possible that upvoting only might have a beneficial effect on help seeking.

6.2.3.3   Learning

Voting had a significant effect on learning, such that students in the up/downvoting condition learned significantly more than students in the no vote condition, $F(2,62)=4.1$, $p=0.02$, $R^2 = 0.41$ ($\Delta R^2 = 0.30$). Students in the upvote only condition performed significantly indistinguishably from either of the other two conditions. This suggests that voting may be beneficial for learning.

6.2.4   Limitations

The SPOC did meet regularly face-to-face, and so the possibility for cross-contamination of conditions was possible. However, students did not publicly mention the realization of there being multiple voting implementations until the fourteenth week of classes when the experiment was nearly complete.

As noted previously, the email prompts were not evenly distributed and their dilute implementation lead to complications in analyzing this portion of the data. More time-sensitive analyses are necessary to better understand how the email prompts impacted student discussion forum behavior.

While this discussion forum is more similar to an out-of-the-box MOOC discussion forum than our Quick Helper system, it is still not a true baseline comparison. However, this particular course has been taught in this format for multiple years, and so it is an appropriate example of a natural setting for a discussion forum. A natural follow-up experiment to this work in a SPOC would examine similar questions in a MOOC that does not meet face-to-face twice weekly.

6.2.5   Discussion

The results from the SPOC experiment align somewhat with prior work. Specifically, the email prompts' lack of effect at encouraging forum participation aligns with the findings from Kizelcec et al. (2014) in

which their email prompts had no effect on forum contributions and were at times harmful to participation. As in the Kizilcec et al. (2014) experiment, this could be due to numerous reasons. Perhaps emphasizing the learning benefit is too obvious a persuasion for students who prefer the forum for social purposes. An additional related explanation is similar to Zhu et al. (2013) in which more experienced Wikipedia editors did not increase their contributions in response to an email prompt containing positive feedback. It is possible that students in this course, who participated in the course for five weeks prior to the initial email prompts, all functioned as experts in the course. In this case, the expert students could have reacted negatively to the email prompts due to challenges to their expertise as students. A third possibility is that the email prompts increased expectancy for learning from the discussion forum, which would only impact the behavior of students who value learning from the discussion forum. However, this conflicts with the results from the Vignette Survey therefore is slightly less of a possibility.

The voting condition had an effect on learning. We know that the difference in learning is not due to our prompting conditions, and voting does not appear to have any effect on any other student behaviors we measured and so it remains unknown through what mechanisms voting impacts learning. It is possible that voting is increasing an additional motivational factor that was not measured in this experiment. This remains an open avenue for further research.

When looking at both email prompts and voting simultaneously and their effect on help seeking, the only way to improve upon a baseline discussion forum (i.e., no voting, no email prompts) and a status quo discussion forum (i.e., up/downvoting, no email prompts) is to have a discussion forum without email prompts, but utilizing upvoting only. This trend aligns with our expected results.

This experiment manipulated voting by examining up/downvoting versus upvoting only versus no voting and there are other possible ways to manipulation the evaluation anxiety caused by voting, from the specifics of the voting mechanism itself. For example, in a threaded discussion forum, we might be able to examine the effect of voting only on the comments versus voting on both the originating post and the comments. This approach might also result in reduced evaluation anxiety since questions are usually the originating post and would not be voted upon.

6.3   Chapter Discussion

This chapter explored the use of increasing the expectancy for learning from a discussion forum via email prompts, and the possible negative effect of voting on commenting and help seeking behaviors. The literature on evaluation anxiety suggests that evaluation apprehension can affect multiple kinds of performances. We have seen that this effect exists for help seeking, with email prompts being particularly harmful and upvote only interactions potentially having positive impact on help seeking. The multiple resources students have available to them in a typical online course may compensate for the potential harmful effects of reputation systems. If it is too costly to seek help from the discussion forums, students have access to many other help sources, and a further analysis of how students choose one help source over another may further explain the results observed in this chapter.

The Vignette Survey informed the design of our email prompts in the SPOC experiment by suggesting that evaluation anxiety can be reduced through the endorsement of learning goals. However, possibly due to the dilute deployment of the email prompts, or to a flaw in the use of email prompts in general there

was no effect of email prompts on commenting behavior. An additional explanation for these results is that emphasizing the increased expectancy for learning from contributing to the forum would only increase the posting behavior of students who value learning. It is possible that these students may have valued other outcomes more than simply learning, especially considering the length of the experiment.

7 Conclusions

In this thesis, I provided initial empirical evidence for Expectancy Value Theory for Help Sources and generated design recommendations for online courses based on the newfound understanding between the theory and student behavior. My high-level research goals were pursued in the context of help seeking in the presence of reputation systems in MOOC discussion forums. Educational technology can be intentionally designed and introduced in such a way as to maintain the benefits of existing technology while reducing negative impact on learning-relevant behaviors. I accomplished these goals through the lens of student expectancy and values for the help source, and costs of pursuing that help. Specifically, I endeavored to determine (1) if Expectancy Value Theory for Help Sources can be used to understand student behavior in online learning environments and (2) if this understanding of Expectancy Value Theory for Help Sources can be leveraged to improve online learning environments.

I grounded this work in the investigation of common reputation system features implemented in a help exchange system in which students select helpers immediately after exposure to experimental manipulations. I reinforced this field work with survey experiments to tie student behavior to survey items measuring Expectancy Value Theory for Help Sources. The combination of in vivo experiments with survey experiments has enabled me to both generate design recommendations for improving online classrooms, but also better understanding the causal mechanisms behind those recommendations.

The **EVT Helper Survey Experiment** showed that the relationship between factors in the Expectancy Value Theory for Help Sources model empirically held the hypothesized relationship with intention to seek help. It also showed that evaluation anxiety is a social cost influencing whether people intend to seek help from a particular source. This initial survey experiment also showed that it is difficult to manipulate value beliefs separately from expectancy beliefs, which was upheld through further studies.

The **QH MOOC Experiment** combined with the **QH Theory Survey Experiment** showed that these theoretical relationships exist in a live system as well. Increasing expectancies and values for the help sources, increased the number of peers invited to help. Reducing evaluation anxiety, a social cost, also increased the number of peers invited to answer the students' questions. Knowing a potential help source's expertise positively influenced perceived values and expectancies for the help source, which also increased the number of helpers selected in a help exchange system. Help Giver badges decreased evaluation anxiety, which explains the interaction between badges and voting that we saw in the QH MOOC Experiment. Badges can be used to decrease evaluation anxiety, while up/downvoting might increase evaluation anxiety.

The **QH Contrast Survey Experiment** supports the theoretical relationships seen in the other two survey experiments, but also explored the connection between help sources level Expectancy Value Theory and help seeking process level Expectancy Value Theory.

The **Vignette Survey Experiment** suggested that evaluation anxiety could be reduced by learning-oriented classroom goals. This result was further explored in the **SPOC Experiment** as an email prompt, along with an examination of how different kinds of up/downvoting impact learning, help seeking and commenting in a live course discussion forum. In the Small Private Online Course, students had increased

access to learning and help giving resources, and an increased amount of time between exposure to our independent variables and measures of our dependent variables. Despite this loosening of experimental control, we still saw some evidence for email prompts having a negative impact on help seeking and up/downvoting having a positive impact on learning.

My dissertation shows that evaluation anxiety is an important factor when investigating student help seeking. This evaluation anxiety can occur at the help sources level, where a particular resource might seem more capable of judgment and it can also occur at the higher-level help seeking process level, where seeking any help may incur social costs. This thesis reveals evaluation anxiety as an important social cost that is not necessarily measured by current measurements of public threats to self-esteem. Existing measures of evaluation anxiety should be included in future investigations of student help seeking in social situations to capture this dimension of costs in a help seeking Expectancy Value Theory model.

This thesis also found that while reputation systems can have positive engagement benefits for student engagement, it may also have negative effects on help seeking. These negative effects can be mitigated through the use of badges that reduce evaluation anxiety, or possibly through the use of upvoting without downvoting. By examining reputation system features through the lens of Expectancy Value Theory for Help Sources we were able to identify the common features that have a positive effect on student expectancies and values while help seeking, as well as those features that enhance the effect of evaluation anxiety in help seeking. In short, if a discussion forum is not leveraging the logistical/organizational benefits of up/downvoting (i.e., as a way of sorting or gauging important topics), then it may be advisable to drop up/downvoting from the course discussion forum entirely.

7.1   Expectancy Value Theory for Help Sources
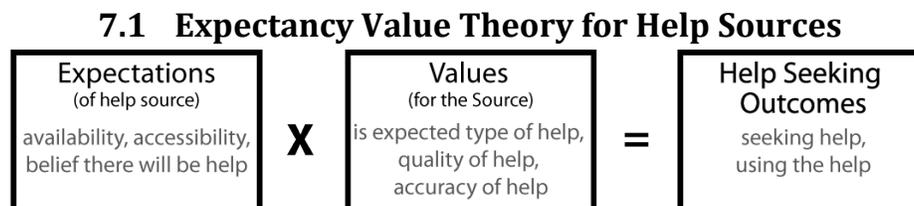
Figure 49. Expectancy Value Theory for Help Sources as presented in Makara & Karabenick (2013).

My research shows that Expectancy Value Theory for Help Sources successfully fulfills the hypothesized relationships between expectancy, value, and cost beliefs and help seeking outcomes. However, some issues were encountered in connecting experimental manipulatives to the beliefs portion of the model. While manipulations can be designed to individually manipulate costs or expectancy beliefs in the model, it seems quite difficult to manipulate value beliefs for the help source separately from expectancy beliefs for the help source. From a practical perspective, this is a minor issue as increasing expectancies or values should both have a positive effect on help seeking.

Trautwein et al. (2012) suggests that an enhancing interaction should exist between expectancies and values. We saw a marginal effect of this interaction term on intention to seek help, but the enhancement relationship was not apparent. Further investigation is necessary to determine if this is an issue with the theory's framing, or with the measurement items used here.

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Additionally, while beliefs for the help source are intended to be separate from process-level expectancies and values, it may be necessary to investigate EVT-HS alongside expectancy value beliefs at the process level to fully explain student help seeking behaviors. As an example, instead of representing Expectancy Value Theory for Help Sources as it was in Makara & Karabenick (2013) (see Figure 49), it might be possible to adopt a longer form of Expectancy Value Theory, in Table 6.

Table 6. A longer form of Expectancy Value Theory of Help Sources.

	Outcomes	Expectancy/Likelihood	Value/Importance
(EVT-HS expectations)	Receiving help from this source	…of receiving any help from this source	…of receiving any help from this source
(EVT-HS values)	Receiving quality help from this source	*…of receiving quality help from this source*	…of receiving quality help from this source
(EVT-HS evaluation anxiety)	This source will think I'm stupid if I ask them for help.	…that this source will think I'm stupid if I ask for help.	…of not being judged as stupid by this source if I ask for help.

When examining the theory in this alternate representation it becomes apparent that the "belief that there will be help" might often be subsumed by the Expectancy/Likelihood factor of EVT-HS values: "The Expectancy/Likelihood of receiving quality help from this source." Further investigation is necessary to determine how to specify values for the help source separately from expectancy beliefs for the help source. This separating Expectancy Value Theory for Help Sources into separate expectancies and values for Expectations for the Help Source and Values for the Help Source will have to be empirically validated, and it too may encounter difficulties distinguishing value beliefs from expectancy beliefs as highlighted by the italicized cell in Table 6. Perhaps instead of considering this a flaw in the theory, it might be incorporated as a common student belief.

This thesis also strongly recommends the inclusion of evaluation anxiety as a cost in an Expectancy Value Theory for Help Sources. Many values of help seeking are based on beliefs that are not a reflection of the student's self-beliefs. Some costs to help seeking are similar, such as time costs (i.e., the amount of time it takes to obtain help is not always a reflection of the student's self-beliefs of competence). However, both social values and social costs can reflect a student's perceptions of self. Going forward, it is important to consider whether social costs and social values are considered differently from non-social costs and non-social values when students decide to pursue help.

We could also hypothesize additional costs at the help sources level that were not included in this dissertation, such as fears of inconveniencing the help source, the expenditure of social capital, as well as the positively valenced social reinforcement. The up/downvoting manipulation mostly operates at the help sources level since Quick Helper requests are private and focused on peer helpers, but many implementations of up/downvoting may operate more at the help seeking level when the help requests are fully public. In many discussion forums, the number of upvotes and downvotes a post receives is displayed publicly which could add to the public nature of the evaluation anxiety.

7.2 Design Recommendations

In pursuing an understanding of how Expectancy Value Theory for Help Sources relates to student behavior, common reputation system features, and evaluation anxiety, I have generated design recommendations for improving online courses. Design recommendations for course instructors include: (1) reducing student evaluation anxiety to increase help seeking, (2) emphasizing a peer helper's potential value and expectancy to increase help seeking, and (3) not implementing email prompts to encourage discussion forum participation.

These design recommendations originated from results showing that up/downvoting forum interactional archetypes increase student evaluation anxiety, and likely should not be used in educational contexts if the voting is not being leveraged to organize large quantities of content. Reducing the options of theup/downvoting was one observed way to decrease evaluation anxiety. Implementing Help Giver badges is another path to achieving this goal.

When emphasizing a peer helper's expertise, it should be noted that displaying expertise levels below "above average" (in Quick Helper's case, 80% topic match) will have a negative impact on how often that student is invited to help. Depending on the design of your system, this may or may not be desirable behavior. In order for a display of expertise to positively impact anticipated expectancies and values, that expertise must exceed a threshold of perceived competence.

Email prompts to encourage participation in a discussion forum are unlikely to have significant impact on evaluation anxiety or forum behavior in general, and may actually be harmful to learning-relevant behaviors. Several research experiments have endorsed cautious use of email prompts for increasing engagement with the targeted task activity.

7.3 Contributions to Human-Computer Interaction

This thesis has examined common interactional archetypes employed in reputation systems to better understand how it impacts users in learning contexts, and specifically help seeking when learning is the goal. I have shown that implementing features intended for another context may not be the most appropriate features for all users in all contexts. I have also generated approaches for adapting these interactional archetypes to a specific setting, that of online courses.

7.4 Contributions to the Learning Sciences

My research has investigated Expectancy Value Theory for Help Sources as presented in Makara & Karabenick (2013), and generated novel empirical evidence to support parts of that theory. A combination of survey and field experiments showed Expectancy Value Theory for Help Sources, as initially presented, may require refinement to separately capture value beliefs for the help source.

My work has also provided evidence for including social costs, specifically evaluation anxiety, into a useful model of help seeking and encourages the inclusion of additional social costs when examining student behavior in social environments.

7.5   Future Directions

In this thesis I have provided the ground work for initial investigations of two main thrusts of research, that of Expectancy Value Theory specifically for concerns related to help seeking, and that of the impact of reputation systems on student learning-relevant behaviors. This work has touched upon several topics of potential interest with future research directions.

7.5.1   Expectancy Value Theory for Help Seeking

My investigation into Expectancy Value Theory for Help Sources included an introduction of how beliefs related to a particular help resource (i.e., this peer helper might evaluate me if I ask them for help) and beliefs related to help seeking in general (i.e., other students will judge me poorly if I ask for help) can influence whether and from whom students decide to seek help. Further investigation is necessary to determine exactly how these multi-level help seeking concerns impact student help seeking in multiple contexts and for different types of students. This future direction of research also requires a more rigorous development of expectancy and value measurements for help seeking and help sources, as well as the development of manipulatives that individually impact expectancy and value beliefs.

Along this same thread, it is not simple to understand how student expectancies and values change over time, or how an initial bad experience with a help source may influence future interactions (or lack thereof) with that help source. Expectancy Value Theory at the domain-level suggests that student's prior successes and failures in a domain will impact their expectancies and values for that domain, and a similar relationship may exist for expectancies and values for help sources and help seeking in general. This dissertation generally treated student expectancies and values separate from a time and prior experience component that likely greatly impacts student help seeking in the long term.

A greater understanding of baseline student evaluation anxiety and providing instructions and support for students to overcome this social obstacle could improve student help seeking outside of the discussion forum. Another possible future research direction is better understanding how to teach students to manage and overcome their evaluation anxiety so that it does not impact their help seeking. Students will encounter varying levels of evaluation anxiety throughout their academic and professional activities, so influencing evaluation anxiety within the student, rather than within the educational environment may also be a worthwhile research direction.

While this work touched very briefly on the anonymity of potential peer helpers, it did not cover the anonymity of help seekers. While Expectancy Value Theory has been investigated at the classroom or face-to-face level, this thesis examines the theory one step further along the anonymity dimension, in which students have usernames to partially identify them. One could hypothesize that our results based on evaluation anxiety and social costs might change the further along the anonymity continuum the help-seeker becomes. The more anonymous the help request, the less evaluation apprehension incited.

Additional social costs and values need to be further understood, including face threat, social capital, and social reinforcement. Along with missing costs beliefs, there are large quantities of expectancy and value beliefs that could also be incorporated into Expectancy Value Theory for Help Sources that require further study. This includes expectancy-value combinations such as the importance of receiving help

punctually (i.e., "Receiving help from this source in time to submit my homework"). The measurement items for Expectancy Value Theory of help seeking and Help Sources need to be sufficiently validated.

Furthermore, in this thesis I have focused on help seeking, but help provision is a second part to the help seeking process. A student's expectancies and values for a help source depends on their success in obtaining quality help in the past from that resource, and so to truly raise expectancies and values for a help resource, we must ensure that the student is actually receiving the useful help they request. Evaluation anxiety is likely also a concern of students providing help, and so the fear of being judged should also be taken into consideration.

7.5.2 Reputation Systems Impacting Learning-Relevant Behavior

This thesis opens up several avenues of possible exploration for many different features of reputation systems that are being adapted to learning contexts. This includes different types of badges, point- and badge-awarding schemes, and ways of displaying this information on student profiles or discussion forums. I also examined up/downvoting in a non-threaded discussion forum, but in a threaded forum, it is possible to examine student help seeking behavior when there is only voting on the response comments and not the originating comment. This would likewise open up research explorations not only into help requesting, but help providing as well, such as how including voting on responding comments impacts potential helpers' evaluation anxiety and desire to provide help.

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9   Appendix A.

9.1   Expectancy Value Theory Survey Experiment Items

Expectancies and values around a particular help source must be measured as well as expectancies and values around first-level outcomes of help seeking. When considering the process of help seeking there are numerous first-level outcomes including: (1) obtaining good/useful help, (2) becoming a better student, (3) looking dumb in front of others, among other outcomes. Each of these outcomes has a perceived likelihood that it will occur (i.e., expectancy) and a value or importance placed on the outcome. Second-level outcomes might include the perceived likelihood that achieving useful help will improve the student's homework score (or course grade), and how much that student values receiving a good homework score.

I have marked questions that I wrote with an asterisk. In many cases, there may not be existing validated measures for what I am investigating.

The PDF version of this online survey produced by Survey Monkey[7] is available upon request, as it includes approximately 50 screenshot images it is 67 pages long.

9.1.1   Experimental Design
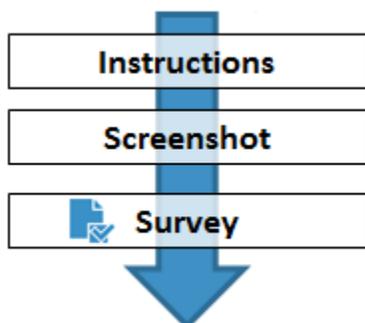
The basic experimental design is (1) to provide the context to the participant in the instructions. (2) Underneath the instructions will be a screenshot. This is the experimental manipulation where participants will be shown different versions of our MOOC manipulations. (3) A short survey follows the screenshot, inquiring about participants' expectancies, values, costs, and evaluation anxiety related to help seeking. Each participant will be shown several screenshots, each preceded by instructions and followed by the same survey.

There are four different phases of the survey:

1. The "help seeking beliefs" phase in which the participant responds to questions about their general attitudes towards help seeking. These are asked after (1) the most costly (i.e., up/downvoting screenshot with no badge and no topic match sentence) and (2) the least costly (i.e., no up/downvoting, a 3 star Help Giver badge, and a highly matching topic sentence). In this way I measure participant attitudes towards help seeking and also determining if our manipulations, in their most extreme versions, can affect students' general attitudes towards help seeking.
2. The "theoretical" version where I manipulate expectancies and values of help sources as close to the theoretical versions of it as possible. The Value Emphasis sentence is "This person offers high

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[7] http://www.surveymonkey.com/

quality help". The Expectancy Emphasis sentence is "This person is available to give help." The cost emphasis sentence is, "This person will evaluate the quality of your question." The control sentence is "This person is a fellow student." This results in four different screenshots to display.
3. The "ecologically similar" version in which we use screenshots direct from the Quick Helper MOOC experiment.
4. The "ecological validity" version in which we show three helpers at a time, identically to in the Quick Helper MOOC course, and ask the participant which helpers they would select. Participants should be shown at least two of these screenshots, and then simply asked which helpers they would select.

Table 7. An explanation of the four parts of the survey experiment and what measurement items are shown after each screenshot.

Help Seeking Beliefs (2)	Theoretical Version (4)	Ecologically Similar Version	Ecological Validity (2)
One Maximum Value screenshot vs. One Minimum Value screenshot	4 Theory Sentences in 4 Single Helper screenshots	3||8 Quick Helper Manipulations Single Helper screenshots	Voting + 3 Helpers screenshot
Items: (1) Expectancies and Values of Help Sources, (2) Costs of seeking help in a particular context , (3) EVT of Help Seeking (general) (4) Alternative Outcomes (general)	(1) Expectancies and Values of Help Sources, (2) Costs of seeking help in a particular context	(1) Expectancies and Values of Help Sources, (2) Costs of seeking help in a particular context	"Would you like to invite any of these potential helpers to your discussion thread via private message?"

9.1.2 Survey Instructions

"Please answer the following questions to the best of your ability. Using the scale below, indicate to what extent you agree with each of the following items." (The items will include an agree/disagree 7-point Likert scale, when appropriate)"

For Expectancy & Value screenshots: "You are enrolled in an online course and are having difficulty with one of the assignments. You decide to seek assistance from some of your peers. You submit your question to the online course website and the course system recommends you ask the following fellow student:"

*For Cost screenshots: "*You are enrolled in an online course and having difficulty with one of the assignments. You decide to seek assistance from some of your peers. The course recommends a qualified fellow student, but it first provides you with a preview of the email it will send the student if you select him/her to help you."

9.1.3 Expectancies and Values of Help Sources

There does not appear to be any survey questions associated with Expectancies and Values of Help Sources. In this case, it might be possible to design survey items originating from the theoretical model:
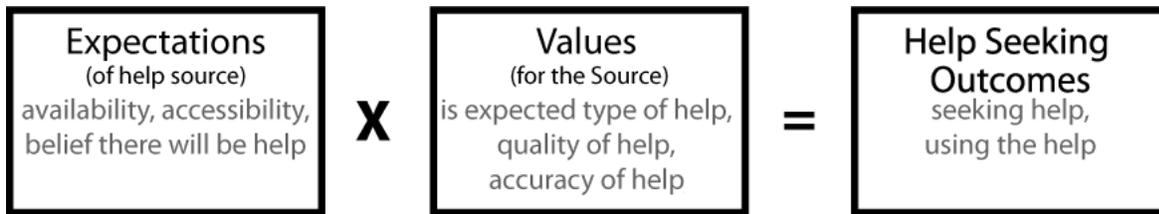
Expectancy

1) *<This person> is available to give me help.
2) *If I ask for help from <this person>, they will give me help.
3) *If I have a question for <this person> they will answer me.

Value

4) *The help from <this person> will be what I need to answer my question.
5) *<This person> will provide me answers of high quality.
6) *<This person> can give me accurate help.

Outcomes (Wolters et al, 2005: 7-9 Intention to Seek Help, 10-12 Intention to Avoid Help)

7) If I needed help in the course, I would ask <this person> for assistance.
8) If I needed help understanding the content required for a class activity, I would ask <this person> for help.
9) If I needed help with the lectures in the class, I would ask <this person> for help.
10) If I didn't understand something in the course I would guess rather than ask <this person> for assistance.
11) I would rather do worse on an assignment I couldn't finish than ask <this person> for help.
12) Even if the work was too hard to do on my own, I wouldn't ask <this person> for help with the task.

9.1.4   Costs of Seeking Help in a Particular Context

Two of our three main experimental conditions came directly from the "Expectancies and Values for Help Sources" model. The up/downvoting condition did not, and so it is important to adapt existing measures to explicitly investigate whether this condition impacted perceived costs of help seeking. To do this, we will adapt appropriate measures from existing evaluation anxiety measures.

Leary, M. R., Barnes, B. D., & Griebel, C. (1986). Cognitive, affective, and attributional effects of potential threats to self-esteem. *Journal of Social and Clinical Psychology*, *4*(4), 461-474.

 "Please rate as accurately as possible how well each term describes how you would feel as you ask this person for help. '1' corresponds to "this term does not describe how I feel at all" and '7' corresponds to "this term describes how I feel extremely well."

13) Nervous
14) Worried

15) Calm
16) Tense
17) Relaxed

"Please read each question and then select the number on the scale that best indicates your response. '1' corresponds to "very slightly or not at all" and '7' corresponds to "extremely.'"

18) How concerned are you with doing well in this experimental task?
19) How important was it for you to do your best in this experimental task?
20) How much would it bother you to find out that you had performed very poorly in this experimental task?
21) How much would it bother you if your instructor found out that you had performed very poorly in this experimental task?

9.1.5   First Level Outcomes - EVT of Help Seeking (EVT from the Learning Sciences)

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary educational psychology*, *25*(1), 68-81.

The following items were adapted from Wigfield & Eccles (2000) and were originally intended to measure student Expectancy Value beliefs for predicting learning behaviors in a math class. They are more challenging to adapt for our purposes of measuring participant expectancy and value beliefs for seeking help. For each potential outcome of seeking help, we should measure the expectation of that outcome, the values placed on that outcome, and if possible, the ability beliefs behind the help seeking effort. From the items I have collected below, we have the following first-level outcomes to consider:

1. Obtaining good help (Utility).
2. Becoming a better student (Benefits)
3. Admitting incompetency (Costs/Private Threats)
4. Appearing incompetent in front of others (Costs/Public Threats)
5. Wasting too much time (Expediency/Executive)
6. Learning (Instrumental/Autonomous)
7. *Inconveniencing the helper (Face threat)*

Each of these outcomes (aside from the first/last) come from the Wolters et al. (2005) survey described later.

9.1.6   First Level Outcomes - EVT of Help Seeking (General)

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary educational psychology*, *25*(1), 68-81.

The following items were adapted from Wigfield & Eccles (2000) and were originally intended to measure student Expectancy Value beliefs for predicting learning behaviors in a math class. They are more challenging to adapt for our purposes of measuring participant expectancy and value beliefs for seeking help. This version of the items is meant to measure the participant's general attitudes about help seeking.

Ability Beliefs Items

22) How good are you at seeking help? (not at all/very good)
23) If you were to list everyone you've spoken with recently from worst to the best in seeking help, where would you put yourself? (one of the worst/best)
24) Asking someone for help is one method for learning. Other methods include explaining thoughts to yourself, and practicing with plenty of time in between practice sessions. Compared to other methods of learning, how good are you at seeking help? (a lot worse/better at seeking help than other methods)

Expectancy Items

25) How effective do you expect to do at seeking help? (not at all effective/very effective)
26) How successful would you be at asking someone new for help? (not at all/very successful)

Utility Value

27) *How useful is the help you will receive from <this person>? (not at all/very useful)
28) *How useful is the help <this person> provides?

9.1.7 First Level Outcomes – Alternative Outcomes (General)

Wolters, C. A., Pintrich, P. R., & Karabenick, S. A. (2005). Assessing academic self-regulated learning. In *What Do Children Need to Flourish?* (pp. 251-270). Springer US.

Eccles & Wigfield have assorted values (utility, importance, interest) that are usually combined into one 'Values' scale. Only the Utility Value appears to make sense when talking about the process of seeking help. However, the other attitudes about help seeking included in the Wolters et al. (2005) survey appear to measure expectations of alternative outcomes to seeking help. As an example, a student may recognize that one outcome of seeking help is obtaining good quality help, but other outcomes may include becoming a better student, appearing incompetent in front of others, etc. Both the likelihood of becoming a better student and the value placed on becoming a better student need to be measured:

Instrumental (Autonomous) Help-Seeking Goal - Expectancies/Likelihood

29) Getting help on this task will make it more likely I will learn to solve problems and find answers by myself.
30) Getting help from this person, would make it more likely I would understand the general ideas or principles needed to solve this problem.
31) Getting help in this class will be a way for me to learn more about basic principles that I could use to solve problems or understand the material.

Instrumental (Autonomous) Help-Seeking Goal - Values/Importance

32) *It is important to me to get help on this task in order to .solve problems and find answers by myself.
33) It is important to me to get help in order to understand the general ideas or principles need to solve this problem.
34) *I enjoy getting help that allows me to learn more about basic principles that I can use to solve problems or understand the material.

Expedient (Executive) Help-Seeking Goal - Expectancies/Likelihood

    35) Asking this person for help will make it more likely I can succeed without having to work as hard.

    36) If I ask for help from this person, it will be more likely that I will quickly get the answers I need.

    37) Getting help with my question will make it more likely I can avoid doing some of the work.

Expedient (Executive) Help-Seeking Goal - Values/Importance

    13) **It is important to me to get help on this task in order to solve problems and find answers without having to work very hard.

    14) It is important to me to get help in order not to work very hard to solve this problem.

    15) *I enjoy getting the kind of help that allows me to solve problems without having to work very hard.

Costs of Help Seeking – Expectancies/Likelihood/Importance

    16) Getting help with a concept from class would be an admission that I am just not smart enough to do the work on my own.

    17) *Others will find out that I needed help with this task.

    18) Asking for help would mean I was not as smart as other students.

    19) Others would think I was dumb if I asked for help.

    20) *Asking <this person> for help would inconvenience them a lot.

Costs of Help Seeking – Values/Importance

    21) *I want to be smart enough to do the work on my own.

    22) I would not want anyone to find out that I needed help in the class.

    23) *It is important that I am as smart as other students.

    24) *I do not want others to think I am dumb.

    25) *I do not want to inconvenience others.

Benefits of Help Seeking - Expectancies/Likelihood

    26) Getting help in the course would make me a better student.

    27) Getting help with the class would make me a smarter student.

    28) Getting help in the course would increase my ability to learn the material

Benefits of Help Seeking - Values /Importance

    29) *It is important to me that I get help in this course to become a better student.

    30) *It is important to me that I get help in this course to become a smarter student.

    31) *I It is important to me that I get help in this course to increase my ability to learn the material.

10 Appendix B.

10.1 Quick Helper Theory Screenshots

The Quick Helper Theory Survey Experiment manipulations were derived from screenshots from the Quick Helper MOOC Experiment. These screenshots varied along several dimensions, as shown in Table 8:
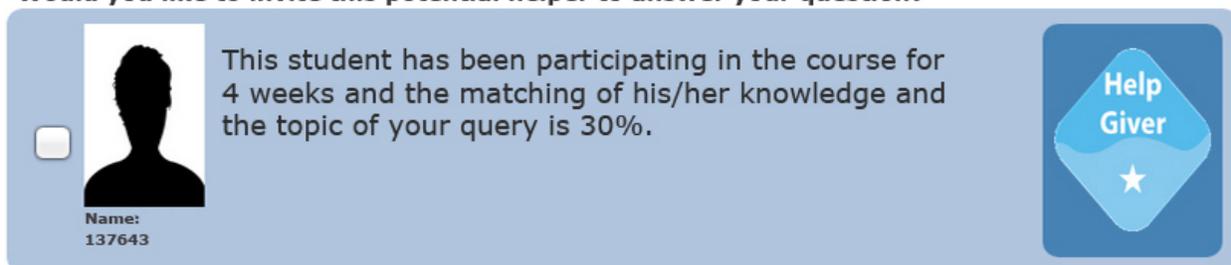
Table 8. All the possible Quick Helper Screenshot levels.

Emphasis	No Emphasis
Badges (1, 3 (not for Irrelevant Sentences), or 4 stars)	No Badges
Relevant Expertise Sentence (4 weeks participation, 30% or 60% or 90% topic match)	4 Irrelevant Control Sentences, [TA sentence, only has 4 star badges]
Voting (3 sample questions)	No Voting (3 sample questions)

From this table we can see that there are 4 Badges X 7 Sentences, or 28 possible screenshots. Although the TA sentence was either shown with 4 star badges, or no badges at all, adding 2 to this total. The Irrelevant/Control Sentence condition was not shown with 3 stars, only 1 or 4 stars, which removes 4 from our total possible screenshots. In total there would be approximately 26 possible Helper Selection screenshots. Only one Helper Selection screenshot was shown per measurement item set. Voting was shown separately, and had 3X3, or 9 possible screenshots. Below are included a few examples of the different kinds of screenshots.

10.1.1 Helper Selection Screenshots

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This student has been participating in the course for 4 weeks and the matching of his/her knowledge and the topic of your query is 60%.

Name: 137643

Help Giver
★
★★

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This student has been participating in the course for 4 weeks and the matching of his/her knowledge and the topic of your query is 90%.

Name: 137643

Help Giver
★★
★★

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This student has been participating in the course for 4 weeks and the matching of his/her knowledge and the topic of your query is 90%.

Name: 137643

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This colleague has a computer and is ready to go.

Name:
137643

Help Giver ★

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This colleague answers email on a regular basis.

Name:
137643

Help Giver ★★ ★★

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This colleague is involved in the course.

Name:
137643

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This colleague uses Web 2.0 technologies.

Name:
137643

Help Giver ★★ ★★

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This is one of the Teaching Assistants selected for this course. All of our Teaching Assistants are highly qualified to answer student queries.

Name:
137643

This student is a good match for answering your question.
Would you like to invite this potential helper to answer your question?

This is one of the Teaching Assistants selected for this course. All of our Teaching Assistants are highly qualified to answer student queries.

Name:
137643

10.1.2 Voting Screenshots

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	Problems with Assignment 2

Message Body: I'm having trouble with the third part of Assignment 2. It says to do an Error Analysis, and I've found where that's shown, but I don't know how to interpret the numbers in the table. Has anyone else figured this out?

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	Using course software tools?

Message Body: Please can someone help explain to me how we're supposed to use the intelligent agent software with the text mining software? It is difficult to keep track of all the new tools we're using. Is there a user guide somewhere?

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Social Network Analysis**
Message Body: Hey everyone - I'm at the social network analysis lecture, and I can't seem to figure out why the colors keep changing, depending on the dataset. I thought the colors were supposed to indicate a group, and the lines connections, but maybe that's wrong?	

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview email screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Help with 5th homework?**
Message Body: I need some help using Weka to complete the fifth homework assignment. I don't think my results are right. Does anyone have some correct numbers?	

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Problems with Assignment 2**
Message Body: I'm having trouble with the third part of Assignment 2. It says to do an Error Analysis, and I've found where that's shown, but I don't know how to interpret the numbers in the table. Has anyone else figured this out?	

Is this a good question? Yes No

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Using course software tools?**
Message Body: Please can someone help explain to me how we're supposed to use the intelligent agent software with the text mining software? It is difficult to keep track of all the new tools we're using. Is there a user guide somewhere?	

Is this a good question? Yes No

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview message screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Social Network Analysis**
Message Body: Hey everyone - I'm at the social network analysis lecture, and I can't seem to figure out why the colors keep changing, depending on the dataset. I thought the colors were supposed to indicate a group, and the lines connections, but maybe that's wrong?	

Is this a good question? Yes No

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

(preview email screenshot)

Hello *Peer_Helper*,

You have been selected as an excellent person to help answer a fellow student question:

Message Subject:	**Help with 5th homework?**
Message Body: I need some help using Weka to complete the fifth homework assignment. I don't think my results are right. Does anyone have some correct numbers?	

Is this a good question? Yes No

If you would like to answer this question, please follow this link to the course discussion forums.

Thank you!

MOOC Automated Help-Matching System

11 Appendix C.

11.1 Small Private Online Course Email Prompts

Email prompts sent to students consisted of a (1) "You've been prompted!" email header, (2) a Welcome Prompt line where the experimental manipulation occurred, (3) an instructor-customizable context instruction, and (4) an excerpt of a comment from the discussion forum. Below are the prompts from (2) and (3), which consist of a 2 level experimental manipulation in the Welcome Prompt, and 2 possible types of suggestions for customizable prompts.

11.1.1 Control Welcome Prompt
1. This is a discussion you can participate in.
2. Here is a discussion you can participate in.
3. This is a thread you can participate in.
4. Here's a thread you can comment on.
5. Here's a conversation you can comment on.
6. Here's a conversation you can participate in.
7. Here is a discussion in which you can participate.
8. This is an opportunity to engage in the class discussion.
9. Here is an opportunity for you to engage in the class discussion.
10. Here's a chance to engage in the discussion.
11. Here's a chance to jump into the discussion.
12. Here's an opportunity to jump in.
13. This is a thread you can respond to.
14. Here is a discussion you can respond to.
15. Here's a conversation to jump in on.
16. Here's a conversation you can respond to.

11.1.2 Learning Emphasis Welcome Prompt
1. Participating in class discussions increases exposure to new ideas.
2. Our class discussion forums increase exposure to new ideas.
3. Exposure to new ideas is one benefit to the class discussion forums.
4. Take some time to explore some new ideas in the class forums.
5. Writing down your thoughts will help you think through complex ideas.
6. Class discussions help you understand concepts, not just memorize them.
7. Participating in class discussions will help you understand the concepts, and not just memorize them.
8. Contributing to the course discussion forums is a good way to learn new things.
9. Participation in course discussions will increase your learning.
10. Expanding on others' ideas is a great way to learn new things.
11. Participating in the class discussions online will help you learn the concepts better.
12. Asynchronous discussions allow for more thought-processing time.
13. Class discussion forums get you to think through your thoughts.

14. Participation from all students is key to everyone's learning.
15. Expanding on others' ideas is a great way to check your own understanding.
16. Writing things down is a great way to check your own understanding.

11.1.3 Customizable Context Prompt – Restate (suggestion)

1. Try to describe what was said on this slide in your own words.
2. Summarize the main point of this slide.
3. Summarize the topic of [Insert concept related to slide here].
4. Summarize, in your own words, what @NAME was trying to say here.
5. Restate, in your own words, what I was trying to explain on this slide.
6. Restate, in your own words, the idea of [Insert concept related to slide here].
7. Restate, in your own words, what @NAME was trying to say here.
8. Try restating, in your own words, what @NAME was saying here.
9. Try and describe the main idea in this slide.
10. Can you summarize the discussion happening here?

11.1.4 Customizable Context Prompt – Question (suggestion)

1. Can you answer the question in this discussion?
2. Try to answer the question in this discussion.
3. What's your answer to this question?
4. How would you answer this question?

12 Appendix D.

12.1 Vignette Survey Experiment

A prior survey study I designed (the Help Seeking Obstacles survey) suggested that our student population does experience obstacles to seeking help, but it did not tell us what those obstacles are. A vignette study may reveal an even more important social factor influencing our sample population's evaluation anxiety and willingness to seek help.

12.1.1 Previous Work

Vignette studies are used in the social support literature to gauge what types of support people receive, and from whom, based upon self-report rather than longterm observation. There is a concern within the literature over the distinct types of support people perceive. For example, Vaux et al (1987) introduces a validated "Social Support Behaviors Scale" (SS-B). With this instrument, they investigate whether participants distinguish between emotional, social, practical assistance, financial assistance, and advice/guidance support participants receive from their family and friends. Ideally, to demonstrate that their SS-B items provide an independent assessment of these five distinct modes of support, they would recruit five groups of participants with a deficit in each of the five support modes and collect responses to the SS-B. However, this is not a simple task, and so the researchers simulate these deficits using a role-adoption procedure.

Participants are randomly assigned to one of an assortment of vignette conditions in which they read their assigned vignette, and then complete the SS-B from the perspective of the role presented in the vignette. Several sample vignettes and SS-B items are shown below:

Below you will find a short description of a person. It might describe your own situation at some time past, or that of someone you know or have known. We would like you to read this description carefully and then to answer the questions on the following pages as you think that person would. Remember, read the description carefully and draw on your own experience to imagine what the person described is like. Then complete the questionnaire the way you think they would.

Vignette 1: Mary has quite a few very good friends- people that she has known for many years and who she can confide in and talk to about anything. She always has someone she can call on to help out with everyday problems, and she has many people with whom she socializes.

Vignette 2: Joan recently moved to a new town. She has settled in well. Her neighbors and the people at work have been pretty friendly, and she gets to socialize quite often and has quite a few people who she can call on to help out with everyday problems. But she hasn't made any really good friends yet-nobody that she feels really close to or can confide in. Since she moved, she almost never gets to talk to her old friends.

--- Social Support Behaviors Scale ---
Use the scale below, (1..5) and circle one number under family, and one under friends, in each row.

1 *no one* would do this
2 *someone might* do this
3 *some* family member/friend would *probably* do this
4 *some* family member/friend would *certainly* do this
5 *most* family members/friends would *certainly* do this

1. Would suggest doing something, just to take my mind off my problems.

20. Would show me that they understood how I was feeling.

27. Would pass judgment on me.

29. Would loan me money for an indefinite period.

A similar approach outlined by Barling et al (1988) also focuses on role adoption, in which the participant is prompted with a short story about a fictional character where the experimental manipulation is the type of support (emotional, instrumental, appraisal, and informational) the character received. Participants would then rate how likely the character would be to succeed and grow. These included items such as "How likely is Mary to cope with her difficulties?", "How likely is it that Mary's feelings about school will change?", "How likely are Joan's grades to improve or decline?", and "How likely is it that Joan's perception of herself will change?" These perceived outcome measures were used to determine if the effect of the social support is dependent upon the type of support.

The vignette study method can allow us to simulate a variety of experimental manipulations as well as student dispositions and perceived outcomes. To identify other social factors that can be purposely designed and impactful within an intelligent tutoring system, we propose designing an informal survey similar to the SS-B, which determines the severity of an assortment of help-seeking obstacles suggested by the literature review and their relationship to evaluation apprehension and help-seeking. Using the vignette survey method, we intend to identify more precisely the features of humans/agents and teachers/helpers that account for our findings in the robot experiment. Ideally, the characters in the vignette stories would be gender-matched to the participants. The most current draft of this proposed vignette survey can be found in the following subsection.

12.1.2 Survey
Below are included the survey items.

12.1.2.1 Demographics
You are being asked to participate in a short survey as part of a research study into education and learning behaviors. The study is attempting to find ways to improve learning resources and your participation is greatly appreciated. You have no obligation to take this survey, and may quit at any time. There is no risk involved in the survey, and your answers are completely private. You need to be at least 18 years old to participate and younger than 30, and completion generally takes 20 minutes. As a participant in this study

you may submit an email address to receive a $5 Amazon.com gift card to thank you for your time. Although your name and email address are requested, those data are not shared with anyone outside of the investigative team. If you have any question, you may contact the one of the researchers, Iris Howley, at ihowley AT CS DOT cmu DOT edu, or the IRB at 412-268-7166.

☐ I certify that I am 18-30 years of age and currently enrolled in an undergraduate program.

<NOTE>Participants will not move onto the next page until this checkbox is checked.</NOTE>

Page 2

1. If you want to receive an Amazon.com gift card, please submit your .EDU email address.

2. If you want to receive an Amazon.com gift card, please submit your Name. You may only submit this survey once and receive at most one Amazon.com gift card.

3. Please select all that apply.

I am a…

☐ Undergraduate

☐ Graduate—Masters

☐ Graduate—PhD

☐ Post-Doc

☐ Teacher's Assistant

<NOTE>If participants do not select 'undergraduate' they will receive an error message stating that they are not eligible for this survey, as per the previous page.</NOTE>

4. Gender

☐ Male

☐ Female

Other

5. Age

12.1.3 Screenshot of basic interaction

Below you will see a screenshot image of a sample interaction between a student and a tutor. The screenshot includes a whiteboard on the left, where the tutor and student can draw, type, and highlight objects. On the right is a chat window where the tutor and student communicate through text-only. In future pages and questions of this survey you will be presented with a collection of short stories about undergraduate students such as yourself using the interface to communicate with tutors.

Please take a moment to study the screenshot.

6. The interface includes the following items (select all that apply):
    a. A video interface, for talking via web cameras.
    b. Whiteboard, for drawing
    c. Chat window, for text-only communication
    d. A profile image of the conversations' participants.
    e. Each participant's user name.
    f. More than 2 participants

12.1.3.1 Vignette Survey

Below you will find a short description of several learning situations with a character who is a student like yourself. Put yourself in the character's shoes, and predict how you would respond in a similar situation.<p>

It might describe your own situation at some time past, or that of someone you know or have known. We would like you to read this description carefully and then to answer the questions on the following pages as you think you would in the situation described in the story. Remember, read the description carefully and draw on your own experience to imagine how you would respond. Then complete the questionnaire as if you were the character in the story.
<INSERT RANDOMIZED VIGNETTE 1>
<INSERT CHARACTER DIFFERENCES ITEMS >

<INSERT RANDOMIZED VIGNETTE 2>
<INSERT CHARACTER DIFFERENCES ITEMS >

<INSERT RANDOMIZED VIGNETTE 3>
<INSERT CHARACTER DIFFERENCES ITEMS >

<INSERT RANDOMIZED VIGNETTE 4>
<INSERT CHARACTER DIFFERENCES ITEMS >

12.1.3.2 Vignette 1 (humanness, sociability)

[Human-Social1]Sam's professor has assigned her problem sets at home. The problems are presented on a course-related website and her work is guided by a [human tutor] [a pre-programmed intelligent software tutor]. They communicate through text-only, like in an instant messenger, and Sam has noticed that the tutor is not very sociable at all [is very friendly/sociable], although the [automated][human] tutor does show considerable expertise in the biology content. The following conversation occurs when Sam logs into the homework system:

> [Sociable1]
> *Sam*: Hello?
> *Tutor*: Hello, Sam. How are you today?
> *Sam:* I'm fine.
> *Tutor:* That's good. I hope you're ready to begin the homework, I am! Did you understand the reading?
> *Sam:* Not really.
> *Tutor:* That's okay, it involved a lot of new terms. I can see how it might be tricky to comprehend. Let's review.
> …
> *Sam:* Okay, so the blood comes from the lungs and heads to the heart, to one of the atriums. I can never remember if it's the left or right.

Tutor: Yes, that is difficult, but taking an educated guess couldn't hurt. We could consider using a mnemonic device. *L*ungs to *L*eft atrium then *L*eaves the heart. Although, I'm not sure that's real effective.

Sam: Yeah, I dunno. You're saying it goes from the lungs to the left atrium…then the left ventricle.

Tutor: Yes, that's right.

…

Tutor: That's all the material we need to go over today. You've covered a lot of ground today.

[Non-Sociable1]

Sam: Hello?

THT: Hello. We will start in a moment.

Sam: okay.

THT: Alright. Let's begin. Did you understand the reading?

Sam: Not really.

THT: Alright. Well, let's review.

…

Sam: Okay, so the blood comes from the lungs and heads to the heart, to one of the atriums. I can never remember if it's the left or right.

Tutor: You could consider using a mnemonic device. *L*ungs to *L*eft atrium then *L*eaves the heart.

Sam: Yeah, I dunno. You're saying it goes from the lungs to the left atrium…then the left ventricle.

Tutor: Yes, that's right.

…

Tutor: That's all the material we need to go over today.

[Human-Social2] Sam's professor is absent from class today, and so the students have been assigned to work in the computer lab using an [automated][human] tutor who communicates with Sam through a text-only piece of software. The following conversation with the [automated][human] tutor occurs when Sam logs into the homework system:

[Sociable2]

Sam: Anyone there?

Tutor: Hello, Sam. I'm here. Hopefully it wasn't too tricky to get logged in today! Let's begin.

Sam: Not at all.

…

Tutor: This next section was a bit challenging. I think a lot of students will have difficulty with it. Do you recall how systole and diastole produce the heartbeat?

Sam: Diastole is when the heart muscles contract and push the blood out.

Tutor: Close. Those vocabulary words are easily confused. Let's spend some extra time, so that we can better remember the difference between these two.

[Non-Sociable2]
Sam: Anyone there?
Tutor: I'm here. I see you have successfully logged in so we may now begin.
Sam: Okay.
...
Tutor: This next section was a bit challenging, but you should have been able to handle it Do you recall how systole and diastole produce the heartbeat?
Sam: Diastole is when the heart muscles contract and push the blood out.
Tutor: Close. I see we're going to need to spend some extra time on this so you can better remember the difference between these two.

[Human-Social3] Sam is taking an online biology course this semester. Each week Sam logs-in to the course website and reads the day's assignment. Today, the instructor has assigned Sam an [automated][human] tutor to help guide his thoughts through a circulatory system project. Sam and the [automated][human] tutor communicate through a text-only piece of software. The following conversation occurs when Sam logs into the homework system:

[Sociable-3]
Tutor has logged-in to the room.
Sam has logged-in to the room.
Tutor: Hello there, Sam!
Sam: Sorry, I think my connection is lagging.
Tutor: That's okay. Information does occasionally get lost in the Internet tubes.
Sam: heh
Tutor: Anyways, let's start with a brief pop quiz to make sure you've got the basic concepts down. When the blood leaves the lungs, where does it go?
Sam: Left atrium.
Tutor: Good. How about after the left atrium?
Sam: To the left ventricle.
Tutor: Correct. It looks like you've at least read the first paragraph ;) Now something a little trickier. What's the function of a vein?
Sam: Veins carry blood from the heart to the body.
Tutor: I think you're thinking of arteries. This is a really common misconception, but easily overcome. I always try to remember this with *A*rteries going *a*way from the heart, if you think that might help.
Sam: Veins return. Okay.
Tutor: Alright, let's move on to a more in-depth discussion of this topic. I hope we'll learn a lot in this session.

[Non-Sociable-3]
Tutor has logged-in to the room.
Sam has logged-in to the room.
Tutor: Hello there.
Sam: Sorry, I think my connection is lagging.
Tutor: That's okay, poor Internet connection can cause lag.
Sam: yeah
Tutor: Anyways, let's start with a brief pop quiz to make sure you've got the basic concepts down. When the blood leaves the lungs, where does it go?
Sam: Left atrium.
Tutor: Good. How about after the left atrium?
Sam: To the left ventricle.
Tutor: Correct. We have covered the first paragraph of the reading. Now something a little trickier. What's the function of a vein?
Sam: Veins carry blood from the heart to the body.
Tutor: You're thinking of arteries, but you just have to remember: arteries carry blood away from the heart. If you can remember that, you will be able to answer these questions correctly.
Sam: Veins return. Okay.
Tutor: Alright, let's move on to a more in-depth discussion of this topic. I hope you'll learn a lot in this session.

12.1.3.3 Vignette 2 (gender, role)
[Gender-Role1]
Casey's professor is absent from class today, and so the students have been assigned to work in the computer lab using a [female/male] automated [helper][teacher]. They communicate through a text-only interface with a whiteboard. The homework tutor introduces himself [herself] as Casey's [teacher] [helper] for this class assignment.

[Gender-Role2]
Casey's professor has assigned him homework problem sets to be done at home. The problems are accessed through a course-related website and his work is guided by a [female/male] pre-programmed intelligent software [teacher][helper]. The homework tutor and Casey communicate through text-only, like in an instant messenger and work on the problem sets together.

[Gender-Role3] Casey's biology class is in the computer lab today, where the students will work through a series of open-ended biology questions hosted on a course website. The professor announced to the class that everyone will have an automated software agent to guide them through the day's assignment. When Casey logs-in to the website to complete the biology questions, the

automated agent introduces itself with, "Hello, my name is [Mr.][Ms.] Darwin, and I will be your [teacher][helper] for today's lesson."

12.1.3.4 Vignette 3 (evaluation, anonymity)

[Evaluation-Anon1]Taylor's biology class is in the computer lab today. He must complete a biology problem set on a course-related website. The professor announced to the class that everyone will have a tutor to help guide them through the assignment. When Taylor logs-in to the website to complete his biology questions he [must use his full name] [is assigned an anonymous name, "student52"]. The tutor introduces itself through a text-only instant messenger with the following dialogue:

> *Tutor:* Hello, [Taylor] [student 52], I'm ready to help with your biology homework. At the end of the session, I will give you [a letter grade for your assignment.] [a summary of your progress at the end of the assignment, but no letter grade.]
> *Taylor[student52]*: Okay.

[Evaluation-Anon2]Over summer break, Taylor is taking an online course in biology. Today's assignment requires learning about the human circulatory system, with a pre-programmed intelligent software tutor communicating through a text-only piece of software with a whiteboard. Taylor always uses [her name][an assigned anonymous name like "student37"] to complete these tasks for her class. Here is how the tutor first introduces itself:

> *Tutor:* Hello, [Taylor] [student37], I see today's lesson focuses on the circulatory system.
> *Taylor[student37]*: Yep.
> *Tutor:* We're on the same page about that now. As always, I will give you [a letter grade for your assignment.] [a summary of your progress at the end of the assignment, but no letter grade.]
> *Taylor[student37]*: Okay.

[Evaluation-Anon3]Taylor's biology class has been assigned a reading and series of questions on the human circulatory system for homework. The materials are available online and Taylor's work is guided by an automated tutor, to ensure learning. They communicate through text-only, like in a chatroom. When logging-in to the biology chatroom, Taylor [must use her full name] [is assigned an anonymous name, "student26"]. The tutor introduces itself as follows:

> *Tutor:* Hi, [Taylor] [student26], today we're going to be covering how blood flows through the human circulatory system. Have you done the reading?
> *Taylor[student26]*: Yep.
> *Tutor:* I guess we are ready to begin. Today, I will give you [a letter grade for your assignment.] [a summary of your progress at the end of the assignment, but no letter grade.]
> *Taylor[student26]*: Okay.

12.1.3.5 Vignette 4 (expertise, achievement goals)

[Exp-Ach1]Morgan is taking an online course in biology. Today's learning task involves learning about the human circulatory system, with a pre-programmed intelligent software tutor communicating through instant messenger. The tutor claims to be [an expert in the assignment content who has tutored biology students for many years] [new to tutoring biology, having only recently taken the same course that Morgan has]. Here is how the tutor first introduces him/herself:

> [Mastery1]
> *Tutor:* Hello, I will be your tutor today.
> *Morgan:* hi.
> *Tutor:* This is my [third semester] [one of my first times] tutoring for this class. I hope we'll be able to learn and have a bit of fun. All my past students felt this was a valuable experience. Are you ready to get started?
> *Morgan:* Sure.
> *Tutor:* I've looked through your assigned readings about the circulatory system. I think it's great to learn about a topic that is so relevant to current events like rising rates of heart disease. How has this new knowledge of bloodflow in the human circulatory system changed your understanding of how the body works…like with the heartbeat?
> *…*
> *Tutor:* Where does the deoxygenated blood go when it is returning from the body?
> *Morgan:* The atrium? I can't remember if it's the left or the right.
> *Tutor:* Good try. Maybe if we review a bit you'll remember. What's important is that we're working at it. Maybe you can recall how blood gets into the left atrium?
> *Morgan*: It comes in through a valve.
> *Tutor*: Almost. Let's take some time to really understand the differences between the two atria.
>
> [Performance1]
> *Tutor:* Hello, I will be your tutor today.
> *Morgan:* hi.
> *Tutor:* This is my [third semester] [one of my first times] tutoring for this class. I hope we'll be able to learn some. All my past students were really smart and did really well on this assignment. Are you ready to get started?
> *Morgan:* Sure.
> *Tutor:* I've looked through your assigned readings about the circulatory system. How has this new knowledge of bloodflow in the human circulatory system changed your understanding of how the body works…like with the heartbeat?
> *…*
> *Tutor:* Where does the deoxygenated blood go when it is returning from the body?
> *Morgan:* The atrium? I can't remember if it's the left or the right.
> *Tutor:* Um, okay. Can you recall how blood gets into the left atrium?

Morgan: It comes in through a valve.
Tutor: Incorrect. The left atrium takes in oxygenated blood. The right atrium handles deoxygentated blood.

[Exp-Ach2]Morgan's biology class is in the computer lab today where they must complete a biology assignment on the course website. The professor announced to the class that everyone has been assigned an automated one-on-one tutor to help guide them through the class activity. When Morgan logs-in to the website to do the biology task the tutor introduces itself through a text-only interface with the following dialogue:

> [Mastery2]
> *Tutor:* Hello, I hope you're ready for the session; we've got a lot of material to cover.
> *Morgan:* Sure.
> *Tutor:* I ['ve been tutoring for awhile] [am excited to try my hand at tutoring. You're one of my first students].
> …
> *Tutor:* It seems like you are beginning to understand. So long as you keep putting forth the effort, you'll master the circulatory system. Do you feel you need more time on this topic, or shall we move on?
> *Morgan:* I think we can move on.

> [Performance2]
> *Tutor:* Hello, I hope you're ready for the session; we've got a lot of material to cover.
> *Morgan:* Sure.
> *Tutor:* I ['ve been tutoring for awhile] [am excited to try my hand at tutoring. You're one of my first students].
> …
> *Tutor:* It seems like you are beginning to understand. You're doing about as well as my previous students. You'll master the circulatory system. We should move on
> *Morgan:* Okay.

12.1.3.6 Character Differences Survey

12.1.3.7 Manipulation Checks <randomize>
Please read each question and then select the number on the scale that best indicates to what extent you agree with the statement. '1' corresponds to "strongly disagree" while 7 corresponds to "strongly agree".

1. The tutor in the story is an automated computer tutor or 'bot'.
2. The tutor in the story was sociable.
3. The tutor was female.

4. The tutor was a teacher.
5. The learning environment did not require the student to use his/her real name.
6. The tutor in the story graded the student's performance on the learning task.
7. The tutor in the story was an expert at teaching students.
8. The tutor was mostly interested in how well <NAME> performed on the task.

12.1.3.8 Evaluation Apprehension

Leary, M. R., Barnes, B. D., & Griebel, C. (1986). Cognitive, affective, and attributional effects of potential threats to self-esteem. Journal of Social and Clinical Psychology, 4(4), 461-474.

Please rate as accurately as possible how well each term describes how <NAME> would feel as s/he asked for help. '1' corresponds to "this term does not describe how <NAME> feels at all" and '7' corresponds to "this term describes how <NAME> feels extremely well."

1. Nervous
2. Worried
3. Calm
4. Tense
5. Relaxed

Please read each question and then select the number on the scale that best indicates your response. '1' corresponds to "very slightly or not at all" and '7' corresponds to "extremely.'

6. How concerned might <NAME> be with doing well on the assignment?
7. How important was it for <NAME> to do his/her best on the assignment?
8. How much would it bother <NAME> to find out that s/he had performed very poorly on the assigned task?
9. How much would it bother <NAME> if his/her teacher found out that <NAME> had performed very poorly on the assignment task?

Heerink, M., Ben, K., Evers, V., & Wielinga, B. (2008). The influence of social presence on acceptance of a companion robot by older people. Journal of Physical Agents, 2(2), 33-40.

12.1.3.9 Perceived Sociability

10. <NAME> considers the tutor a pleasant conversational partner.
11. <NAME> finds the tutor pleasant to interact with.
12. <NAME> feels the tutor understands him/her.
13. <NAME> thinks the tutor is nice.

12.1.3.10   Perceived Social Presence

14. When interacting with the tutor <NAME> felt like he/she was talking to a real person

15. It sometimes felt as if the tutor was really looking at me
16. <NAME> can imagine the tutor to be a living creature
17. <NAME> often thinks the tutor is not a real person.
18. Sometimes the tutor seems to have real feelings.

Perceived Enjoyment

19. <NAME> enjoys the tutor talking to him/her.
20. <NAME> enjoys doing things with the tutor.
21. <NAME> finds the tutor enjoyable.
22. <NAME> finds the tutor fascinating.
23. <NAME> finds the tutor boring.

Heerink, M., Ben, K., Evers, V., & Wielinga, B. (2008). The influence of social presence on acceptance of a companion robot by older people. Journal of Physical Agents, 2(2), 33-40.

12.1.3.11   Intention to Use
24. <NAME> will choose to use the tutor the next few assignments.
25. <NAME> will certainly use the tutor the next few days
26. <NAME> plans to use the tutor the next few days

12.1.3.12   Perceived Usefulness
27. <NAME> thinks the tutor is useful.
28. It would be convenient for <NAME> to have the tutor for all classwork.
29. <NAME> thinks the tutor can help with many things.

12.1.3.13   Perceived Ease of Use
30. <NAME> thinks s/he will know quickly how to use the tutor
31. <NAME> finds the tutor easy to use
32. <NAME> thinks s/he can use the tutor without any help
33. <NAME> thinks s/he can use the tutor when there is someone around to help me
34. <NAME> thinks s/he can use the tutor when they have a good manual.

12.1.3.14   Help-Seeking Behaviors

Wolters, C. A., Pintrich, P. R., & Karabenick, S. A. (2005). Assessing academic self-regulated learning. In *What Do Children Need to Flourish?* Springer US, 251-270.

General Intention to Seek Needed Help

35. If <NAME> needed help with the assignment, <NAME> would ask someone for assistance.
36. If <NAME> needed help understanding the content required for the task, <NAME> would ask for help.
37. If <NAME> needed help with the readings for the assignment, <NAME> would ask for help.

General Intention to Avoid Needed Help

38. If <NAME> didn't understand something in the assignment <NAME> would guess rather than ask someone for assistance.
39. <NAME> would rather do worse on an assignment <NAME> couldn't finish than ask for help
40. Even if the work was too hard to do on their own, <NAME> wouldn't ask for help with the task.

Perceived Costs of Help-Seeking (threat)

41. Getting help in the assignment would be an admission that <NAME> is just not smart enough to do the work on their own.
42. <NAME> would not want anyone to find out that <NAME> needed help in the assignment.
43. Asking for help would mean <NAME> was not as smart as other students.
44. Others would think <NAME> was dumb if <NAME> asked for help with the task.

Perceived Benefits of Help Seeking

45. Getting help in the assignment would make <NAME> a better student.
46. Getting help with the task would make <NAME> a smarter student.
47. Getting help in the assignment would increase <NAME>'s ability to learn the material

Instrumental (Autonomous) Help-Seeking Goal

48. <NAME> would get help in the assignment to learn to solve problems and find answers by themselves.
49. If <NAME> were to get help in the assignment it would be to better understand the general ideas or principles.
50. Getting help in the assignment would be a way for <NAME> to learn more about basic principles that <NAME> could use to solve problems or understand the material.

Expedient (Executive) Help-Seeking Goal

51. The purpose of asking somebody for help in the assignment would be to succeed without having to work as hard.
52. If <NAME> were to ask for help in the assignment it would be to quickly get the answers <NAME> needed.
53. Getting help in the assignment would be a way of avoiding doing some of the work.

13 Appendix E.

This experiment is described in detail in Howley at al. (2014), but an overview of the results is provided below.

13.1 Evaluation Anxiety, Help Seeking, and Educational Robots

Evaluation anxiety's impact on help seeking has been implicitly explored in the context of technology enhanced learning environments in Howley et al. (2014). Relying on prior work on social presence and its relationship to evaluation anxiety (Karabenick and Knapp, 1988; Power et al., 2007), the authors hypothesized that more help would be sought from a pedagogical robot than a human tutor in a one-on-one tutoring context. A second dimension relied on an increase in authority (i.e., social role; Hinds et al., 2004) increasing evaluation anxiety. This 2X2 experiment (human vs. robot, helper vs. teacher) specifically investigated how social presence and role of a one-on-one tutor impacted conceptual learning and help seeking behaviors on a learning task with the following hypotheses:

> *Robot Hypothesis 1:* Participants will be more likely to request help from a robot tutor than a human tutor, due to a decreased prevalence of evaluation apprehension.

> *Robot Hypothesis 2:* Participants will be more likely to request help from a learning assistant than a teacher due to a tutor's elevated social status.

59 students from a local university in Japan were recruited for the study: 39 males and 20 females ($M =$ 22 years old, $SD = 2.15$). Participants were pseudo-randomly assigned to one of four conditions in a 2X2 factorial experiment: human or robot tutor, and helper or teacher role. Initial random assignment was partially weighted toward the robot conditions. 21 participants were assigned to the "robot helper" condition, 20 to the "robot teacher" condition, 9 to the "human helper", and 9 to the "human teacher" condition. The laboratory set-up for the robot condition is shown in . Participants completed a prequestionnaire, pretest (15 minutes), reading (10 minutes), worksheet (20 minutes), posttest (15 minutes), and post-questionnaire. Learning materials in this experiment were adapted from materials used by Chi et al (2001) for one-on-one human tutoring of the human circulatory system. Some content from the conceptual reading was withheld for the worksheet and tests, so that we could examine help seeking of all students, including those with advanced reading comprehension. Questions pertaining to the withheld content is referred to as "Help Available", and the analyses and discussion focus only on these quiz items.
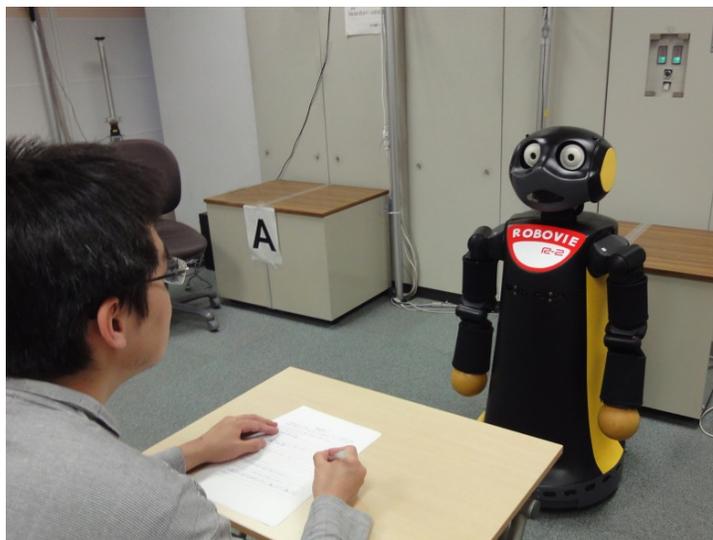
Figure 50. A photograph showing the laboratory setup for the robot condition. The human condition had a human tutor sitting in a chair in the same spot the robot is positioned.

Results showed general help for the hypotheses: help seeking was a marginal moderator of the relationship between condition and learning using an ANCOVA with pretest as a covariate, $F(3, 55) = 2.45$, $p = 0.07$, R^2 of 0.30 ($\Delta R^2 = .13$), $d = 0.52$. As can be seen in , a post-hoc Student's t-test revealed that participants in the human teacher condition learned significantly less than students in the other three conditions. These same students also asked marginally less questions from their human teacher tutor. Further discussion of results and analyses can be found in Howley et al. (2014).
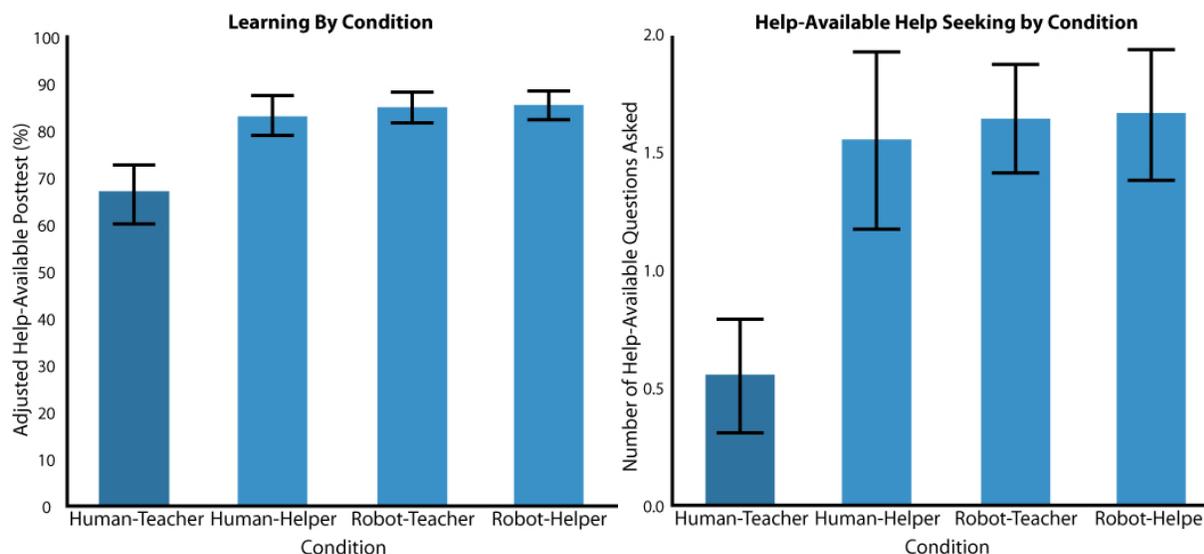
Figure 51. Results of the Howley et al. (2014) Robot Experiment by 2x2 condition, with learning results on the left and help seeking on the right. Participants in the Human-Teacher condition learned significantly less than participants in other conditions, and help seeking was a marginal moderator of that relationship.

These results show that students learned significantly less from the human teacher, partially due to the fact that they asked the human teacher marginally fewer questions. While students asked marginally fewer questions from human teachers than the human helper, the authors did not see the same distinction made for robot teachers and helpers. So, Hypothesis 1 (participants will seek more help from robots) appears to only have support when considering human teachers in contrast to robots, and Hypothesis 2 (participants will seek more help from a learning assistant) is only supported if we consider the human teacher separately from the robot teacher condition. There are a few possible explanations for this, the first being that the robot's perceived social status is so low that the robot teacher did not cause enough evaluation apprehension to affect question asking and learning. Or perhaps perceived social status of robots is still such a novel concept that participants cannot consistently place the robot on the social presence continuum.

This experiment shows that evaluation anxiety may very well have impact on help seeking, and that the fear of being judged can possibly be reduced through the intentional design and presentation of the technology enhanced learning environment.