Virtual Socialization in Engineering Education: Identifying the Impacts of a Socializer-Based Intervention on Second-Year Engineering Students

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ABSTRACT

With student attrition in engineering most frequently occurring during the 2nd year due to perceptions of poor teaching and advising, curricular overload, and a lack of a sense of belonging, this study sought to address these concerns in a novel way through videos. This study was inspired by the success of existing on-campus mentoring services that enlist more advanced students to act as academic and cultural mentors, and sought to connect with students who may feel unwelcome or socially inhibited from attending similar services.

On-campus support services have historically experienced service-level concerns with regards to overhead costs that have resulted in targeting specific audiences over restricted durations of time. Through these measures, both lack of awareness and social inhibition to attendance has resulted in some students not receiving the support that they need in order to succeed in engineering. To address this concern, this study developed and tested a video-based intervention on 2nd year students identified as "at-risk-for-attrition" through GPA and self-reported measures of belonging in engineering. The intervention involved 18 junior- and senior-level engineering students participating in videotaped interviews that were segmented by topic into 305 videos and posted to a private Vimeo channel. These videos acted as static virtual mentors for the study participants.

To evaluate the impact of these videos, an exploratory case study was conducted with 13 "at-risk-for-attrition" participants that included 7 women and 6 men. The participants completed a pre-intervention interview concerning their current status in engineering, a reflection of their first year, and perceptions of on-campus support services. Participants were then asked to watch one hour of videos, keep a notebook of their experience, and record the date and time that each video was watched. Once completed, participants participated in a post-intervention interview concerning their video choices, reactions, and outcomes of the experience, and any affordances that they saw in the intervention tool.

Drawing on expectancy-value theory, the results of this study yielded a model for how participants made their video selections, how they reacted to virtual mentors and interpreted their video content, and how these reactions led to collective identity beliefs and intentions to act on the advice provided. Additionally, participants highlighted some of the affordances of offering mentoring through static videos. Of particular importance was the perception of shared identity between participants and mentors as a precursor to impacting future intentions to act on their advice. The findings led to recommendations regarding the redefinition of desired mentor traits for at-risk-for-attrition students was discovered, and also, the potential for offering virtual mentoring as a proxy or precursor to attending on-campus services without the program- and student-level concerns hindering current offerings.

Dedication

To my dad,

William Sevilla

Acknowledgements

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Chapter 1: Introduction

1.1 Statement of the Problem

Engineering education has a retention problem. Substantial research in the form of both large quantitative and small qualitative studies (e.g. Seymour & Hewitt, 1997; Marra, Rodgers, Shen, and Bogue, 2012) has identified the most salient factors related to students' persistence and attrition in engineering. The list of factors include, but are not limited to, entry credentials from K-12 (Keenan & Gabovitch, 1995), instructional methods and student-faculty interaction (Marra et al. 2012), curricular difficulty (Marra et al., 2012), academic and social support from peers and other socializers (e.g. Frome & Eccles, 1998; Amenkhienan, 2000; Jacobs & Eccles, 2000; Amenkhienan & Kogan, 2004; Marra et al., 2012), and perceptions of belonging (Marra et al., 2012). Many of these factors have shown to be most critical during the second year of the curriculum as this period has shown to the time at which a majority of students elect to leave the major (Min, Zhang, Long, Anderson, & Ohland, 2011).

As knowledge of these attrition factors has been disseminated, universities have taken measures to address them. University-sponsored support services have not only been developed, but have proven successful in scaffolding the academic and social success of students at risk for leaving engineering (e.g. Abrams & Jernigan, 1984; Hrabowski & Pearson, 1993; Hrabowski & Maton, 1995; Keenan & Gabovitch, 1995; Amenkhienan, 2000; Amenkhienan & Kogan, 2004). With the subsequent success of these programs in retaining students, the inevitable increase in demand led to two sets of problems. The first set involves the services themselves in terms of overhead (personnel and logistical costs), which has led to programs targeting specific audiences and certain time periods in order to maintain effectiveness (C. Zawaski, personal communication, May 2013). The consequences of targeting certain audiences and time periods has led to a secondary set of problems in that students who might otherwise benefit from

these services are either not targeted, or hindered by other social barriers to attendance (Amenkhienan, 2000; Amenkhienan & Kogan, 2004); online tools offer a potential alternative.

With current online tools for gathering information about courses (e.g. www.Koofers.com) and instructors (e.g. www.ratemyprofessor.com) relying on decontextualized walls of text from anonymous contributors, the need for enhanced online tools beyond courses and instructors that incorporate a greater level of credibility and rigor . With recent developments such as online mentoring facilitated through email (www.mentornet.net), and digitally-created anthropomorphic role models showing promise in addressing stereotypes about engineering and other beliefs such as self-efficacy (Johnson, Ozogul, DiDonato, & Reisslein, 2013), there still lacks a means of providing age relatable individuals that can act as both academic and cultural mentors in a format that is accessible to all students in an online format.

1.2 Research Purpose and Primary Research Questions

To help address these problems, the purpose of this study was to develop and test an intervention using online videos aimed at providing academic and social support analogous to that received through on-campus university-sponsored support-services but without the service-level limitations and student-level inhibitors to attendance. In contrast to current online resources lacking credibility because of the anonymity of the experts and/or lacking personal connection through text-based information, this study provided advice from junior- and senior-level students through pre-recorded videos. Such use of videos as a proxy for, or precursor to, on-campus support services through contextually-specific student testimonials is something that has yet to be explored.

If the benefits of on-campus support services can be made accessible to students who would otherwise not seek out assistance through virtual means, then similar efforts could also be developed and tailored to a variety of contexts that both meet the needs of struggling students and provides additional options for institutions seeking to support their needs.

1.2.1 Research Questions

To achieve this goal, this study involved the development and testing of a virtual mentoring tool targeting at-risk-for-attrition students. The goal of the study was to understand how students engage with virtual mentoring videos. The following research questions were posed:

RQ 1: What criteria best explain students' viewing choices and preferences?

RQ 2: How do students react to virtual mentors and the contents of their videos?

RQ 3: What immediate outcomes result from engaging with this type of tool?

RQ 4: What affordances does this type of tool provide?

1.3 Research Approach and Methodology

Given the lack of existing research on virtual mentoring in engineering education, most of the important factors regarding both the development and impacts of this type of intervention remain largely unknown. As a result, an exploratory case study approach was used to analyze the impact of a virtual mentoring intervention. Participants were recruited based on results from a survey administered at the beginning and end of their first-year program. While the survey measured several constructs, the focus during recruitment was on identifying individuals with low GPA's (between 2.0-2.99) for their history of being at-risk-for-attrition from engineering (Ohland, Zhang, Thorndyke, & Andersen, 2004). In total, thirteen second-year students, including six males and seven females, elected to participant.

Data collection involved pre- and post-intervention interviews and a series of handouts that were completed during the intervention, as illustrated in Figure 1. The first interview was a context-defining interview targeting participants' beliefs regarding their current coursework, first-year experiences, and perceptions of university-sponsored support-services. After completion of the pre-intervention interview, participants were given three handouts. The Participant Handout (PH) (Appendix D) guided the participants on how to access and navigate the intervention materials. The Complete Video Index (CVI)

(Appendix E) introduced the video mentors, listed their videos, and asked for participants to record when each video was viewed. The Participant Notebook (PN) (Appendix F) provided space for students to reflect on their viewing experience every five videos. Participants were asked to view exactly one hour's worth of video over the next 7-14 days and keep a log of their experience through the provided handouts (see Figure 1).

Once viewing was completed, participants returned for a post-intervention interview regarding the impact of the experience. This interview focused on choice behaviors, reactions to mentors and content, outcomes of the experience, and affordances the tool provided. While four data sources were collected, including the pre-intervention interview transcripts, post-intervention interview transcripts, the Complete Video Index, and the Participant Notebook, this dissertation focuses exclusively on the post-intervention interview transcripts with a variable-centered analysis in order to answer the posited research questions for this study. The complete rationale for this choice is covered in Chapter 3.

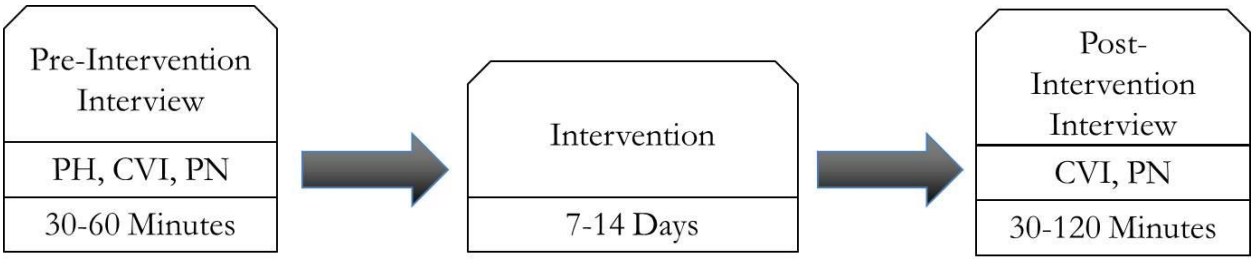

Figure 1 Data Collection Chronology and Focus

Once data collection was completed, interviews were transcribed and analyzed using both *a priori* codes grounded in Eccles' expectancy value-theory (2009) and emergent codes. Coding took place in three phases including categorization coding, detailed coding, and clarification and refinement coding. Categorization coding broadly identified choices, reactions, outcomes, and affordances by mapping responses to specific interview items with their corresponding research questions. Each category was then divided into several sub-codes corresponding to their respective expectancy-value constructs or to

emergent themes not captured by expectancy-value theory. Lastly, a final phase of coding involved the clarification and refinement of codes before the final write-up took place.

1.3.1 Limitations

This study had several limitations. The first limitation was that all data was collected from a single institution. The effect of using only a single context is that there are several contextually specific variables and biases that limit the extent to which transfer to a broader audience are viable. However, since this study purposely sought to test the effects of contextually-relevant social influences, particularly the provision of junior and senior-level student mentors on 2nd year students, the single institution limitation was not a primary concern, and moreover, was done intentionally.

The second limitation of this study was that study participants self-selected to be part of the study; this self-selection was unavoidable as participation could not be made compulsory under IRB mandates. The self-selection by virtual mentors was not a concern, but for the second-year students, it was. Since one of the major goals of this study was to test the effects of virtual mentoring on lower-achieving students, one underlying assumption is that these students also had not, or would not, seek out on-campus opportunities. As a result, the participants in this study, who chose to engage, may not have been representative of the target audience for this intervention. Because students for this study were required to email the researcher directly, participate in two interviews, and complete a series of handouts, there is no guarantee that the participants in this study are similar to students who would likely be in danger of leaving engineering.

In addition, participants in this study were paid $50 for their efforts. While historically payment has not been the driving factor in student participants' decisions to take part in a study, it does need to be noted, and may further limit the transfer of the findings.

1.3.2 Researcher Bias

As a former engineering dropout due to poor academic performance and a history of silence regarding the issue, my stance as a researcher is biased by my own prior experiences. These biases had the potential to impact data analysis in a way that represented my personal views on the matter rather than the objective opinion that participants were trying to convey. During data collection, the pre- and post-intervention interview protocols were reviewed by experts and pilot-tested with graduate students. To help objectify the analysis, a second researcher was introduced, and discrepancies in interpretation were negotiated to an acceptable standard of variation. A more detailed discussion of the analysis procedures used in this study will be covered in Section 3.6.

1.4 Definition of Terms

Several terms are presented here for clarification and contextualized within the bounds of this study. The terms are referred to throughout the remaining chapters with these definitions in mind.

At-risk-for-attrition

Students were classified as “at-risk-for-attrition” if they performed poorly during the first year of their program. Specifically, students with GPAs between 2.0-2.99 and ‘belonging in engineering’ scores 4.0 or less on a 5.0 Likert scale were classified as at-risk-for-attrition.

Socializers

Socializers are people that contribute to an individual’s perception of self (Eccles et al., 1983). The most influential socializers for K-12 children have shown to be parents and teachers (Eccles, 2007), while for higher education, the role of these parties remains but is augmented by the inclusion of respected peers, namely, fellow students (Amenkhienan, 2000). Interaction with socializers has been shown to influence one’s perception of self through observational learning (Eccles, 2007).

University-Sponsored Support-Service

A university-sponsored support-service is any effort by a university that seeks to support students' academic and social needs. University-sponsored support services can be academic (e.g. office hours), social (e.g. LGBTA group), or a combination of the two. For this study, university-sponsored support services will refer to those services that offer both academic and social support through the provision of student mentors.

Virtual Mentor

A virtual mentor is a junior- or senior-level engineering student who volunteered to take part in a video-taped reflective interview focused primarily on their second year experiences. Details on how the videos were processed and posted to the web are discussed in Chapter 3.

1.5 Significance of Dissertation

The significance of this dissertation is that it developed and tested a video-based intervention that provided academic and social support analogous to that which is available through university-sponsored support-services without the service- and student-level problems. To address the disadvantages of on-campus support services in a way that improves on existing online tools, this work brings together contextually relevant and age-appropriate mentors in a virtual format that is inclusive to all individuals and that maintains confidentiality of the user in its delivery. By providing an array of information about each virtual mentor and providing a variety of available mentors and content, participants are able to explore a range of topics that enables them to identify with the information source and assesses the credibility of the conveyed message. As the first tool of its kind, the potential for this type of virtual mentoring tool is currently under-studied in engineering education and has the potential to become its own field of inquiry in the near future.

1.6 Summary of Remaining Chapters

Chapter 2 provides a review of literature concerning the most recent issues related to student attrition in engineering education. Following a discussion of the current theoretical landscape on retention and attrition, the foundations of Eccles' expectancy-value theory are presented as the primary framework for analysis in this study. The discussion includes expectancy-value theory as a developmental framework, as well as recent developments incorporating emerging personal and collective identity into the model. Particular attention will be focused on the role of socializers in the model and how they can affect conceptions of self and belonging in engineering. Building on this framework, an analysis of current university-sponsored support programs will be discussed, with particular emphasis on their construction, limitations, and inhibitors attendance. Based on this analysis, a foundation supporting the need for a virtual proxy for these services will be presented.

Chapter 3 outlines the details concerning the development of the virtual mentoring intervention and an analysis of its impacts on at-risk-for attrition students through an exploratory case study method and a variable-centered analysis. Methods used in the recruitment of participants, the development of interview protocols and codebooks, and qualitative analysis procedures are presented.

Chapter 4 displays the results of the coding process with respect to the four research questions: choices, reactions, outcomes, and affordances. Chapter 5 uses the results of Chapter 4 to answer the research questions and situate the findings in prior research. Chapter 6 outlines the theoretical contributions of the work with respect to identity beliefs of at-risk-for-attrition students and the potential outcomes and applications of interventions like the one tested in this study. Lastly, recommendations for the development of future interventions are presented, along with associated research agendas that may be explored.

Chapter 2 Literature Review

2.1 Identifying the Problem

Engineering education has a retention problem in that large percentages of students are leaving the major during the first two years of their curriculum (Marra et al., 2012; Min et al., 2011). While the rate of attrition has not shown to be statistically significant when compared to other majors (Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton, 2008), the fact remains that students leaving engineering are rarely replaced by students from other majors (Ohland, et al., 2004). As a result, student attrition in engineering is a problem as the shortfall in US graduates over time will force industry to look elsewhere in order to fulfill its needs.

The factors that have contributed to student attrition and the timeframe in which these decisions have occurred have been well documented. Seymour and Hewitt's (1997) seminal work on the issue converged on two general categories of students that left engineering: those who became bored or disinterested in the curriculum and those that felt that were forced to leave due to a loss of academic self-confidence. This work was recently updated by Marra et al. (2012), who quantitatively and qualitatively analyzed the second group, namely, those who left due to a loss of academic self-confidence. In their study, they identified three main factors that most contributed to student decisions to leave engineering including poor teaching and advising, curricular difficulty, and a lack of belonging. Poor teaching was linked to both faculty members and graduate assistants, while advisors were seen as giving poor advice and perceived as non-responsive to student needs. Curricular difficulty was expressed as the combination of overall curriculum difficulty and discouragement due to poor grades in engineering courses. And the last factor, lack of belonging (general), was strongly correlated to lack of belonging in engineering and the feeling that a non-engineering career may be more fulfilling.

While all three factors addressed in the Marra study were important, the statistical analysis showed the social factor, lack of belonging, to be more influential in students' decision to leave engineering than either of the academic factors (curricular difficulty and poor teaching). The significance of a lack of sense of belonging was not only the most salient factor in attrition decisions, but it also determined whether or not students transferred to a technical or non-technical major. As Marra showed, the greater the lack of belonging, the less likely the student was to declare another technical major thereafter.

With respect to timing of students' departure, Min et al. (2011) identified the 3rd through the 5th semesters as the period with the highest percentage of students leaving the major (particularly the 3rd semester). As shown in Figure 2, these results highlight this time period as critical for better understanding student persistence and attrition decisions, and as such, a potential focal point for intervention efforts.

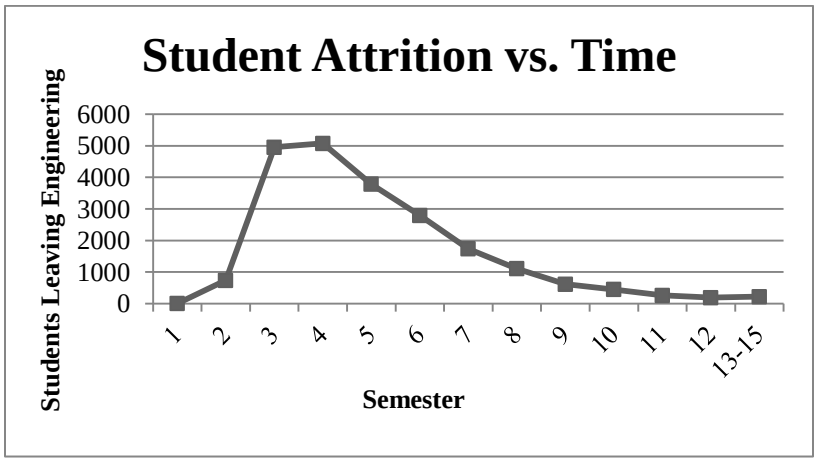

Figure 2 Min et al. 2011 Engineering Student Attrition vs. Time

2.2 Expectancy-Value Theory

To investigate the potential for an intervention aimed at addressing the needs of at-risk-for-attrition students in engineering, Eccles' expectancy-value theory (EVT) (Eccles, 2007) will be used for its proven track record in explaining and predicting student behaviors in academic contexts.

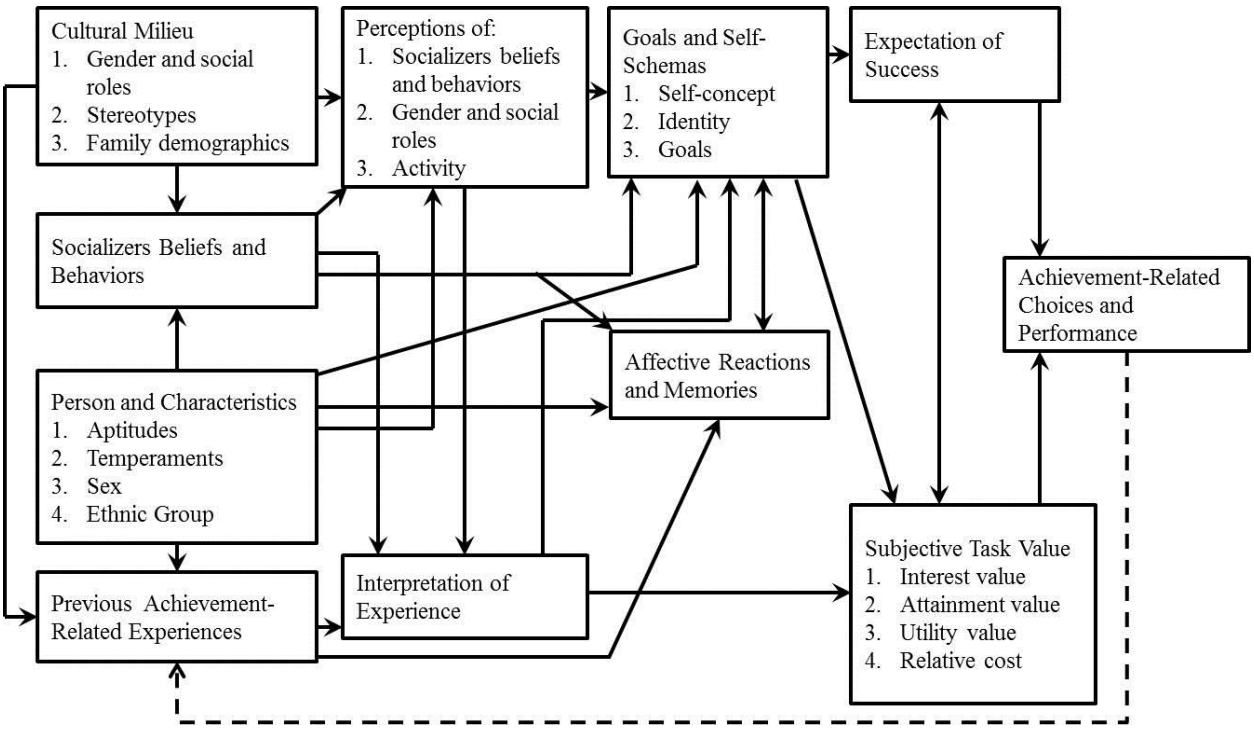

Figure 3 Abbreviated Expectancy-Value Theory Model adapted from Eccles' et al. 2007

As Figure 3 illustrates, aptitudes, combined with an evaluation of past experiences and interpretation of relevant socializers, establishes one's sense of self. This sense of self, in turn, plays out in the choices people make related to their persistence and performance within a given domain. Building on work related to decision making, achievement theory, and attribution theory (Eccles, 1983), EVT has been used in a variety of contexts, mostly academic, resulting in a model that describes how individuals who possess high expectations for success and assign high importance or value to a particular task or activity, choose to enroll, persist, and perform greater than those who do not (Eccles, 2007). While success and value beliefs can be formed in a variety of ways, with variations by sex (Eccles, Wigfield, & Schiefele, 1998; Ruble & Martin, 1998; Eccles, 2007), external factors such as cultural norms, vicarious experiences, and the impact of socializers such as parents, teachers, and, most relevant to this study, peers (Eccles, 2007), all play a role in the development and internalization of these beliefs.

While Eccles' model was initially used as a tool for studying K-12 contexts, particularly to ask why fewer women enter math and science fields (Eccles, 1983), it has more recently proven useful in engineering education research to study enrollment decisions (Matusovich, Streveler, & Miller, 2010), career choices (Matusovich, 2008), and motivation across first year programs (Jones, Paretti, Hein, & Knott, 2010). Based on its currency in engineering education and its proven utility in explaining student behavior in academic contexts, it has been selected as the primary framework for this study. Specifically, this study focuses on the influence of supportive social influences (socializers) as key inputs to positively impact student beliefs about themselves and the activities that they choose to engage in.

With a chosen focus on socializers, the question becomes what type of socializers are the most relevant for a given situation, and second, what types of beliefs can they impact?

2.3 Socializers

During the pre-college years, parents and teachers are the primary socializers who influence children's self-beliefs (Eccles, 2007). In particular, Eccles investigated the interplay between home and school environments in either supporting or undermining the development of positive achievement motivation and school engagement. The impacts of parents and teachers as social influences was analyzed and connected to students' decisions to engage or disengage from academic activities and their resulting academic performance.

Parents try to organize their children's social environments in order to promote specific opportunities, to expose their children to particular experiences and value systems, and to restrict dangers and exposure to undesirable influences (Eccles 2007). Parents manage the resources and time of their children, and oftentimes, the choice of activities for their children resulting in both their children's interest and competence in these activities (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999). The impact of domain-specific parental practice and role

modelling behaviors is more domain-specific achievement-related beliefs and behaviors in children (Eccles, 2007).

In terms of school achievement, parents' engagement in managing their children's experiences and intellectual skills firsthand is directly and powerfully related to their children's subsequent academic success (Epstein, 1992; Booth, & Dunn, 1996; Eccles, & Harold, 1996). Evidence suggests that high levels of parental involvement in school demonstrates a higher valuing of children's school achievement, which in turn influences the value that children assign to school themselves (Grolnick, 2003).

Parental involvement both at home (e.g. homework help) and at school (e.g. interaction with teachers) has predicted improved classroom behaviors and academic achievement several years later (Izzo, Weissberg, Kasprow, & Fendrich, 1999). With the effectiveness of parents on interpersonal support and regulation of school success through the K-12 years (Lent, Brown, Schmidt, Brenner, Lyons, & Treistman, 2003) the question becomes what happens to children's beliefs and behaviors as this level of regulation and support lessens in the transition to a higher education environment?

As parental influence and regulation over achievement-related behaviors in school lessens, the effects of other socializers can become quite strong, particularly during transitional periods between levels of schooling (Eccles et al.,1993). During the transition from high school to college, students' developmental needs change, resulting in perceptions of belonging in their new environment (Marra et al., 2012). This transition can be particularly difficult for students enrolling in engineering who have "experience[d] few academic challenges in high school and are therefore often unprepared for the level of work expected in college engineering courses" (Amenkhienan, 2004; p. 523).

Students who have experienced few academic challenges prior to enrolling in engineering, may not have had to exhibit self-regulatory behaviors over their own behaviors in order to succeed. As a result, these students often struggle to sufficiently self-regulate themselves in terms of the application of effort

and the time management skills necessary in order to succeed in engineering (Amenkhienan 2000; Amenkhienan, & Kogan, 2004).

In the absence of sufficient self-regulatory behaviors for success, the impacts of teacher social support and peer social support can be particularly salient in impacting student perceptions of belonging (Astin, 1999; Roeser, Midgley, & Urdan, 1996) and resultant academic behavior and performance (Amenkhienan, 2000). Students who feel supported socially by teachers tend to meet teachers' expectations more frequently than those who do not feel supported, and this, in turn, results in higher academic performance (Garnefsi, & Diekstra, 1996; Wang, & Eccles, 2012). Additionally, peer social support increases students satisfaction with school, making them more behaviorally and emotionally engaged in school (Garcia-Reid, 2007) in a way that both lowers their risk of detrimental behaviors to their academic success and positively influences their subjective valuing of learning (Wang, & Eccles 2012).

Ongoing social interactions teaches individuals about themselves and about what is needed in order to effectively fit within a particular environment (Martin, & Dowson, 2009). In academic domains, feelings of relatedness impact student beliefs pertinent to persistence, goal striving, and self-regulation. As these relationships strengthen, individuals learn particular beliefs that are useful for functioning in particular environments, eventually internalizing these beliefs that are valued by significant others (Wentzel, 1999). Through this mechanism, beliefs held by other individuals become part of one's own belief system.

2.4 Subjective Task Value

Just as individuals develop and internalize the beliefs and behaviors they are socialized to assume, so too do they develop and internalize the subjective task value that they place on succeeding or failing on any particular task. Eccles et al. (1983) identified four subjective task value constructs the socializers have the ability to impact; these include attainment value, interest value, utility value, and cost.

Attainment value is the importance of doing well on a task. Interest value is the immediate enjoyment one gets from engaging in an activity. Utility value is the importance of a task in the achievement of short- or long-term goals. Cost value is the cost of success or failure when engaging a task.

This study will focus on utility and interest as the most recent definitions of cost and attainment are either not-relevant or captured by other constructs. Specifically, attainment value has been defined in reference to who people are and what they want to be (Eccles, 2011). For this study, personal and collective identity beliefs (Section 2.5) will be used to capture beliefs of who participants are and who they want to become. Additionally, cost value, or the negative aspects of engaging in a task (e.g. anxiety and fear of failure) will not be directly addressed as it is not relevant to this study (Chiu, & Wang, 2008).

Instead, this study will focus on the interest value and utility value of engaging with the mentoring videos as previous studies have shown these to be strong predictors of student career plans (Jones et al., 2010). While the authors admit that they only captured "intentions" to choose a career, and had no data proving whether not students "actually chose" to pursue a career in engineering, the goal of impacting the future intentions of students matches the goals of this study. The contextually-specific definitions of interest value and utility value are outlined in Chapter 3.

2.5 Expectancy-Value and Identity

The importance of understanding the impacts that socializers play in the development and internalization of self-beliefs and values lies in their connections to the identity formation process. While Eccles' (2007) expectancy-value model discusses these topics at length, a more recent modification will be used for this study that integrates current and emerging identity beliefs into the general expectancy-value model. The new model (Figure 4) outlines "…a social cognitive model, grounded in both expectancy-value theory of task choice and sociocultural theories of socialization, self-socialization, and social influence" (Eccles, 2009; p. 79) as a means of explaining behavior through an understanding of individual's ongoing identity-formation process.

The model includes two types of identities, personal and collective/social. Personal identities ("Me" self) are those that serve the psychological function of making one feel unique, while collective/social identities ("We" self) are those that serve to strengthen ties to a valued social group (i.e. race, gender, class, culture, etc.). Both types of identities are important in explaining behavioral choices. Behavioral choices are the "primary mechanisms through which individuals enact their personal and collective/social identities and thus validate their identities" (Eccles, 2009; p. 79). Thus, in order to understand individuals past behavior, and to potentially influence behavioral change, it is important to first understand how individuals' form their initial identity beliefs, and second, what factors or influences have the power to change those beliefs thereafter.

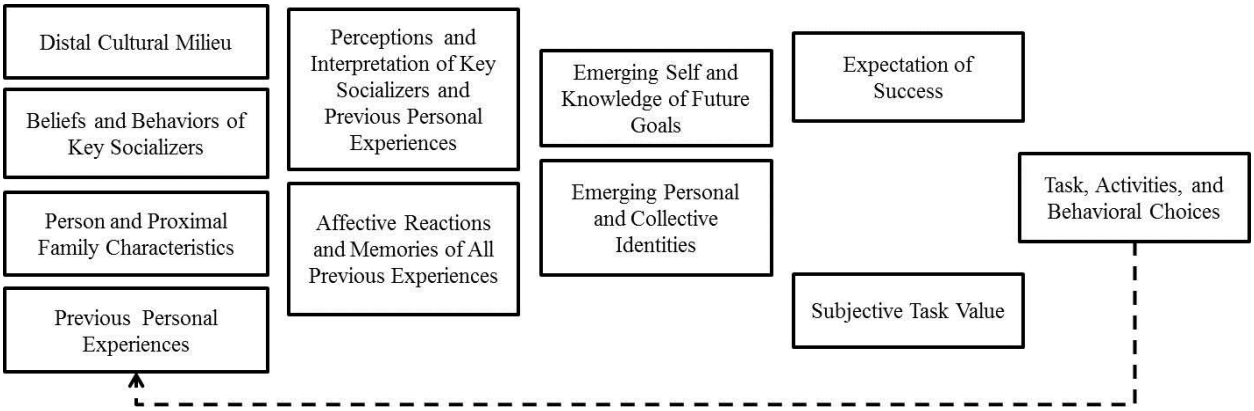

Figure 4 Abbreviated Expectancy-Value Theory Model adapted from Eccles' 2009

Individuals have multiple personal and collective identities that change in content, salience, and centrality over situations and over time (Eccles, 2009). As an individual moves from context to context, each containing its own characteristics and social norms, the salience of certain identities emerge that influence behavioral choices within that context (Eccles, 2009). For example, an international student may adapt his language and social customs to match the norms of the new environment rather than continue the practices from his home country and be viewed as different. The salience and valence of various personal and collective identities evolve over time and are based on 1) the experiences that individuals have as they grow up and progress through adulthood; 2) their own agency in interpreting and

creating experiences that reinforce, redefine, or potentially undermine particular personal and social/collective identities (Eccles, 2009).

Eccles and colleagues state that social experiences, as well as each individual's interpretation of, and agency in, the selection of social and individual experiences provide the initial information for individuals to form their own notions of their "Me" and "We" selves (Eccles, 2009). In simple terms, an individual's experience in any given situation is framed by the beliefs about themselves that they bring the situation. Based on the individual's experience within the situation, identity beliefs are either reinforced or redefined based on this experience. With increasing maturity, individuals become better able to pick social contexts and experiences that also allow them to shape their own sets of beliefs, creating new sets and modifying existing sets of self and task/activity/behavior-related beliefs (Eccles, 2009). These new beliefs may be incorporated in the salience, centrality, and content of many possible personal and collective/social identities. Thus, the process of forming "Me" and "We" selves and then assigning value and importance to them is a dynamic process that continuously evolves across contexts at a given point in time or within a single context across time (Eccles, 2009).

Individuals develop this set of beliefs about who they are and who they would like to become (Higgins, 1987; Markus & Nurius, 1986) through an ongoing socialization process. In particular, the combination of both external socialization and the more agentic self-socialization shape individuals' perceptions of self and value for a given domain. In this sense, socializers are one of the primary inputs that enable a constantly updated "Me" self, and provide causal attributions for how individuals interpret their own experiences over time (Eccles, 2009).

In summary, identities are the characteristics that individuals value about themselves and the collective groups that they affiliate with. Personal and collective/social identities are formed through the combination of external social influences along with an internal evaluation of the salience and valence of these influences with regards to the self in context. Based on the context, behaviors related to expectations

and social norms are enacted through these personal and collective/social identities. For this study, the impact of external social influences on the identity formation of at-risk-for-attrition students will be the focus.

However, the identity formation process for at-risk-for-attrition students is an area of research that has proven difficult to study due to the fact that struggling engineering students rarely wish to discuss their experiences (Amenkhienan, 2000). The result of this behavior is that the socializers most able to affect the identity beliefs of struggling engineering students in a positive way remains largely unknown.

2.6 University-Sponsored Support Services

Still, universities are making significant efforts to address the need. Given the lack of diversity in engineering programs relative to the general population (Platt, 1987), services have been developed by universities to offer support and scaffold students' academic and/or social needs for groups that have historically had difficulty finding mentors and role models due to representation in engineering, and otherwise (e.g. Abrams & Jernigan, 1984; Hrabowski & Pearson, 1993; Hrabowski & Maton, 1995; Keenan & Gabovitch, 1995; Amenkhienan, 2000; Amenkhienan & Kogan, 2004). While some services have been aimed at supporting exclusively social concerns (e.g. LGBT), and others on academics (e.g. tutoring), the focus of this study is on services that offer both social and academic support through student mentors. Keenan & Gabovitch (1995) found that students who enter college with weaker credentials and participate in support-oriented programs perform as well as or above non-participants who entered the university with stronger credentials.

One common feature of on-campus support services is the focus on better assimilating students into a college-level engineering curriculum is through matching new students with more advanced peers acting as academic and cultural mentors (Shuman, Delaney, Wolfe, Scalise, & Besterfield-Sacre, 1999) as "as students are more often open to accepting advice from peers" (Marra et al., 2012; p. 21). These mentors are typically older students from similar majors (Brophy, 2008; Matin, & Dowson, 2009), and

are able to express feasible expectations and means to meet them through cooperative goals with their students (Qin, Johnson, & Johnson, 1995). These efforts have been described by students as having value through the provision of academic support, informal tutoring, and knowledge of other academic and social support services on campus (Amenkhienan, 2000). Additionally, student mentors help students with course and professor selection during registration periods, facilitate the formation of study groups, and promote networking and interaction both academically and socially to assist students during their transitional first year (Amenkhienan, 2000). The mentoring practices used in these settings have targeted students regardless of whether or not they are high achieving or low achieving, motivated, or unmotivated (Martin, & Dowson, 2009). What this implies is that mentoring services should be effective for any group (Ladsen-Billings, 1995), and further, the need for the establishment of socialization antecedents for achievement strivings is not unique to any particular group or time period (Graham, 1994).

Through interactions with mentors, mentees may elect to adopt the beliefs, behaviors, and practices of their mentors. In this sense, mentors act as auxiliary social influences to existing faculty and peer relationships. Consistent with the similarity hypothesis, the provision of upper-division students as mentors offers mentees a relatable social influence. As one student stated "It was really nice to go to someone who had been through all of it [engineering] and survived it [engineering] and could say, 'Yes you're going to be fine!'" (Amenkhienan, 2004; p. 535). With the documented success of mentoring programs on support struggling engineering students, the question remains why many students still leave engineering due to poor academic performance and sense of belonging issues despite programs in place designed to specifically support these needs?

Two possibilities have emerged in the literature. First, according to the similarity hypothesis, students are more persuaded by social models that are similar to themselves, or who match their ideal image (e.g. Bandera, 1986; Mussweiler, 2003; Schunk, Hanson, & Cox, 1987; Wood & Bandera, 1989). As Brophy suggests, more advanced students with direct experience and more fully developed interests can better speak to the affordances and applications of school-related information in a contextually

relevant way (Brophy, 2008). However, while ideally every student should have access to relatable social models to support their social and academic success, Trenor and colleagues (2008) found that access to role models in engineering can be particularly difficult for certain groups (e.g. women, racial minorities) due to a relative lack of representation in the major. Importantly, despite significant effort, the number of women and racial minorities in engineering classes who have peers, mentors, and faculty role models is not improving at a rate fast enough to effect these groups (Seymour & Hewitt, 1997). Given the relatively small numbers of ethnic minorities, racial minorities, and women to draw from as mentors, along with the time involved to act as a mentor given the already burdensome workload in engineering programs, the pool of potential mentors cannot keep up with demand (Hersh, 2000).

Second, from Amenkhienan's study (2000) of second year engineering students, students with low GPAs showed a greater tendency to not attend mentoring services, and not utilize other academic resources made available to them. The students who did not attend mentoring mentioned a downward spiral that began with an inability to adjust to the academic demands of college as well as difficulty in taking action to mitigate their academic situation; these factors resulted in decreased self-esteem and depression. The negative emotional toll from these experiences, coupled with an inability or discomfort in making contacts with fellow students and faculty, made it even more difficult for such students to reach out for help (Amenkhienan, & Kogan, 2004). This negative cycle, and its subsequent impact on academic performance, is consistent with previous studies (e.g. Pascarella & Terenzini, 1991).

According to Amenkhienan (2004), usage patterns of on-campus support services can be summarized by students' awareness of available services, and their personal level of comfort with seeking help. Additionally, service-level concerns with overhead have led to capping enrollment, targeting certain audiences (e.g. services targeted to under-represented groups, women, etc.), and limiting scope. In response awareness, Amenkhienan recommends advertising services on a regular basis. Recognizing that students are reluctant to use support services, faculty and student endorsements of these resources is recommended. In response to services targeting certain audiences, the importance of establishing support

services that are inclusive to all students is recommended. Lastly, with the proven benefits of attending support programs in engineering, especially during the transitional first year, exploring the cost-benefit analysis around the expansion of programs is recommended.

While these recommendations do address some of the concerns, ultimately the issue of how to overcome overhead issues and social inhibitors to attendance remains unanswered.

2.7 Virtually-Enabled Student Support

To offset some of the issues of on-campus mentoring services related to overhead (i.e. physical space, personnel cost, administration), audience (i.e. target specific groups), and scope (i.e. target specific time periods), as well as student-level issues of awareness and social inhibitors to attendance, several alternatives to on-campus support models have been tested to varying success.

Literature on online mentoring suggests that computer-based agents can be effective when they are similar to participants in terms of race or gender when seeking to affect self-beliefs (Bandera, 1986; Mussweiler, 2003; Schunk, at al., 1987; Wood, & Bandera, 1989). Research has shown that people tend to apply human social rules to computer technologies (e.g. Baylor, & Kim, 2009; Nass, & Lee, 2001; Nass, & Moon, 2000; Reeves, & Nass, 1996), apply gender stereotypes to computers (Nass, Moon, & Green, 1997), ethnically identify with computer agents, and exhibit social behaviors toward computers (Nass, & Moon, 2000). Because people apply human social rules to human-computer interactions, social rules should also apply to people's interactions with computerized interface agents (Rosenberg, 2010). Given a visibly present agent, research in social psychology suggests that the agent's characteristics would be important in determining how persuasive a social model is for influencing the identity-based beliefs of the viewer (Bandera, 1997; Chaikden, 1979; McIntyper, Paulson, & Lord, 2003).

From the list of existing online programs, several have focused on either connecting current engineering students with professional engineers for face-to-face meetings (Brainard, & Ailes-Sengers, 1994), email exchanges between undergraduate and graduate students with industrial mentors (Pavone, 1997), or on the development of anthropomorphic computer agent proxies (i.e. simulated mentors)

(Rosenberg, 2010). Electronic communication is unique in that it offers equity among its users, and can be more efficient than some live alternatives (Sproull, 1992). Benefits of electronic communication include gaining additional information, encouragement, advice, insight, and a sense of community using a technology-based strategy to gain access to a supportive virtual community. As electronic communication technology has become commonplace in the everyday lives of students, acceptance of a supportive virtual community has as well (Mueller, 2004). While both live and email-based programs have shown some level of success, the administrators of the latter model admit the importance of not underestimating the amount of human resources and staff required to operate an effective electronic mentoring program (Mueller, 2004). This is a very important point in that online programs which have publicized themselves as being more efficient and cost-effective than on-campus programs, acknowledge the amount of time and effort required for their programs upkeep is quite high as well.

In response to these concerns, recent technologies have been created that use simulated role models in place of live mentors as a means to address this overhead concern. Interface agents, which are anthropomorphic, 3D-animated computer characters have been used previously to positively influencing interest, motivation, and even self-efficacy regarding engineering (Baylor & Plant, 2005; Rosenberg-Kima, Baylor, Plant, & Doerr, 2008) as well as to challenge gender stereotypes of women in engineering (Rosenberg-Kima et al., 2010). In a previous study that used White and Black character options, and White and Black participants, findings illustrated that given the option, Black participants preferred Black agents from the same sex and age group, while for White participants the distinction was less important (Moreno, & Flowerday, 2006). When participants interacted with an agent that matched their race, they were more likely to report both higher utility and interest for engineering than when interacting with agents who did not match their race (Rosenberg-Kima et al., 2010).

At the same time, while interface agents were found to positively impact self-perceptions in the short term (Rosenberg-Kima et al., 2008), what remains unclear is whether or not these changes persist longitudinally after access to the intervention materials has been removed. According to Bickmore and

Picard (2005), the effects of such an experience can last up to four weeks, but this remains largely untested.

With the proven success of on-campus support services, limited only by overhead, audience, and scope, the possibility of offering social and academic support online is both relevant and feasible. As Rosenberg-Kima (2010; p. 36) explains, "It would be useful to find alternative mechanisms for providing social models that are both accessible for a large population of students and that can be personalized depending on the individual needs of the student." While online programs have proven themselves to be more inclusive and efficient then some on-campus services, the logistical costs of matching undergraduate students with mentors, either live or through email, remains quite high due to upkeep and oversight.

With a current understanding of the benefits of social models toward identity formation and its resultant behavior, this study will seek to fulfill the recommendations of Amenkhienan's work regarding increasing awareness of support programs, expanding the audience through a web-based interface, and increasing scope by enlisting the input of advanced students to speak about their previous experiences across various years. Lastly, and potentially most importantly, this study will seek to address the social inhibitors to attendance issue through the use of static videos that removes the need to "attend" any facility or admit the need for help or support.

2.8 Summary

In summary, engineering education has a retention problem in that large percentages of students leave the major during the first two years of the curriculum due to academic and social struggles resulting in negative perceptions of belonging in engineering.

With knowledge of this information, universities have developed and implemented measures to address these concerns, and yet, issues still remain. From the list of available services, this study will focus on the mentoring-based programs that offer both academic and social support through the provision of junior- and senior-level students acting as academic and cultural mentors. The choice to focus on mentoring-based programs was made due to their proven track record of retaining their members and

other previously-noted benefits. From an EVT standpoint, mentors as supportive social influences (socializers) have been shown to impact mentees beliefs about themselves, the value they place on given tasks, and ultimately, influence potential behaviors.

Despite the level of success of the mentoring-based program model, the impact of this success has in some cases resulted in an increased demand requiring additional overhead costs that may or may not be feasible. In response to demand, programs have had to respond by capping their enrollment in order to maintain their effectiveness. By targeting certain audiences over restricted time periods, some programs have been able to continue to operate and maintain their effectiveness.

From the student perspective, the results of targeting certain audiences over restricted time periods has resulted in some students either feeling unwelcome or otherwise socially inhibited from attending. With this understanding, the goal of this study was to provide mentoring to all students through a static video presence. By using junior- and senior-level student mentors as socializers, an examination of their impact on the identity beliefs of the participants in this study and how the subjective task value of their message was established will be conducted.

Chapter 3 Research Methods

3.1 Introduction and Purpose

As explained in Chapter 2, retention problems in engineering have led to considerable research identifying the salient variables that influence student decisions to persist or attrite in engineering. With the largest proportion of students leaving engineering during their second year for reasons related to curricular difficulty and a lack of a sense of belonging, this time period represents an important focal point for intervention efforts that seek to reverse this trend. While university-sponsored support-services have been developed to support and guide students' through their social and academic concerns, oftentimes these services are either not readily available to all students or are not utilized by those who would otherwise benefit from them.

This study sought to address factors that have historically limited access to support programs for all students, while simultaneously easing the social barriers that inhibit students from participating through video. To achieve this aim, an intervention was developed and its effects observed on a small sample of low-GPA second-year students. The goal of the study was to develop and test a static virtual mentoring tool targeting at-risk-for-attrition students. The intervention used students recruited based on major and age group (see Section 3.3) to create videos that provide both academic and social support through the sharing of prior personal experience. Because the study was exploratory in nature, having no similar prior studies to directly draw from, an exploratory case study was chosen to investigate the impacts of such an effort in as much depth as possible to provide a benchmark for understanding static video-based interventions. To understand how students engaged with the virtual mentoring environment, the following research questions were posed:

RQ 1: What criteria best explain students' viewing choices and preferences?

RQ 2: How do students react to and interpret the virtual mentors and the contents of their videos?

RQ 3: What immediate outcomes do students describe from engaging with this type of tool?

RQ 4: What affordances does this type of tool provide?

3.2 Research Design

To answer the research questions and test the effectiveness of static videos as a substitute for, or precursor to, in-person mentoring alternatives, web-hosted video content featuring a diverse selection of junior- and senior-level students was created and its effects studied using qualitative methods.

Qualitative methods have previously been shown to be effective in answering questions related to what is occurring, why something occurs, and how one phenomenon affects another (Borrego, 2009). More specifically, qualitative methods provide the tools necessary to study complex phenomena within their respective contexts (Baxter, 2008). From the many qualitative research methodologies available, this study used an exploratory case study method to investigate and understand how sub-3.0 GPA students engage with virtual mentoring videos. Exploratory case study methods have previously been used to explore situations in which the intervention being evaluated had no clear, single set of outcomes (Yin, 2003), and as such, were particularly relevant for this study. Yin defined the three conditions by which case study methods are appropriate, including: (1) the nature of the research question is typically explanatory, exploratory, or descriptive, typically structured “how” or “why”; (2) the investigator lacks methods to control the site and participants; and (3) the phenomenon being studied is contemporary and the context is real life; Table 1 maps these three conditions to this research setting (Yin 2003; p.1).

Table 1 Case Study Conditions Mapped to Research Setting

Conditions	Research Setting
Research Question	The research is exploratory in nature and seeks to understand
	how at-risk-for-attrition students interact with virtual mentoring videos
Ability to Control	The researcher had no control over participants while they viewed
	videos and kept a log of their experiences
Real-Life Context	Participants viewed videos on their own accord in a real-life context
	as they would outside of a research study environment

As shown in Table 1, this study met the three conditions outlined by Yin (2003) deemed necessary for case study methods to be an appropriate form of inquiry. Central to this method was the definition of the case, the boundaries of that case, and identification of the unit of analysis. As stated above, the study involved the development of a previously untested intervention on sub-3.0 GPA students and was bound by time and place (Creswell, 2003), time and activity (Stake, 1995), and context (Miles & Huberman, 1994). Specifically, this case study was restricted to 13 second year engineering students with GPAs between 2.0-2.99 who had previously reported low measures of belonging. The participants watched one hour's worth of videos that featured virtual mentors and content relevant to the institution that they were attending. These bounds help clarify the circumstances of the study, and any subsequent contexts in which similar interventions may be effective.

For an exploratory case study with multiple participants, Yin (2013) recommended a sample size of 6-10, with the actual size dependent on reaching a state of saturation, in which the collection of additional data would not likely result in any further discoveries. In this case, 13 students participated in a pre- and post-intervention interview sequence that identified the context of each participant first, and then explored their experiences with the intervention. Coding and analysis was undertaken via a replication strategy (Yin, 2013) and with the assistance of a second researcher in order to ensure that a state of saturation had been reached and that further data collection and analysis was not necessary to answer the research questions posed for this study. The details of the intervention development and methods used to evaluate its effectiveness are described in the sections that follow.

3.3 Intervention

The intervention involved videotaped interviews that were conducted and recorded during the spring semester 2013 at a large mid-Atlantic state university.

3.3.1 Intervention Purpose

The purpose of the intervention was to provide a set of virtual mentoring videos and test their impact on 2.00-2.99 GPA students. Specifically, the provision of academic and social support information was tested as a means of offsetting both in-person mentoring limitations as well as social barriers that inhibit certain students from seeking them out. As the second-year has shown itself to be the critical year for a majority of engineering students with regards to attrition or persistence in engineering (Min et al., 2011), the purpose of the videos was to provide relevant information from students who had successfully completed their second year and could therefore act as both virtual mentors and role models for the so-called at-risk-for-attrition students through their direct personal experience.

3.3.2 Intervention Subjects

Solicitation to potential virtual mentors took place primarily within two upper-division courses, one in aerospace engineering and one in mechanical engineering. Specifically, students were recruited from Spacecraft Dynamics and Controls, and Dynamic Systems-Controls Engineering, two elective courses, during the last two weeks of the spring semester to participate in 30-60 minute interviews concerning their second-year experiences. The focus on junior- and senior-level students was done deliberately as they represented models of success through the second year hurdle, and thus, could act as potential role models and mentors given their direct experience with the context.

In both courses, students were given a short presentation outlining the goals of the study and what their participation would involve. Following the presentation, a sign-up sheet was distributed to the class asking for the names and emails of interested students. Each of the two courses has roughly 30 students, with 39 signing up, and 18 eventually participating. While all 39 students were contacted, 21 did not

respond to email requests to complete the interview, leaving 18 to act as the virtual mentors for the intervention. Of these 18 students, 11 were male and 7 were female. Demographically this group was comprised of 11 Caucasians, 2 Asians, 1 Hispanic, 1 African-American, 1 multiple races, 1 non-resident alien, and 1 not reported. These numbers were similar to the overall makeup of the university:

Table 2 Intervention vs Institutional Demographics

Race	University	Intervention
American Indian or Alaskan Native	~0%	0%
Asian	~8%	11.11%
Black or African-American	~4%	5.50%
Hispanic	~4%	5.50%
White	~70%	61.11%
Two or More	~3%	5.50%
Not Reported	~3%	5.50%
Non-Resident Alien	~9%	5.50%

3.3.3 Intervention Procedures

Students who volunteered their contact information at the two solicitations were contacted the following week via email to schedule their videotaped interviews. The interviews took place in the researcher's office over the final two weeks of the Spring Semester 2013. During the interview, participants were provided with an example curriculum for their major and were videotaped as they progressed through the protocol shown in Table 3. Upon the conclusion of the interview, participants were given notice that upon the completion of the video editing and Vimeo channel creation they would be able to view the content and retract their contribution at any time.

3.3.4 Intervention Protocol

The interviews were semi-structured in nature in that they contained open-ended questions with multiple probes (Leedy & Ormrod, 2005). Semi-structured interviews allowed participants to provide in-depth descriptions of their experiences without being overly confined by a rigid sequence of questions (Patton, 2002). The protocol was developed around specific expectancy-value constructs and reflections of personal experience related to courses and other collegiate experiences:

Table 3 Intervention Interview Protocol

Constructs	Questions
Introduction	1. What is your name and where are you from? What is your major and what year into your curriculum are you? 2. Who or what influenced your choice of major? 3. What are your plans after graduation?
Task-Value for Engineering	4. What are your interests in engineering? a. What do you like about your major? b. What do you not like about your major? 5. At what cost have you been successful or not in engineering? a. How much time per week would you say you spend working on engineering assignments or in class? b. Does this time commitment keep you from doing other things you would like to do?
Previous Experience	6. Tell me about your first year in engineering. a. What were your expectations? b. Were there any academic or social challenges that you faced? c. Did any of these carry over into your second year?
Second Year	7. After first year what were your expectations going into your second? 8. What content from your first year have you since found useful? 9. What courses did you take and which were the most difficult? Why? a. What were some of the challenges that you faced, and how did you overcome them? b. What strategies would you recommend to be successful in these courses? 10. If you could go back and complete your second year again, would you do anything different, and if so, what?
University-Sponsored Support	11. Have you ever approached faculty or teaching assistants for help outside of class? a. Through what means? (email, office hours) b. What was this experience like and what advice would you give to someone who might be intimidated or hesitant to do

	so? 12. Are you familiar with other forms of academic and social support provided by the university? If so, which ones, and have you ever attended? a. What was your experience like?
Final Word of Advice	13. If you could sum up all of your experiences into one statement of advice that you wish someone had told you going into your second year, what would that be?

3.3.5 Intervention Development

The 18 interviews resulted in approximately 30 hours of video data, which were edited and segmented into videos of approximately 30 seconds to 2 minutes according the topic under discussion. Topics were selected according to their place in the Eccles model (2009) related to mentors' previous personal experience and their beliefs and behaviors with regards to both academic and social experiences. Some example topics included how to succeed in particular courses, time management strategies, how to create and contribute to study groups, attendance at TA an faculty office hours, coping strategies for handling difficult subject matter and poor teaching and more.

Apple iMovie was used to edit the videos, and www.Vimeo.com was used to host the final content. In order to protect the confidentiality of the interviewed students and to control visibility, a privately hosted Vimeo channel was created and accessed only during the data collection sessions. Access required specific login information that was provided to study participants by the researcher upon the completion of the first interview.

Figure 5 Vimeo Channel Image

The channel menu was organized around searchable terms (See Appendix D) such as courses, professors, and common academic and social issues that second year student often face. The topics covered in each video were made evident in their respective titles, which are listed in the Complete Video Index (See Appendix E).

3.4 Research Study Participants

To study students' experiences with these videos, research participants were drawn from a single, large, public university. These students were drawn from a previous study population based on GPAs and responses to survey items related to their sense of belonging in engineering. Initially the search focused on mechanical and aerospace engineering students exclusively to match the video mentors, but later

expanded to include industrial systems engineering, and engineering science and mechanics in order to reach the desired sample size for the study. In total, 6 men and 7 women completed the study. The assigned pseudonyms, participant major and participant GPA are listed in Table 4. Both men and women were recruited due to previous variations in attendance patterns and perceptions of university-sponsored support efforts by sex (Amenkhienan, 2000; Amenkhienan & Kogan, 2004). For example, white males have historically utilized university-sponsored-support-services the least, and secondly, females reported issues in attendance due to low self-efficacy and identification with engineering stemming from a lack of visible role models and mentors in their major (Zeldin, 2000; Zeldin & Pajares, 2000).

Table 4 Participants

Pseudonym	Major	S13 GPA	Overall GPA
Abbey	ISE	3.10	2.90
Arista	ME	3.17	2.98
Calera	BSE	2.21	2.37
Illusiona	ISE	3.28	2.81
Oliva	ISE	3.25	2.77
Padrona	ISE	2.96	2.93
Starr	MATH	3.70	3.70
Ashton	ISE	2.90	2.85
Balcones	ME	2.68	2.60
Collier	AOE	2.80	2.99
McKeel	ME	2.52	2.98
Melville	ME	3.10	3.50
Rocky	ME	2.28	2.43

Following IRB approval (IRB# 13-782), recruitment took place during Fall Semester of 2013 based on responses to a first-year engineering survey administered during the previous academic year. Selection criteria initially included students with a cumulative GPA between 2.0-2.7 but due to a low response rate, the GPA range was extended to 2.0-2.99. Initial contact involved an email outlining the details of the study, including what participation would involve as well as a tentative timeline for the pre- and post-interviews (see Appendix B). For those that elected to participate, follow-up emails were sent and initial interviews scheduled. Upon the completion of the study, participants were compensated $50 for their efforts.

3.5 Data Collection

Data collection involved a two-interview sequence and a set of three handouts. The first interview involved a semi-structured protocol (Patton, 2002) targeting each participant's second year predications of their academic performance, a reflection on their first year academic performance and socialization, and opinions on university-sponsored-support-services. The pre-interview lasted 30-60 minutes and took place during the first four weeks of the semester to capture student perceptions of their courses prior to any high-stakes testing or significant graded work. Both of these factors have shown to have a strong impact on student motivation and perceptions of teaching, particularly with lower achieving students (Roderick & Engel, 2001). Upon completion of the first interview, participants were introduced to the Vimeo channel and given a short tutorial on how to navigate the channel. Participants were instructed to watch exactly one hour's worth of video over the course of a 7-14 day period and to log their experiences on their complete video index and participant notebook that were to be submitted at the time of their post-intervention interview (see Figure 6). The details of these two documents are discussed in the following sections.

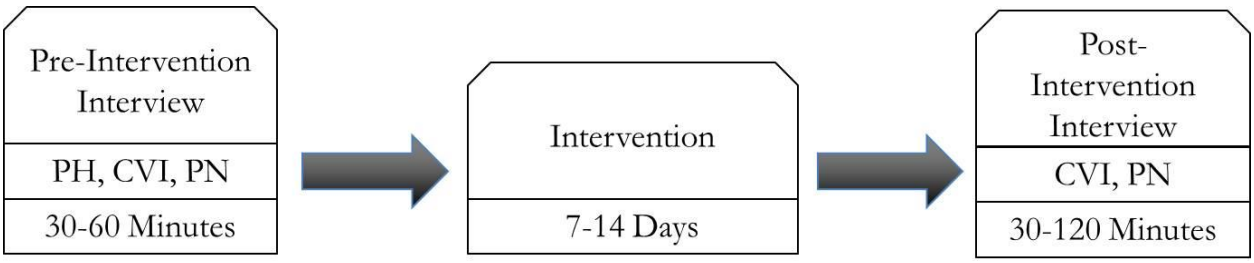

Figure 6 Data Collection Chronology

Once students completed their viewing, they returned their complete video index, their participant notebook, and participated in a post-intervention interview concentrated on their experience with the videos. Specifically, questions targeted choice and search behaviors, reactions to mentors and content, outcomes of the experience, and any affordances they saw in the intervention as a future tool. The complete data collection sequence is shown in Figure 6 and the details of each phase are discussed below.

3.5.1 Pre-Intervention Interview Protocol Development

The pre-intervention interview protocol shown in Table 1 began with a background question identifying participants' name, year in school, and major. Participants then identified the classes that they were enrolled in and how they expected to perform in those classes. The question that addressed prediction of performance was drawn from Hutchison-Green's (2008) self-efficacy protocol of first-year engineering students and was used verbatim. Next, participants were asked to evaluate the instructors that they had for each course and describe any coping strategies that they might implement if they perceived a potential conflict between their learning and the instructor or the methods used by the instructor in the course; these questions were taken directly from Chemers et al. (2001) coping efficacy instrument.

To address first-year experiences as well as perceptions of university-sponsored support programs, Amenkhienan's (2000) protocol was used in its entirety. These items were especially relevant as they were developed for second-year engineering students, and sought to understand similar behaviors related to perceptions and usage of university-sponsored support programs. Upon the conclusion of the interview participants were introduced to the private Vimeo channel, provided with copies of their complete video index, participant handout, and participant notebook.

Table 5 Pre-Intervention Interview Protocol

Constructs	**Questions**
Introduction	1. Would you mind introducing yourself? a. Name, where you are from, year in school, and major
Second-Year Predictions	2. What classes are you taking this semester and how successful do you think you will be in them? 3. How would you rate the quality of your instructors in these courses?
First-Year Academic Performance	4. Were there any experiences during your first year at Virginia Tech that really stand out to you? a. Probe: Academic, social? b. What about the experience stood out, and second, what was the impact?
First-Year Socialization	5. During your first year: c. How would you describe your level of satisfaction with your social life? i. Did you find this supportive or detrimental to your academic performance? d. How would you describe your time management and level of self-regulation exhibited throughout your first year? e. How would you describe the level of effort dedicated to your academic coursework? f. How would you describe the frequency and quality of interaction with your engineering peers? g. How would you describe your interaction with faculty?
University Sponsored Support Services	6. Which, if any, of Virginia Tech's academic support services did you use during your first year? h. Did you find these services helpful? If so, in what ways? i. If you did not attend, which types of services or resources would you have liked to have access to and why? 7. What non-academic factors do you feel influenced your academic performance? j. Financial concerns (job, loans) k. Discrimination based on race or gender

	l. Competitive and unsupportive culture, perception of a weed-out tradition 8. If you experienced any of these factors, how did they impact your academic performance? 9. Overall, if you were to summarize all of your experiences at Virginia Tech, what would you say is most responsible for your present level of academic performance? [Introduce Vimeo tool here] 10. Under what circumstances would you consider watching videos like this if you were not part of this study?

3.5.2 Complete Video Index

This complete video index (Appendix E) was a document that displayed a complete list of all videos created for the intervention. The document presented a photo of each virtual mentor, a list of self-identified descriptors, video titles and their corresponding lengths. Each video had a check box to the left of the video title and two columns to right of the video length for marking the date and time that any particular video was watched. For the hour that participants watched the intervention videos, they were instructed to check the box of each video that they watched and record the date and time that they watched it. This completed document was submitted at the time of the post-intervention interview along with the participant notebook.

3.5.3 Participant Notebook

In addition to the complete video index, participants were provided with a participant notebook (Appendix F) to take notes and reflect on their viewing experience every five videos. Participants submitted their notebooks at the beginning of their post-intervention interviews.

3.5.4 Post-Interview Protocol Development

The post-interview protocol included questions related to timing effects between the pre- and post-interview, overall intervention impact, choice and search behaviors, reactions and interpretations of mentors and content, affordances of the tool, outcomes of the experience, and recommendations for improvement. Without a similar study utilizing this type of intervention, the protocol had to be created and modified through an iterative piloting process. This process involved a series of consultation sessions with fellow engineering education researchers concerning order and wording of various questions.

The initial protocol was pilot tested with two second-year students (one male and one female), who watched a sample of videos, progressed through both instruments, and offered feedback regarding the implementation procedures of the study. These meetings concluded with a debriefing session that covered both clarity and order of the questions. Once these pilot interviews were completed, the notes and recordings from these meetings were shared and analyzed with other engineering education researchers to review the data quality, and the protocols were further revised as needed. Based on this feedback, the final protocol involved items concerning choice and search patterns, including where participants started, where they went next, and what types of information guided their selections. Participants were asked what content they found useful or interesting and in what ways they were able to relate to the various virtual mentors. Following this line of questioning students were asked about any affordances they felt the tool provided and if they perceived any potential behavioral changes in themselves as a result of the experience. The complete protocol is provided in Table 2.

Table 6 Post-Intervention Interview Protocol

Constructs	**Questions**
Timing Effects	1. Since the previous interview, have you had any academic or social experiences that greatly impacted you? a. Probe: Tell me about your week
Overall Intervention Impact	2. So tell me about your overall experience with the videos. a. Probe: Entertaining, useful, a waste of time, difficult to navigate?

Choice and Search Patterns	3. What did you watch first? 4. Where did you go next? 5. Were you looking for anything in particular? a. If so, what was it, and did you find it? 6. Did you have any overall search strategy that you used when progressing through the videos? b. Probe: Did you focus on the website or the handout? 7. Was there any additional information that you would've liked to have had about the students in the videos? c. Probe: GPA of the student, grade received in the class? d. Probe: The year and/or professor? 8. If no photo was provided, how would you have selected which videos to watch?
Reactions and Interpretations	9. Was there any content in the videos that you found particularly useful? Not useful? 10. Did you see any of yourself in these students? e. What about these students could you relate to? 11. Could you relate to any of the experiences that were discussed in the videos? 12. Did watching these videos make you feel any particular way?
Affordances	13. Of the material discussed in the videos, approximately how much had you heard before? f. From whom? 14. How would you compare the experience of hearing the same information from someone you know or have interacted with, with hearing it through these videos?
Outcomes	15. What did the videos do for you, if anything? 16. Did you get any advice from these videos that you might try and implement?
Closing Questions	17. After watching these videos what do you think the point of this experience was? 18. What recommendations would you make to improve the tool in the future?

	19. Verbal consent: Since you elected to maintain your membership to the Vimeo channel, would you mind if I contacted you in the future regarding any further use of the tool? 20. Do you have any closing comments that you would like to add regarding any aspect of this experience?

3.6 Data Analysis

While four sets of data were collected for this study, including the pre-intervention interview transcripts, the complete video index, the participant handout, and the post-intervention interview transcripts, this dissertation focuses exclusively on the analysis of the post-intervention interview transcripts. This decision came as a result of a shift in research design after all data had been collected and a preliminary phase of analysis had been completed. Initially the study was framed as a multiple case study with each participant acting as an individual case. For this model, the pre-intervention interview acted as a case-defining interview and the subsequent data sources acted as a means to tell their story. Upon reflection of the research questions posed for this study and a consultation with the advisory committee, the decision was made to alter the study to an exploratory case study with a variable-centered analysis. Under these new conditions, the post-intervention interview transcripts acted as the primary data source used to answer the research questions posed for this study.

The post-intervention interviews were audio recorded and stored on the primary researcher's laptop computer. The recordings were transcribed verbatim using the InqScribe software package and coding using *a priori* and emergent codes (Patton, 2002). Essential to this analysis was the meaning making process that involved the sequence of code development, pattern making, and clustering of statement related to emergent themes (Miles & Huberman, 1994).

3.6.1 Codebook Development

To analyze the post-intervention interview transcripts, a codebook was developed around the four research questions posed for the study. The codebooks were developed using a team-based approach (e.g.

Carey, 1996) that involved identifying each code, locating its theoretical definition, defining its contextualized definition, stating its inclusion criteria, and locating examples quotes (MacQueen, 1998).

The development of the codebooks involved one researcher whose primary responsibility was to create, update, and revise the codebooks and a second researcher who served to establish intercoder agreement. For the first stage in the development of the codebooks, structural coding (MacQueen, 1998) was used to broadly map responses from the post-intervention interview protocol to respective research questions related to four major categories (choices, reactions, outcomes, and affordances). For this iteration, both the question being asked and the dialogue between the proctor and the participant were listed in full to preserve the flow of the interview and provide context for the segment.

After this round of analysis, the primary researcher combined the initial codes into an initial codebook. The codebook included the name of each code, its theoretical definition, an initial contextualized definition, and some example quotes. At this junction a second researcher was integrated into the analysis process. Prior to coding herself, she reviewed codebook for clarity and was given a few examples of each code application. Once this was completed, the second researcher coded three transcripts independently using the codebook and the MAXQDA software package. During this phase, two experts in motivation and identity research were consulted to oversee and approve the coding as it was taking place. The results of coding between the two researchers involved the identification of detailed codes within each category and an updated codebook. Detailed codes represented sub-codes with each category that were either a priori from Eccles expectancy-value model (2009), or were emergent in nature if they did not neatly fit into the constructs of the model.

In the third iteration, both researchers coded three new transcripts with the updated codebook, with inconsistencies noted, discussed, and resolved. Resolution involved the discussion of segments that were coded differently by each researcher until a consensus was reached about where it belonged. At the culmination of this exercise, the codebook was finalized, and the remainder of the transcripts coded.

The first research question (What criteria best explain students' viewing choices and preferences?) used both *a priori* codes and a single emergent code. The *a priori* codes came from Eccles (2009) definitions of personal identity, collective identity, interest value, and utility value. The *a priori* codes were adapted from Eccles' original definition to a futuristic perspective in that rather than making reference to the current state of these constructs, initial choice behaviors were made based on the assumption that a particular mentor or content could be potentially relatable or valuable. In addition, the code 'overall search strategy' emerged that captured statements identifying preferences for choices made based on material found in the complete video index, including virtual mentor photos, descriptors, video titles, and video lengths.

For the second research question (How do students react to virtual mentors and the contents of their videos?) both *a priori* and emergent codes were used. As with the first research question, Eccles' constructs of personal identity (both positive and negative cases), affective reactions, and utility value and interest value were found to be relevant. Lastly, emergent codes related to video lengths and the level of detail covered in the videos was found.

The third research question (What immediate outcomes result from engaging with this type of tool?) was analyzed using exclusively *a priori* codes from Eccles including emerging collective identity and intentions. The first outcome was the discovery of an emerging collective identity through watching videos of virtual mentors who were similar to themselves or had gone through similar experiences. The second outcome, "intentions," was directly related to Eccles "Task, Activities, and Behavioral Choices" construct but was only expressed as an *intent to act* rather than an affirmation that an action had taken place.

The fourth and final research question (What affordances does this type of tool provide?) was analyzed simply through references to either positive affordances or negative drawbacks to the tool. Table

4 shows the abbreviated codebook that includes each code and its contextualized definition. The complete codebook that includes Eccles' definitions from EVT can be found in Appendices G, H, and I.

Table 7 Abbreviated Codebook

Code	Contextualized Definition
Choice Codes	
Overall Choice Strategy *Emergent*	Statements identifying overall choice strategies related to navigation of the tool.
Personal Identity *A priori*	Choices made based on perceptions of personal uniqueness without reference to a larger group affiliation.
Collective/Social Identity *A priori*	Choices made based on one's perceived affiliation with a specific group.
Utility Value *A priori*	Choices made based on the perception of the usefulness of content based on the virtual mentor's perspective or video title.
Interest Value *A priori*	Choices made based on potential interest in, or curiosity of, virtual mentor's perspective or the video content.
Reaction Codes	
Reaction to Virtual Mentors	
Affective Reaction	A resultant objective or emotional response to virtual mentors and/or video content
Current Identity *A priori*	The realization that a given virtual mentor is similar to the participant as they exist today
Not Current Identity *A priori*	The realization that a virtual mentor is not similar to the participant's current self
Interpretation of Content	
Agree/Disagree *Emergent*	Confirming agreement or disagreement with the content of a particular video.
Interest Value *A priori*	The finding of video content to be interesting
Utility Value *A priori*	Resultant perception of the usefulness of a video's content in terms of reaching one's short- and long-term goals.
Video Length and Level of Detail	
Video Length and Level of Detail *Emergent*	Evaluation of video length and connection to level of detail within a video's content
Outcome and Affordance Codes	
Emerging Collective Identity *Emergent*	The realization that one's perceptions of uniqueness in being or experience are not, in fact, unique.
Future Intentions *Emergent*	Intention to act out a potential behavior resulting for viewing a particular video or set of videos.
Affordances *Emergent*	Unique affordances of the tool in comparison to in-person alternatives.
Drawbacks	The drawbacks of the tool compared to in-person

Emergent	interactions.

3.7 Research Quality

To ensure the quality of the research, issues related to the credibility, transferability, replicability, and objectivity all need to be addressed. Credibility, or believability of the work (Lincoln & Guba, 1985), was established through framing the study within a larger body of research and through the utilization of robust research methods and analysis techniques proven in previous studies pertinent to the research questions being asked here, as described in the previous section. In addition to using methods previously shown be appropriate for this level of study, experts in both identity and expectancy-value theory were actively involved during all phases of data analysis and write-up of the final dissertation document.

Transferability, or the applicability of research findings to other settings (Lincoln & Guba, 1985), could be done with knowledge of the makeup of the virtual mentors and the study's participants, the limitations of this study, and the contextually-specific nature of its aims. . With the study tied to a single institutional context, transfer of the findings to another setting could be limited by the relatability of some of the mentors and the relevance certain video content. As many of the videos created in this study were tied directly to a particular course, instructor, or experience unique to the institutional context, a percentage of the videos would most likely not transfer well. On the other hand, the findings related to the importance of identity-based connections between mentors and mentees and the preference for mentors that embody a model of transformation over a model of excellence should be applicable to other contexts provided a similar sample of study participants.

Replicability of the work was supported through a chain of reasoning and clear outline of the procedures used. The study used multiple codes, outlined the development of the codebook, and endorsed the recommendations from experts in the theoretical foundations of the work. With the rationale for each step outlined and supported by previous research, the ability to replicate this study should be attainable for those who wish to do so.

Lastly, the issue of objectivity, the ensuring that data analysis was conducted based on participant responses rather than researcher biases (Lincoln & Guba, 2000), was addressed through the introduction of a second researcher both during interview protocol development, codebook development, and during data analysis. Upon completion of the analysis and the corresponding write-up, an external review committee further checked the work for all four of these criteria that established the overall "truth value" of the work (Lincoln & Guba, 1985, p.290).

3.8 Researcher Bias and Limitations

A post-positivist worldview was taken in the analysis of the interview transcripts through a focus on trying to identify a single, general model of experience amongst all participants in this study. In order to better understand the context of my analysis a bracketing of my personal experience will be presented here. Bracketing involves the presentation of an open and honest narrative of my background experiences that may have influenced my interpretation of the data in this study (Creswell, 2003).

I grew up in southern California with upper middle class parents including a Hispanic father and a White mother. Given this dynamic, I was bestowed with a Spanish last name that resulted in several unique opportunities throughout my life, most notably so during my college years. Beginning with my college applications, I frequently received invitations to join Hispanic student support organizations that provided academic and social support beyond what the average student would likely receive. Personally I never felt comfortable approaching these organizations as I don't consider myself to look particularly Hispanic, and felt that these organizations should not target students like myself as I didn't feel like I had to overcome any hurdles to success beyond those that any other student would face. My main concern with these programs was that fact that I was targeted for participation based on demographic information that included me, and seemingly excluded others.

While my initial inhibition to attendance was based on recruitment strategies, I was later against attendance for a fear of judgment. During my second year of college my grades began to fall, and having

previously been known as a “smart” individual, I was hesitate to vocalize my struggles and seek out the help that I needed. The downward spiral of struggling in engineering and not seeking out help from programs designed to help me was a major source of anxiety that led to me eventually leaving the university during my third year.

While I eventually learned from these experiences, and went on to graduate, these experiences directly influenced the development of the intervention, the recruitment of potential participants, and the perspective which I embodied in the analysis of the data. To help offset the impact of my personal experience, a second researcher was used to objectify the analysis, and a committee of experts in engineering education were used to ensure that the theoretical framework and rigorous research methods guided the analysis and rather than my personal experiences and biases.

3.9 Summary

To answer the research questions posed for this study, a qualitative investigation focusing on at-risk-for-attrition students was conducted to analyze the impacts of the video-based intervention. With few existing studies to draw from, an exploratory case study analysis was chosen that focused on 13 participants that met specific criteria that identified them as potentially at-risk for attrition.

While the study involved the collection of four data sources, only the post-intervention interview transcripts were used in this dissertation. The post-intervention interview focused on participant choice behaviors, reactions, outcomes, and affordance-based questions that mapped directly to the research questions posed for this study. Data analysis involved several phases and researchers to ensure both the quality and objectivity of the analysis, and the results of this analysis are presented in Chapter 4.

Chapter 4 Results

4.1 Introduction

The goal of this study was to develop and test a virtual mentoring tool targeting at-risk-for-attrition students. To understand these students' experience of engaging with the virtual mentoring tool, the following research questions were posed:

RQ 1 What criteria best explain students' viewing choices and preferences?

RQ 2 How do students react to and interpret the virtual mentors and the contents of their videos?

RQ 3 What immediate outcomes do students describe from engaging with this type of tool?

RQ 4 What affordances does this type of tool provide?

To answer these questions, data analysis focused on choice behaviors (RQ1), reactions (RQ2), outcomes (RQ3), and affordances (RQ4) related to the use of the virtual mentoring tool. The following sections present results for each of these questions based on participants' post-intervention interviews. The following sections describe each code in discrete terms, but as several of the quotes suggest, codes often interact with each other and are often closely related; Chapter 5 deals more fully with this interplay.

4.2 Choice Results

Participant choice behaviors centered on five major categories: overall choice strategies, personal and collective identity beliefs, utility value, and interest value. Participants made choices based on either the perception of a given virtual mentor, or the content that they believed to be relatable their present situation.

4.2.1 Overall Choice Strategy

Several participants began their video selection with some kind of "overall choice strategy" that focused on the information provided on the complete video index sheet (see Appendix E). Codes in this section focus on the kinds of information participants used to make their initial video choices. Most notably, the image of the virtual mentor, their list of descriptors, video titles, and video lengths provided the information necessary to guide participants towards or away from videos based on personal preference. As the nature of the study required participants to make video selections on an ongoing basis over the course of their hour, reactive choices will be covered in the sections starting at 4.3.

With respect to pictures, some participants, like Ashton, simply stated *"the picture was the main thing I looked at,"* while others made choices based on a specific visual impression regarding the virtual mentor photo. Illusiona, for example, said "*I watched Ellen's videos because of her picture. I was just, like, 'oh she looks pretty normal."*

For other participants, the text description was more critical, as Balcones explains: "*Description is more useful than anything…cause you want to relate to whatever they're doing and then look at their courses."* In some cases though, descriptions were far less important. As Oliva stated "*I don't really care about their other interests and stuff."* Oliva's dismissal of descriptors was replaced by alternative choice strategies and points of focus discussed in later sections.

Other participants made choices based not on the person but on the content. In the case of Collier, for example, the video titles were the single most important piece of information when making his selections, "*I didn't even see their names. It just completely blanked out and I only saw titles."* Importantly, the titles meant different things to different students. In Abbey's case, video titles served to disconnect the content from the mentor: *"By reading the titles pretty much, like a lot of things had like statics in it, I didn't really pay much attention to the person that much.*" In Rocky's case, the title served to disconnect the video content from the mentors' major affiliations and thus opened the search space: "*I*

would like glance what type of major they were like aerospace, mechanical, materials science, industrial science, stuff like that, but I wouldn't focus mainly on that cause the courses are the courses, it doesn't matter what type of engineering you are." Title also showed precedence in some cases over video length, as they did for Abbey, who stated "*I don't know; if it had a catchy title like 'Life After Dropping Statics', even if it was only like 26 seconds long, I still had to scope it out, you know."* This choice behavior is important as video length showed to be a variable that some students were quite sensitive to. But while a majority of students referenced video length (e.g. *"I tried to watch the longer videos"* [Arista]), most used it as a secondary filter behind content or mentor characteristics. It is also important to note here that video length may be less meaningful outside the context of this study, which required strict adherence to the one hour viewing limit. While these overall choice behaviors are important, a closer look at how participants perceived the mentor or content within a specific video proved more useful in understanding the use of this tool.

4.2.2 Choice - Personal Identity

The basis for each participant's search strategy was most often in reference to a search for mentors that were relatable to themselves and their perceived individuality. From Eccles (2009), participants' views of themselves were classified as components of their personal identities. According to Eccles, personal identities are the aspects of one's identity that serve the psychological function of making one feel unique. They represent the most valued aspects of the self that one knows through observation of one's own behaviors and characteristics (Eccles 2009). In this study, choices based on personal identity characteristics emerged in two ways: through characteristics participants associated with themselves (coded as 'self') and through characteristics associated of people they knew (coded as 'peer'). Choices based on personal identity were those in which participants made choices in which they perceived the potential for a connection with a virtual mentor or video content based on information provided in the complete video index. In this comparison, participants sought either similarities or differences that impacted their viewing behaviors.

4.2.2.1 Self

Arista captured the essence of personal identity choices when she said "*I'm looking for me.*" This search for "me" manifested itself most clearly in reference to shared past negative academic experiences, and academic and social life balance perceptions of themselves and the people around them.

The preference for shared past experience, particularly negative experiences, showed up repeatedly across all participants. Shared past experience had several components, starting with direct reference to a single course. Students such as McKeel focused on

> *The fact that I've got a D+ as well [Laughs]. So that's what really drew me to that, but its, I guess cause I could relate to that to see how he went through that situation to just compare how he went through the situation to how I went through the situation.*
> [McKeel]

In most cases, importantly, it was not so much the negative experience itself that seemed important, but the fact that the mentor had persevered through that negative experience. In the case of Arista, she was particularly keen on empathizing through shared struggles and perseverance to keep going: *"I'd like try to watch the people on how did they get through the struggle of getting like B's and C's and stuff like that."*

In addition to general references to beliefs about higher achieving students, participants made specific references to videos that addressed academic/social life balance:

> *…if they said like 'spending time outside of engineering' like that's something that I enjoy doing. I can't do engineering 24/7. So I felt that she would be able to relate to me or I wanted to see her opinion on spending time outside of engineering would entail.*
> [Padrona]

The assumption here that students with certain GPAs have similar lifestyles and similar approaches to balancing the academic and social aspects of their lives should also be noted. This

assumption acted as a trigger in some cases either towards or away from future viewing behaviors. As Arista explained, when "*people that said they did 80% schoolwork obviously don't have a social life and I couldn't relate to them, next!"* [Arista] This belief that someone could devote so much of their time exclusively to schoolwork removed credibility and directed Arista to explore other mentors potentially more like herself.

4.2.2.2 Peers

Beyond the references comparing the virtual mentors to them, a few participants indicated that they either knew the mentors, or had seen them in another context. As Arista simply put *"I went to people that I knew,"* and Balcones, *"He's in one of my classes this semester, so I just wondered, what the heck."* While this association happened with very few participants, it was important as it guaranteed connection with the mentors. In Collier's case, for example, his preference for videos from Mapp was clarified in explicit detail: "*That's why I watched so many of Mapp's cause I know Mapp and I know he doesn't just bullshit when you ask him a question."* While these relationships were rare, they did explain the personal choice behaviors of some participants.

4.2.3 Choice - Collective Identity

In addition the choices made in reference to personal identity and acquaintances, a number of participants made choices based on a group affiliation through a collective/social identity belief. Eccles defines collective identity as "those personally valued parts of the self that serve to strengthen one's ties to highly valued social groups and relationships" (Eccles, 2009; p. 79). Within this study, collective identity choice behaviors refer to one's affiliation with any defined group, not necessarily social in nature. The cited collective identities were those advertised in the list of descriptors under the virtual mentor's photo. Although not intentionally designed to do so, these descriptors functioned to define a full range of social groups for each mentor that included not only race and gender, but campus groups, GPA, college major, and learning communities.

The most salient of these affiliations was college major. College major was referenced by every participant to some extent. Regardless of major, participant affinity for someone in their own major was obvious both through explicit statements and implicit video preferences as shown in their submitted complete video indexes. Ashton was a prime example of this as he had a very strong preference to hear from mentors in his major:

> *Because she's ISE, so it's like taking advice from someone that's in the same boat as you rather than someone that's like taking advice from some stranger versus your brother. You get a bit more connection from someone whose actually in the major you're going in.* [Ashton]

Ashton's sensitivity for ISEs even made him feel a bit excluded at times as there were a disproportionate number of mentors from other majors: *"I feel like a lot of them were aerospace and mechanical, so it wasn't very diverse and I felt a little excluded because I'm not aerospace or mechanical."* The relevance of major was often linked to current courses: "*So I watched the thermodynamics ones, I watched like the intro to thermal fluids one, and I watched ones that pertained to mechanical engineering"* [McKeel]. The preference for major was linked to both general experiences and future courses, as Ashton explained: "*experiences that I wanted to know that I was going to experience."* The ability to visualize a possible future was something that several participants brought up in one way or another, linking collective identity to utility (Section 4.2.40. That is, as these examples suggest, collective identity was one basis for determining utility of content. Thus, an inherent overlap exists between collective identity beliefs and utility in that individuals from the same major were deemed most qualified to comment on existing courses and potential future experiences that participants most likely would face.

Besides major, GPA was another salient collective identity that was mentioned by every participant. Participants' preference to seek out "*anything about not doing well whether it's in one class or GPA or dropping a class"* [Calera] or *"…people who didn't get a 4.0 and you know, didn't have it*

super easy" [Padrona] was interesting for several reasons. First, the phrase "*have it super easy*" is also reflected an underlying assumption that "A" students are "*people that just study."* [Arista] These references to "A" students were interesting because they reflected a secondary stereotype that these individual did not possess a level of academic and social life balance that the participants in this study seemed to value. For these participants, "A" students in general were "not me," not only because of grades, but because of values. Several participants in fact, explicitly considered their GPAs a function of their ability to balance academics and social life, thus explaining their lower GPAs. This value manifested itself in statements like, "'*A' students study all the time. That's what I've found, just studying, but the B's and C's normally balance a little more, you know what I mean... and so that's where I look[ed] at cause [that's] where I fall in most of the time is B C."* [Rocky] Such statements reflect the perception that grades are linked to identity in addition to ability.

Besides college major and GPA, many choices were based on other group affiliations, either positive or negative. In the positive cases something as simple as "*He plays soccer and is foreign*" [Balcones] was enough to establish shared collective identity, while in other cases, membership in a common on-campus program was important: "*Daniel cause he was below [3.0] and did Galileo, and I was in Hypatia."* [Padrona] The strength of these affiliations was particularly strong for students that considered their collective identity marginalized such as Rocky with his membership in the Corps of Cadets: *"But I looked a lot on Emily's and Joe's since they were in the Corps, so kind of relate more on them."* This link was important as there was a perception of an unspoken understanding between members of the same collective/social group. As Rocky explains,

> *…they're direct to the point. They don't beat around the bush, run around everything. It's just hey (snaps fingers) this guy was this and this, that's how the Corps teaches you how to talk. It's not oh we'll jog around this area, then we'll come back maybe, touch a little bit, then go somewhere else. No it's more direct, we're going to tell you how it is… cause it has to be quick and efficient.* [Rocky]

Rocky's initial preference to hear from members of the Corp of Cadets was the perception that they used speech patterns and language that he would be able to relate to. This dimension of collective identity highlighted the importance of not only what mentors said, but also how they said it.

In addition to the perception of a potential connection based on collective identity, the reverse scenario also emerged, namely, differences in collective identities that resulted in a deterrent to participant choices. This negative effect was particularly true for members of the Corp of Cadets, but also extended to other groups as well. In Illusiona's case, she explained, "*I don't think I can relate to cadet people at all. They're very, like, diligent and they come from a completely different world than me."* Other times, negative responses were stated in blanket statements over a single particular collective identity. In Arista's case, on-campus group membership acted as a deterrent to viewing, *"The reason why I didn't watch a lot of her videos was cause she's Galileo/Galipatia."*

While many participants were able to find at least one similar collective identity between themselves and a virtual mentor, some participants were able to find multiple links. In the case of Collier:

> *I look down and realize he's aerospace! Oh he did Galileo! Hmm, and he took a philosophy class [getting excited as he lists these], so I saw this and I'm at a 2.99 right now, so I'm looking at his and I'm like 'Daniel on Falling Below a 3.0 and Rebounding,' I'm like I gotta watch that, cause I gotta rebound.*

Through the establishment of multiple collective identity dimensions (i.e. major, GPA, Galileo, etc.), the connection between the student and their virtual mentors was strengthened.

The ability to connect with the virtual mentors through common collective identity dimensions had a very strong impact on viewing preferences. Students differed in their perceptions of which collective identities were relevant, as when Oliva said "*where they're from… I don't think that super-makes a difference,"* while Ashton noted *"just seeing the extracurricular activities and where they're from kind of drew me to them."* As stated above, shared collective identity established credibility of the

mentor, and as a result, the weight of their message. Participants who were unable to find the connections that they sought, like Balcones, called for "*more different students like, for example, there are no ESM [Engineering, Science, and Mechanics] students,*" so that they could connect in the same way.

4.2.4 Choice - Utility

Another important value-based code that explained choice behaviors was the perception of utility, or usefulness, of a video's content. As Eccles defines it, the subjective-task value of utility is "the value a task has because it fulfills a less personally central goal" (Eccles, 2009; p. 83). Choice utility was based on participants' perception of video content being *potentially* useful but not necessarily related to who the participants were as individuals. References to this perception of usefulness related to the applicability of content to either validate a past experience or assist with a present or potential future concern.

Utility of video content was described as generally as "*videos that can apply to me and like even now or in the future"* [Calera] or more specifically depending on the content. Perceptions of potential usefulness often began with the validation of a past action such as changing majors, as Collier explains: *"The things that helped me the most, like changing, I wanted to see why she changed majors to validate if mine fit that type of situation."* Usefulness also extended into more sensitive topics such as failing a course, as in McKeel's situation: "*The reason I chose this [video] initially was because I had taken this class and then dropped it. So I was interested to see what his experience was, to see if he had the same kind of experiences I did."* [McKeel] While the statement explicitly states interest, the underlying concern was over the utility of this information in validating a past experience.

In addition to validation of past experiences and behaviors, utility also encompassed the search for useful information related to current situations such as difficult coursework or balancing of academic and social life. Calera, for example "…*watched almost every single multi-variable calculus video that there was… because I'm not doing very well in that class and wanted to see what everybody else had to say about it."* [Calera] For other participants the focus was on a different class, such as Collier who

"*ended up watching 3 or 4 Statics videos…stuff that I knew I was having trouble with.*" [Collier] Regardless of the course, choices based on "*how people received past classes I've taken and future classes [that will be taken]*" [Collier] came up repeatedly.

Utility also touched on foundational engineering courses, especially in cases like Rocky who watched videos on statics because, as he explains, "*I'm the driver of the struggle bus in that class.*" Calera shared this sentiment when she said "*I thought that I could maybe use that information next semester when I have to take Dynamics.*" [Calera] Collier gave the most thorough explanation regarding what he wanted to know about his future coursework:

> *What I'm taking in the future. So like with mechanical engineering, C++, materials, I going to be jumping in, like dipping my hand in all those things so I'm like okay let's see what they're doing, what struggles they have, what they don't have, so like some advice.* [Collier]

In addition to coursework concerns, participants also focused on utility relative to social concerns that they faced, especially the balancing of academic and social responsibilities. With the one exception of Balcones, whose preference was for exclusively "*want[ing] to get more academic things out of this as opposed to social,*" a majority of participants were more concerned about social issues and how to better achieve a sense of balance in their lives. As Ashton explains:

> *I navigated more towards the social aspect because the classes, if you study for them, they're not hard. Like the material is pretty simple: it's not hard to make it through them. It's just like making you sit down and study and do all that stuff. The social aspect, how to balance your social life versus your academic life is what I gravitated to more than I did the classes. Cause like I KNOW what the classes are, I've been in them.*

Similarly, Oliva explicitly claimed that the social factors were more important than the academic ones:

I did watch a few of the class-type videos, but I watched a lot of the ones that were like, 'Getting my First D+' or, 'Balancing Social Life' and those kind of things 'cause I think that they're a little more important.

As is evident through these examples, different students had different goals in mind when selecting which videos to watch.

Besides positive perceptions of utility, negative perceptions of utility resulted in participants explicitly avoiding videos that they could not see has being potentially useful. Videos were perceived to be less useful for several reasons including difference in major ("*I'm not aerospace, so I didn't see them as being useful."* [McKeel]), professors that would not be encountered ("*they're talking about a specific professor that they had who I don't have or won't have…I can't apply that to myself unless I have that professor"* [Calera]), courses that would not be taken (*"classes I will not ever take"* [Illusiona]), and courses that did not provide any issues (*"classes I'm doing okay in that I didn't think I needed advice on"* [Arista]). References to not needing advice were usually based on current success in a course or meeting personal expectations regardless of objective success. Negative utility was almost exclusively related to academic concerns, which was unique in comparison to other choice-related codes.

4.2.5 Choice - Interest

In addition to utility value, interest-value was also important in the explanation of choice behaviors. Eccles defines interest as the "intrinsic interest in, and enjoyment of engaging in a task" (Eccles, 2009; p. 82). Like utility, interest-based choices were based on the perception of content being interesting either due to a unique perspective or stemming shared interest as identified through information contained on the complete video index sheet. Participants focused on mentors' perspectives, such as Balcones' comment that "*I guess maybe the only other thing that might have been interesting to watch would be like the cadets, maybe an interesting perspective,"* [Balcones] or in the case of Illusiona:

> *I just kind of would look at their little bio there and, like, see who I found interesting. That's why I went to John's because I saw he failed out and I kind of wanted to hear that story. And the same with Lexi's; I wanted to hear her story because of her international-ness.*

Lexi was particularly popular in this sense because she provided several videos about her experience as an international student. Ashton noted that "*Lexi was kind of cool cause like there's a lot of questions I want to ask the foreign exchange students.*" Such comments describe curiosity about the video content based on the perceived uniqueness of the mentor and their listed experiences. While some participants found Lexi's international perspective interesting, others, such as Illusiona, were drawn to mentors with different on-campus commitments, "*But I still kind of want[ed] to hear from him, because I think it's really cool he's on the football team and does engineering because he's probably one of the very few people who do that.*"

Interest was linked not only to specific mentor perspectives, but also to video content. Several participants referenced 'Andrew's Dream Job' video, such as Starr: "*I just watched some on like this guy's dream job. I thought that would be kind of cool.*" Interest was often inadvertently prompted by enticing video titles; Illusiona, for example, was interested in "*The one guy who didn't go to office hours…I wanted to know why.*" Starr also noted,

> *I watched the not wanting to go to college one cause I thought that was really interesting cause I think it says on there '4.0 student' and it's like you didn't want to go to college but you have a 4.0, like that's amazing.* [Starr]

These instances of interest showed up often and suggest that video titles, especially provocative ones, can entice many different types of viewers.

Besides the perception of a unique perspective, interest also emerged through potential connections via shared interests as identified on the complete video index sheet. Most simply put,

Balcones touched on the idea of a shared interest as a point of connection with the virtual mentors when he explained, "*I guess that there is just a connection I guess, I mean if you're interested in the same things as someone."* Shared interests were both academic and non-academic in nature. Everything from "*he was a home-brew"* [Ashton], caught participants' attention. Interest could be based on currency, such as "*I just circled robotics cause that's my thing"* [Arista], or to future interests, such as "*He's into robotics, which I always wanted to do as well, I'm interested in that a lot."* [Rocky] The result of these many facets of interest based on a unique perspective or shared interest helped explain the subsequent viewing behaviors of the participants. Notably, though, interest was most salient at the beginning of the viewing process as a starting point for exploration. As participants progressed through the videos, interest faded in salience, ultimately becoming overshadowed by stronger beliefs related to shared identity with the mentors and the resultant utility of the content in these videos.

4.2.6 Choice Summary

Participants based their initial video choices on information presented in their complete video index packet including mentor photo and descriptors, video titles, and video lengths. Using this information, participants selected videos based on the perception of an identity-based connection with the mentors, or the task-value of the content.

4.3 Reaction Codes

After viewing any particular video or series of videos, participants expressed a range of reactions to the virtual mentors and the contents of their videos. Reactions to video content were reflected in these two major categories, with several layers of complexity. The first category was reactions to the virtual mentors that ranged from affective reactions to realizations of identity-based connections. The second category was the interpretation of content from either agreement or disagreement with opinions expressed in the videos, to finding the content interesting or useful. Reactions were the most important feature of the experience as they impacted reactive viewing choices, established collective identity beliefs, and ultimately, shaped future intentions based on these beliefs.

To understand these behaviors, it is important to first identify the expectations of the participant for a given mentor or the content of a given video. In the case of Padrona, she consciously chose to watch a video with Galileo in the title, but was disappointed when she realized "*He didn't talk about Galileo [in the] video, but that's what grabbed my attention.*" Similarly, Mapp came up several times as he was the only mentor that was part of the university football team. Starr recognized "*there was a football player in there but I don't think he talked about football."* These disconnects between expectations and reality had one of two results: Either participants were put off and moved on to other mentors, as Abbey explains: *"If I didn't like one of those then I went back here [video index] and was like looking at the different ones [mentors]."* Or participants had a positive experience that lead to subsequent viewing:

> *I watched her final word of advice because I thought her videos were the most interesting… I didn't really want to watch people's final word of advice unless I watched other videos from them and knew where they were coming from. Since I liked her videos, that's why I watched both of them.* [Starr]

The impact of reactive choices towards or away from mentors or content was a complicated phenomenon with several caveats; the details of this discussion will be covered throughout the remainder of this section.

4.3.1 Reaction to Mentor

Many participants in the study had affective reactions to the mentors themselves, based either on the mentor's emotions displayed in the videos or on the mentor's personal identity. In both cases, participants talked about reacting directly to the mentor either through an emotional connection or deeper identity-based connection.

4.3.1.1 Affective Reaction

Mentors' emotional investment had one of two results: either the emotion of the mentor was transferred to the participant, or, the emotion was evaluated objectively as a point of connection or disconnect that impacted future viewing.

The mentors' emotions played a significant role in participant responses. As Collier explains "*For me, the biggest thing is seeing their emotional reactions and the way they navigate towards answering a question."* He went on at length to describe the details of the mentors that he responded to the most:

> *I think the biggest proponent of this that benefited me and has the potential to benefit other people is the emotional investment and the visual response and being able to see that. Being able to see their hand movements, see their facial expressions, see their pauses when they think about something, that's even more intrinsic and relatable to them rather than just an answer…so like seeing the way they react to the question and the response and the way their face changes basically as they go through what happened…it's pretty good.* [Collier]

Collier was not the only one to take notice of non-verbal cues. Rocky also appreciated the emotional investment of the mentors. Specifically, he responded to

> *The way they delivered the message. You can tell, some people, like Nadia, she was emotionally attached to what she was saying. She wasn't just blasting out words for no apparent reason, she was thinking very sincerely before she talked and when she did, it had emotional undertones to it and you could tell she actually cared.* [Rocky]

While emotional undertones were valued by Collier and Rocky, other participants, such as Illusiona, went a step further and assumed the mentor's emotional investment, as she explains: "*Nadia just seemed a bit negative, [Laughs]. Like, a bit stressed out. Like it was getting me stressed out for ISE. I was, like, 'Oh my goodness!'.*" [Illusiona] While this type of emotional transference was rare, several

participants did connect with mentors through similar emotional makeups and responses to various experiences. Ashton was a prime example when he explained, "*I wanted to watch more of her videos because she's like okay I have this super anxiety. I had these panic attacks. I was like 'yeah me too,'"* or more generally *"I connect with how you feel, cause I feel the exact same way*" [Ashton]. Emotional connection was thus a major factor in his experiences with the videos.

Beyond emotional connections were other emotional reactions that were expressed more simply, including excitement ("*I was excited that he thought the same thing as I did"* [Arista]), humor (*"Oh yeah and then she went to the Chinese restaurant to find out where she lived, that's what she said. God that was funny"* [Collier]), and annoyance, (*"when that guy said engineering economy was the easiest class, I got really pissed off. I was like, 'no it's not!' So I gotta kind of— I don't even know what emotion that would be [Laughs]. Annoyance.*" [Illusiona]). Such reactions occurred either through participant statements explicitly or implicitly.

As suggested by several of the examples above, these emotional reactions resulted in different outcomes for different participants. In Oliva's case, empathizing with mentors' experiences provided a sense of relief:

> *They made me smile to myself, 'cause I'm just like, 'yeah! I totally went through that. I just kind of felt a relief almost that I'm not the only person that thinks that way or did that badly or went through that issue or whatever.* [Oliva]

For others, like Abbey, the emotional undertones of some videos acted as a deterrent to future viewing:

> *I mean like the 8 minute video I thought it was going to be good and juicy and like she struggles walking from there to there isn't useful to me, I mean yeah I guess I feel sorry for you, and [name of town's] wind and snowing or whatever but I don't know when you start to get all emotional and everything it's like neeeh exit* [Abbey]

Lastly, in some cases, like Starr, emotional connection escaped her focus, *"I kind of wish I would've paid more attention to like their actual charisma and presence cause like that's probably a reason why I liked his videos.*" But, as she acknowledges, it may have subconsciously impacted her preferences. What this comment illustrates is that emotional *perception* is important as certain participants were cognizant of the effects, while others were not.

4.3.1.2 Current Identity

While some participants described affective reactions to the mentors' emotions, others reacted specifically to the mentors' personal identities. In these cases, the affective reactions of the participants tended to reflect a sense of connection – as simple as "liking" a mentor or, in more articulated cases, as a clear description of what the mentor and participant shared (e.g. "I'm the same way", "they were more like me," or "that's who I am.").

Current identity encompasses the personal and collective identity dimensions of the self that are salient at the present time. Current identity was the reaction that came up most often among both affective reactions to mentors, and interpretation of video content. As an affective reaction, connections between individuals arose as the participants saw aspects of themselves in the various virtual mentors. Importantly, while both personal and collective identities were salient for choice behaviors, current personal identity was the dominant factor in affective reactions. The experience of discovering commonalities between the virtual mentors and themselves reflected several facets of current identities.

First, past failures provided a critical link towards connecting the identity beliefs of the participants and the mentors. For example, Abbey found that Channing had recently experienced exactly what she was currently going through, *"I liked him. We went through the same struggles and then when he dropped statics [and] focused more on his other classes and did better in his other classes…I feel like that's me right now;"* Arista shared a similar sentiment, "*Like I related to him and I thought he was a cool guy who like struggled but made it through; that's what I like cause that's who I am.*" In both cases, participants used language that linked failure to identity. Phrases such as "that's me" and "that's who I

am” make reference to a shared identity. For others, such as Collier, the link went beyond the experience of a shared past to include shared responses to that past.

> *He seemed like he accepted the fact that he did how he did and some people have trouble doing that. When something happens in my life, I accept it and the first thing I do is take step-by-step of writing whatever happened and improving and ended up in a better place. And it seemed like basically all he was saying was this happened, I'm moving forward, I'm moving on with my life, there's no point in dwelling in the past cause you get stuck back there and miss what’s happening in the present. He seemed really cool. I think I would have related to him a lot actually.* [Collier]

In addition to shared experiences, current collective identities markers such age, race, and gender were key dimensions of identity that elicited an affective reaction for participants like Calera, “*I liked hearing from second years more because that's where I am right now…it’s what I am”* References to “who I am” was also linked to national origin: “*Being a foreigner, I guess he [Adhemar] didn't really talk about, at least the videos that I watched didn't really talk about that aspect of being foreign, but I would think he would've had that sort of experience”* [Balcones]. Sex was also salient, especially for women, “*It was good to hear from other girls that they also didn't know what they were doing and they seemed like relatively smart people and they've made it farther than me in school”* [Calera]. In fact, Oliva especially took notice and even recognized tangible differences between the male and female mentors in their videos:

> *Yeah, um, the girls more than the guys because I think the girls were more like, into talking about experiences instead of just like, 'this is what we did' and done. But I did watch a couple of the videos that were like, being a woman in the engineering field and a lot of them said, like, 'oh I have a bunch of guy friends because guys aren't really fussy about things.' Like, that's totally me! Everyone I know is a guy. Um, so yeah, it's kind of one of those things that you think you're so weird, but then you listen to other people talk*

about and you're like, 'oh, I didn't realize that other people had that problem,' or other people feel that way. So yeah, I related a lot to the girls. [Oliva]

In Olivas's case, the issue was not solely being a female in engineering, but rather, also about her sense of personal identity as a female with lots of guy friends.

In addition to demographics, voice and personality traits that were common between the participants and their mentors were important as they too elicited affective identity connections. For example, Collier, related to "*Mapp kind of because we are both straight-forward and blunt, I'll tell you how it is and that's what he does."* Similarly, connections based on demeanor were important for Abbey. As someone from a rural background and slower pace of life, she enjoyed Channing and Daniel's videos:

I don't know…they were just like laid back and straight forward…I don't know they seem like the type of guys I would just be friends with. You know what I mean? Like just average guys… So I felt like they were more like me, just like the average kids, like you know, trying to make it. [Abbey]

Other references to personality traits included similarity in emotional response, such as Ashton, when he explains, "*I have been feeling all these emotions and things and like people have just been portraying them and I'm like wow that's me, I'm going to write that down. Every video was like "wow that's me."* Effort and mindset also played a role, as illustrated by comments from Arista: *"Cause he got a C+ in C++. And he like you know doesn't do amazing but he does good, he tries and he does whatever he can do and like that's what I do"* and mindset,

The stuff that he said, like having the right mindset was one of his things, definitely is something that I know that I have for engineering and the way that he went about his stuff after he brought his GPA back up is kind of how I go about everything and that was pretty cool. I thought his stuff was really cool cause it's kind of the same thing that I see

my friends dealing with and I see myself dealing with so definitely Daniel I could relate to the most. [Arista]

Affective reactions based on personal identity also extended to social habits beyond strictly academic topics. For Abbey, the concept of academic and social balance was of crucial importance to establishing a current personal identity connection.

So I think she said here that she devoted like Sundays through Thursdays to like homework and like that's totally me…then she said she kind of maxes out like if she's doing homework for over 4 hours that she's just kind of like dead you know and I'm the same way. [Abbey]

Similar work-life balance perspectives were also important, particularly in seeing someone that was still in engineering and doing well.

In several cases, participants found multiple points of connection with the mentors that had a summative effect, such as Oliva's outlook on one of the mentors,

Um, I mean, just the visual appearance of her kind of made me think of myself because I'm a very, like, T-shirt and messy hair kind of person. Just like, the way she talked and everything, um, just reminds me of me. And um, I don't know, she seemed like a chill person and I'm kind of a chill person [Laughs]. [Oliva]

Similarly, Melville explains that he and one of the mentors are, "*…almost the same person right now."* [Melville].

Overall, personal-identity-based affective reactions strongly impacted participants as the realization that mentors were like themselves both established a personal connection that resulted in the credibility of that mentor, and thus, the content of their videos. Personal-identity-based connections

formed the formation for emerging collective identity beliefs and were the main catalyst for future intentions based on mentors' advice.

Besides establishing collective identity and influencing future intention, connections to mentors affected reactive video choices. This realization of connection was additive in that multiple points of connection increased the likelihood of reactive video choices. In Rocky's case, he formed identity-based connections across multiple mentors; he specifically referenced,

> *Joe and Emily, then Nadia, a lot. So like those three cause I could just like "hey, that's what I'm going through." I discussed about the money problem, all that good stuff, with Nadia. Emily and Joe, cause they're in the Corps I'm like hey I can actually relate.* [Rocky]

Being a Corps of Cadets member himself, Rocky found it easier to relate to Joe and Emily as they too were in the Corps and he continued to watch their videos as a result. Additionally, as one of the few Corps members not on scholarship, he found Nadia's discussion of financial issues related to degree progress comforting as it was a topic he did not feel comfortable discussing amongst his peers. Specifically, Rocky viewed "Nadia on Non-Academic Influences on Course Selection", "Nadia on Taking One Less Class", and "Nadia on the Semester from Hell", all of which discussed these topics at length.

The importance in seeing oneself in a particular mentor or set of mentors established credibility of the videos. However, once a participant perceived a disconnect between themselves and a particular mentor, they reacted by questioning the credibility of the video content and often the choice to discontinue viewing that mentor. These disconnections took many forms. Arista was the most vocal of all participants in this regard. She was sensitive to talk activeness ("*I didn't see myself in Channing cause I have a lot to say and he didn't have a lot to say…he was quieter")*, perception of intelligence, (*I couldn't relate to her as much cause I feel like she was too smart for me [Laughs])*, and social stereotypes, (*I almost did Hypatia but I'm glad that I didn't because a lot of them are socially awkward…But I'm just*

saying I don't relate to them). Participants like Calera did not see herself as an individual who performed well in courses that they did not: "*The one video where somebody actually enjoyed multi-variable calculus and didn't think it was that hard, I was, that was not me at all."* Illusiona shared Calera's reaction when she said "*Someone was talking about how she got like, a 100 on the deforms final and I'm just like, 'Good for you. That is not me,' 'Ah, I have a perfect life and I got a 4.0 and I liked aced every class' you know, cause that is not how my college life is going."* In total, all participants found some aspects of themselves in one or more of the virtual mentors except Starr who purposely tried to avoid mentors like her,

> *I didn't really want to watch videos of people that were like me so much, but there was definitely little tidbits here and there of students like had similarities to me but I don't think there was one student that stood out to me that was like "Oh! They are just like me".* [Starr]

Overall, affective reactions to mentors can be summarized as the emotional connections that participants felt with their virtual mentors. Through an evaluation of the emotional investment of the mentors and the content of their videos, participants felt a sense of connection that established the credibility of the mentors, and thus, the relevance of their advice. Through affective reactions to mentors, participants ultimately found an emerging collective identity with their mentors and articulated future intentions based on their recommendations. A more complete discussion of these outcomes is presented in Sections 4.1 and 4.2.

4.3.2 Interpretation of Content

Besides reacting to the mentors as people, participants also interpreted the content of their videos. In the evaluation of content, participants either agreed or disagreed with statements, or evaluated the content as either useful or interesting.

4.3.2.1 Agree

Agreement was important, for example, in Calera's case:

> *I mean it makes you like the person more and the video more and sort of listen more to what they're saying cause if you don't agree then you kind of just shut yourself down and close yourself off from the video because it's like okay this doesn't really apply to me but if you can relate, then that makes it better.* [Calera]

The nature of agreement ranged from abstract, such as Calera's statement above, to very specific. Abbey, for example, explained,

> *I agree with him on getting to know faculty members like he was talking about letters of recommendation and stuff that you're going to need and the value of office hours he said how intimidating it is at first because you think that like you're going to go in there and ask a dumb question, you know, that's everybody's fear, like the teacher is just going to look at you and be like 'what were you thinking?'* [Abbey]

Similarly, Starr reflected*, "She talked about how math is usually easier for her to work by herself whereas other classes are easier to work in group which I COMPELTELY agree with."* [Starr]

Agreement often had a comforting effect, as it did for Ashton based on some of his grade concerns:

> *Yeah and there was one, coping with grade realities, like she was in the honors program and she was like "you may not get the 4.0, you may not get 3.0 that you need or whatever, but it's okay, like you'll be okay" and I was like "Are you sure?" ...alright, I believe you* [Ashton]

Abbey also took comfort in her impending summer school attendance from the idea that the course could potentially be easier and more enjoyable in comparison to taking it during the regular semester.

> *Yeah I remember watching that one when he, yeah I totally agreed with that. Like I think over the summer when I'm taking it just by itself it's gonna be a lot easier, I'm sure I'll*

have a job but still like easier than with multi and physics and you know everything else. [Abbey]

4.3.2.2 Disagree

Participants also expressed disagreements concerning content discussed regarding college difficulty (*"...Adhemar was like you know thinking that he was better, cause he was like oh VT isn't hard, I was like are you kidding me, this is the hardest thing ever"* [Arista]), course difficulty ("*And then he was saying like, it was easy for him, thermal fluids was really easy for him, I find that kind of hard to believe"* [Balcones]), and overall advice ("*I can kind of relate to Caroline's stuff in [that] I just disagree with it completely"* [Melville]). Disagreement was a very important reaction as it was one of the primary experiences with the videos that directed participants away from particular mentors. Calera expressed this reaction when she said,

> *If they had the same opinion on a class or study groups or I mean whatever the video was about, if they had the same opinion as I did then I listened more but as soon as they started saying things that I didn't agree with I was kind of like okay, maybe not.* [Calera]

In Arista's case, disagreement over sentiments expressed in a particular video permanently severed any future viewing: *"After he said that I was like I'm not going to watch you"* [Arista]. This reaction was powerful, as Illusiona further made clear:

> *...he talked about Engineering Economy. He said it was, like, the easiest class ever...either that class has changed or it's different for our majors because that class is impossible. I was just sitting there and he's, like, 'it's the easiest class, I got like, an A and I don't even have to take the final,' and I'm like, 'I got a 60 on the last test, so it's not what I want to hear.'* [Illusiona]

Because some participants assumed the intervention tool to be focused on providing advice, they also seemed to assume that most of the content would be positive and reinforcing. Once participants had a

negative experience with a given mentor over the content of their video, participants would often move on until they found what they were looking for.

4.3.2.3 Interest Value

Interest was another important code as participants who found particular content interesting either in a general sense, or for a particularly unique perspective on a given issue. McKeel expressed interest in a very general sense when he said,

> *One of the first videos I watched was about going to professors during office hours and that they're …more interesting outside the classroom than they are in, which I've heard before but I've never really taken to heart. She was talking about how they would just talk about anything, and that was kind of interesting to me.* [McKeel]

In addition to topics such as finding professors in office hours interesting, Starr responded to Nadia's candid responses regarding failure and recognized the importance of first-hand experience.

> *You're going to fail a test, you're probably going to fail at least one test so I thought that was interesting cause she obviously went through a lot of anxiety and a lot of stress so she's like a really good person to take as an example.* [Starr]

Starr also found first-hand accounts useful in the promotion of previously unknown on-campus services:

> *She had a couple of videos on the counseling center, which I don't know anything about, and I don't think most people do, and I thought it was really interesting to learn about that and I think people should like know about that.* [Starr]

Also mirroring the choice codes, participants found individuals' perspectives interesting. In the case of Illusiona, hearing from Lexi's perspective as an international student was interesting from a social comparison standpoint.

I was super interested because I have never…been partners with people who have been complete international students…I never have gotten [to hear] their story. I was just interested in why she came here, and how like, big of a transition that is cause transitioning from Northern Virginia to Blacksburg was tough for me. So I just thought… her whole story was super interesting. [Illusiona]

Besides unique perspectives, other participants, like Balcones, found it interesting to hear from multiple mentors on similar topics, "*It's interesting to see how people, how different people approach the same class"* [Balcones].

4.3.2.4 Utility Value

4.3.2.4.1 Utility of Content

As with choice, reactions to the utility of video content referred to the finding of information useful in either validating a past experience, its current relevance, or in regards to a potential future. The distinction between utility in choice and utility in reaction is that choice refers to the *perception* that a video *could be* useful while the reaction utility refers to *actually finding* the information useful. Utility of content was one of the most important themes that arose out of the interviews. Utility emerged in several ways, as Collier explained: "*Some of them were actually really helpful, others solidified what I was thinking and other things reversed what I had a conception about.*" In this regard, utility was the process of confirming or redefining one's view about a particular topic or experience.

Participant perceptions of utility were connected to things such as changing majors (*"I thought it was actually pretty cool when she's talking about her architecture engineering, that's kind of what I was thinking about doing too."* [Melville]), coursework and future experiences, (*"Some things were really useful, like, hearing about classes I'm in, hearing about things I'm going to face"* [Illusiona]), and the promotion of previously unknown opportunities, ("*I didn't know about the credit by exam thing so that was kind of cool*" [Arista]). Utility was often time-dependent, with the greatest priority given to

immediacy. For Balcones, the tool served as a useful supplement as he explained, *"I watched them last night and this morning actually. Just because, I did course request last night, actually that was kind of helpful."* Immediacy was also mentioned by McKeel, *"It's interesting to hear her take on writing a formula sheet, and it was actually helpful for one of my tests."*

In addition to the utility of specific content, participants also identified utility through the relatability of the message to their views about themselves. For Melville, the "normalcy" of Caroline's experiences made her videos useful to learn from:

> *...she had a lot of experiences that she talked about which were pretty cool so like learning from her mistakes…Like she didn't make huge mistakes, but like what normal people would do, what normal people would have to go through.* [Melville]

For others, like Padrona, an overlap occurred as shared identity formed the basis for her subsequent judgment of the utility of video content. Padrona linked usefulness with the proximity in age of the virtual mentors and herself, and the immediacy of their experiences as they related to her current coursework, *"I thought a lot of these kids were second year or third year so I am going through a lot of the classes, so I thought that was pretty helpful…because I am dealing with that now"* [Padrona]. While Padrona used connections to a common collective identity such as age and major as a source of credibility, and ultimately the usefulness of content, Balcones did not. Balcones often questioned credibility, "*you don't want to take advice on balancing academic and social life from somebody who has a 2.0 cause obviously they are not doing a very good job of balancing those two*" [Balcones], and seemed more judgmental when asked what was applicable to himself "*I just didn't find his advice that useful to me*" [Balcones]. Overall, positive reactions concerning utility were linked with the ability to validate a past experience or the ability to relate to current or future situations from trustworthy mentors.

In contrast, several participants found certain content particularly not useful. As Balcones "*wanted to get more academic things out of this as opposed to social,*" he saw limited utility in several of

the videos that discussed social topics. For Starr, she found overly general advice not useful, "*Differential Equations. I think she just kind of talked about it and didn't really give any advice or she was just kind of talking, and I didn't really find it very helpful;*" she also saw limited utility in advice that had been said and heard several times before, "*I watched a lot of the ones about faculty cause like I just thought that is useful stuff to know but it was the same advice that everyone kind of gives*" [Starr].

The alternative to being overly general in nature was being overly specific which also limited utility for some participants. As Calera explains,

> *Some of the things that didn't apply to me were because like they're talking about a specific professor that they had who I don't have or won't have and so like they thought that the class was hard or easy or they did this because of that specific professor and I can't apply that to myself unless I have that professor.* [Calera]

Similarly, major-specific information was often not useful for participants who were not in that major, as Illusiona explains,

> *A lot of the videos I watched were very aerospace-related, which like, was interesting but not useful at all for me. Like, it was cool, but like, it just does not apply to me at all. So that's probably my fault for watching them.* [Illusiona]

As Illusiona admitted herself, the onus was on her in this case as she was aware of the major of the mentor and had a general idea of the video content based on the title before viewing. Balcones did something similar when he chose to watch material that was no longer relevant: "*most of these I guess didn't apply to me too much anymore. But they would be useful for other people, cause they haven't taken [the classes] yet*" [Balcones].

Overall, in fact, participants were unanimous in linking the level of detail in the video to its usefulness and applicability. As Abbey explains, "*What classes gave you the most difficulties and how did you do that, like what did you do? I need to know what you did [Laughs]. So I can learn from it."*

[Abbey] Detail was crucial to participants' ability to learn from others' mistakes which required understanding exactly what the mentor struggled with and what steps were taken to address those struggles. As Melville explains,

> *Whenever they gave examples of something that happened to them, that was awesome instead of just generalizing it, so like statics is hard, well tell me why statics is hard you know? And managing time is hard, well tell me what you've struggled with that, what tests have you not been prepared for, how many tests have you not been prepared for?* [Melville]

This level of detail was clarified by Starr when she explicitly stated:

> *It's kind of useful to me to know whether it's hard or not, but it's more useful to know why it's difficult and how to fix it. Um, so if the videos were geared a little bit more towards that then that would be more helpful.* [Starr]

As can be seen from the statements here, the level of detail was a very important feature that participants used when judging the utility of videos, although, as Calera noted, too narrow a focus (e.g. on a specific professor) could limit this assertion.

4.3.2.4.1 Utility and Video Length

While participants generally agreed on the utility value of concrete detail, the relationship between utility and video length was expressed even more clearly. While some students found shorter videos more useful, like Collier, ("*Sometimes the shorter ones gave the best answers cause the longer ones got off topic")* or Calera, ("*Some of the 30 second ones I was like okay that was short but it still packed a punch and got its point across in the short amount of time"*) other students felt the opposite. Padrona, for example, saw shorter videos as a waste of her time: "*I thought some videos were kind of short, like the 14 second one was kind of could've done without in my life."* Oliva also supported this stance but also specified her preference for length:

> *I found the ones that were, like, 15 seconds or less, 20 seconds or less, kind of less useful than the ones that were around a minute to a minute and a half… the videos that are less than 20 seconds are kind of useless.*

Other participants shared this preference for longer videos as they provided greater detail. Melville explains

> *You can tell if it's a really short video, a lot of them said what happened but they didn't really give advice… The main thing is like whenever they said something that happened that was bad to them, they didn't explain how they got through it.*

Arista also supported this stance when she explained, "*longer ones usually were the ones with the better content so I tried to watch those,"* as did Abbey, who put it most simply: *"I feel like the longer ones just had more explanation."* For many participants, the complete story of a video seemed to have a greater impact than a single factoid. The general consensus was summarized by Melville:

> *[Videos should be]…at least a minute cause I feel like you can get a lot of information across in a minute but there were some of them that were like 20 seconds and I'm like you're going to tell me one thing about statics and that's it, I'm not going to get too much information on that… if you spent 28 seconds on something I'm probably not going to remember but if you hit a spot between 1 and 2 minutes there's some stuff that you can take from that you know.*

Overall, while the utility of academic and social content was evaluated differently based on the participant, what was consistent was the importance of who was speaking, how relatable their experience was, the length of time, and detail required to convey their message.

While in general the experiment had limitations because of the required viewing time, this requirement also sensitized participants to video length, which provided information that may have not emerged otherwise.

Overall, reactions to mentors and the interpretation of their video content illustrated participants' preferences for their desired characteristics in virtual mentors and their preferences in video content. In particular, participants favored mentors that they could emotionally connect with through a shared identity or experience, and preferred content that was either interesting or useful in the validation of a past experience, or that was immediately or potential useful to them.

4.4 Outcome Codes

Following choices and reactions, experience with the intervention videos yielded two main outcomes: 1) awareness of an emerging collective identity and 2) the identification of future intentions, or as Eccles called them, "task, activity, and behavioral choices" (Eccles, 2009; p. 80).

4.4.1 Emerging Collective Identity

The first major outcome was the realization of an emerging collective identity. Emerging collective identity is the realization that one's perceptions of uniqueness in being or experience are not in fact unique. Emerging collective identity was realized as participants discovered connections between themselves and the virtual mentors. As Oliva explained:

> *On a very surface level, it made me feel less stupid, but on a bigger level, it was kind of, like, these people go to my university and we share the same attributes and that's what's really cool about everyone that goes here. Like, we're all kind of the same person on some level. So, that was cool.* [Oliva]

This feeling of camaraderie also had larger implications with respect to students' feelings about their own negative experiences. Participant feelings such as "I am alone" or "I am the only one" were put to rest as they watched mentors explain that they went through similar experiences. As Melville put it:

> *That I'm not the only one dealing with this kind of stuff. I'm not alone! It's just nice to know that other people go through the same stuff, like I'm not this one kid that's just like behind and everyone else is succeeding, stuff like that. It's cool.* [Melville]

Multiple participants expressed a similar sense of relief through seeing that other students shared their academic and social struggles, as the following examples illustrate:

> *I'm going through the same exact thing and they're getting through it really well, so it's like inner connection basically. I'm like wow this is not uncommon I guess.* [Rocky]
>
> *It was interesting to see that I wasn't the only one that felt ways about certain classes and just about school and life. A lot of people were saying like it's difficult, and it stays difficult and I was like 'wow, okay, I'm not the only one'* [Ashton]
>
> *…people talked about struggling in certain classes that I'm having a hard time in. That was kind of good to hear, just to get, like, you're not the only one.* [Illusiona]

This idea of shared struggles as a source of emerging collective identity often served to validate a past experience or previous behavior, as Oliva explains:

> *The office hours videos were great because there was one kid that said that, like, he never went to office hours because he thought that the teachers would judge him for coming the day before the homework is due, and I was like, 'oh my gosh, that's totally me.' They just give you this look, that like, why didn't you do this over the weekend? Like, and then, I feel bad. I like office hours; they're important. So, that was kind of, like, validation that I'm not the only person that does that either.* [Oliva]

For Illusiona, collective identity helped validate experiences:

> *Being a female in engineering is kind of hard. It's different; people, like, treat you differently. Um, so it's good to hear that it's like, obviously you're not the only one, but, like other people go through it too and like, how Ellen was saying, like, you're tough to the guys. Like, sometimes I'll feel bad, like, sometimes I'm like, 'oh, I'm just being a giant bitch to these people.' But I'm glad to see, like, I'm not the only one. It's acceptable [Laughs]*. [Illusiona]

In addition to validating past experiences or behaviors, the emerging collective identities also eased anxieties over potentially unavoidable realities. For Calera, such a choice involved taking a 5th year in order to graduate due to the difficulty of certain courses:

> *I've heard that it's okay to take 5 years to graduate but hearing more people talk about how that's probably going to be end up happening to them, that makes me feel more okay with I might be here more than four years. And not doing well in classes, the more I hear it, the more I don't have to stress about it because it seems like if a lot of people are in the same boat, then you don't have to worry as much because you're not the only one.* [Calera]

As these examples suggest, awareness of an emerging collective identity occurred as participants found mentors who described experiences and perspectives similar to their own, which in turn eased anxiety. As Abbey explained, realization that her issues were not unique "*reassured and secured that everybody was pretty much going through the same thing… it made me feel better about myself really."* Similarly, Oliva explicitly stated a sense of relief in reaction to the news that she was not unique in her struggles.

> *They made me smile to myself, cause I'm just like, 'yeah! I totally went through that.' I just kind of felt a relief almost that I'm not the only person that thinks that way or did that badly or went through that issue or whatever*. [Oliva]

The power of finding an emerging collective identity related to struggling in engineering was a particularly important finding for its connection to sense of belonging beliefs. The implications of this connection will be discussed in Chapter 5.

4.4.2 Future Intentions

The second major outcome was participant's intentions to act on the advice of certain virtual mentors. While Eccles expectancy-value theory identifies a model that leads to task, activity, and behavioral choices (i.e. Eccles 2007; Eccles 2009), for this study the term "future intentions" was used. Future intentions were defined as the intention to act out a potential behavior as a result of viewing a particular video or set of videos. Future intentions represented a positive outcome of the intervention experience that was directly connected to the credibility of the mentor as established through the emergence of a collective identity connection (see Section 4.4.1). With 305 videos of advice on a wide array of topics, the list of future intentions based on what mentors had done was extensive, and ranged from talking with professors, to attending (or not attending) lectures, to finding more effective places to study. The examples below highlight a small sample of intended actions:

> *…using the resources that we have that I don't is something that I need to do.* [Padrona]

> *If you don't go to office hours and you start watching these videos and you realize that everybody says that office hours are helpful then you can think 'oh, well maybe I should start going and it's not too late to turn it around.'* [Calera]

> *I might go to one of [Professor]'s lectures just to see how it is even if I don't keep going.* [Balcones]

> *How [Professor's] office hours are just like huge and lots of people in the same room just working and I'm kind of wanting to go try that now.*

When he said 'sometimes you just don't need to go to the lecture'…I thought that was interesting cause…I know walking to the classroom that I am not going to learn anything today and I feel sometimes just like 'Why didn't I just go to the library this morning instead and like do actual work, like just do the homework?'… So I thought that was interesting and kind of good advice cause like you really should figure out how to use your time like if you're not going to learn anything for an hour and a half like don't waste your time sitting in a classroom on Facebook. [Starr]

Trying to start homework earlier and be on top of things, trying to spend more, try to force myself to spend more time studying and getting used to that kind of habit instead of being used to being lazy I guess. [Arista]

…never thought about going to a classroom to find a study place. Finding a good place to study, I will definitely try some of those places, going to classroom and studying in there… maybe I will find a place like he had with the white boards where you can just work and I'll find something like that so I can do the same, so I'll probably use some of those things. [McKeel]

I liked what she said about the formula sheet, 'cause she said how most people just write down everything and that's definitely what I do and it's definitely not helpful. 'Cause I'll just write down everything for statics and then I won't even use it during my test because it's just not helpful. So just like, interesting to hear that I could approach it differently and it would probably be more useful than what I've been doing. [Illusiona]

Importantly, in comparison to advice previously received from other sources, several participants cited an increased likelihood to follow the advice from the virtual mentors with whom they had identity-based connections with, as discussed in Section 4.3.1.3. As Calera clarified,

Hearing from people I know personally was typically like adults or teachers in high school who were giving you advice before you go to college saying like 'when you go, make sure you go to office hours' and I didn't really listen to them because…they weren't in college as recently. Hearing [advice] from students who are in college now saying office hours help, that makes me listen a little bit more, even if I don't know them because they're here now…it doesn't matter that I don't know them. If it worked for them and they are advising me to do it and they seem sincere in saying it, and they're taking the classes that I'm taking then I should probably take their advice. [Calera]

4.5 Affordances

4.5.1 Affordances

In addition to explaining the choice strategies, reactions, and outcomes, the data also revealed a range of affordances offered by this type of virtual mentoring tool, particularly in comparison to in-person and online alternatives. The list of affordances includes 1) awareness, 2) unique perspectives, 3) multiple perspectives, 4) extended scope, 5) distributed identification, and 6) confidentiality.

First, the intervention tool provided a means of spreading awareness of on-campus opportunities. In Illusiona's case, the realization of an opportunity to join a research-based design team was exciting, "*…the microgravity team, I didn't even know we had that!*" Second, through the provision of 18 virtual mentors, participants cited unique perspectives as an affordance of the tool that they appreciated. As stated in previous sections, unique personal stories such as "*John's because I saw he failed out"* [Illusiona] and Lexi's "*I wanted to hear her story because of her international-ness,"* [Illusiona] provided opportunities to hear from fellow students that participants did not interact with on a daily basis.

Third, participants valued the availability of multiple perspectives on the same topic. As McKeel explained,

> *I'd given advice to people based off of how I viewed the class, while hearing this, they had a different view of that, the advice I'd given, and so I guess that weighs in now with the future advice I give. Because now I've got two viewpoints as well because of what I've heard and what I've experienced, so I can give even better advice to people I know that are going to take the statics next year, so okay, sit in this part of the classroom of this teacher.*[McKeel]

This ability to have access to multiple perspectives on a relatively small set of topics enabled the strengthening of messages identified in the videos through repetition. As Collier explained, "*If they watch 14 videos on study habits and they only respond to 2 of them, [then] that's a plus. They just learned two new study habits. It may have taken them 3 months to figure out, maybe even more."* For some people this was essential, as in Padrona's case:

> *I need to hear it multiple times cause I think I've heard it from, I mean it's definitely different to hear it from a TA or a teacher who says 'come to my office hours' then a student saying 'oh that was really helpful' so I think that's a difference but I have heard it from students that have said go to office hours so just their repetition of hearing it and maybe like oh, next time I'm really struggling on something, going to office hours would be a good tip.'* [Padrona]

In her case, not only repetition of the message was important, but also that the source of the information came from a student like herself. Starr also referenced age as an important factor is establishing the credibility of the individual in the video and the overall impact of the message.

> *Whereas I mean a lot of advice is stuff I've heard from my parents or like I said …but that was usually from adults. So it's definitely nice to hear advice from people your age I think. I don't know, this sounds bad but I usually like younger teachers better just cause*

like they are closer to your age so they can relate to you more, which is I feel like more with students like when they give advice it's a lot more relevant. [Starr]

This ability to relate to virtual mentors was enhanced through the provision of multiple age-appropriate individuals from diverse backgrounds. Diversity was especially recognized by female participants such as Illusiona *"It's such an interesting thing I think because, like, there's not a lot of girls in engineering. It's just good to hear from other girls on what it's like because sometimes it can be annoying."*

Fourth, the extended scope of advice beyond the second year was particularly impactful for Collier through the foreboding effect of seeing mentors with similar backgrounds discuss their experiences,

So it's almost like when you watch these, it's almost foreboding. You know, and if you watch enough of them you can relate to the person that you think is most similar to you and it forebodes how you may do and you can use their, the way they look back as a foreshadowing for yourself and you can use it as experiential insight and affect positive change on how you may have otherwise done without this knowledge in front of you. [Collier]

The ability to see commonalities between oneself and the virtual mentors was impactful from a mentor-mentee perspective, but also, the ability to more clearly visualize a potential future through the mentors' experiences impacted participants quite strongly.

Fifth, the number of options also removed the need to identify with one specific mentor for all of the student's needs. In fact, the ability to identify across several mentors, termed here "distributed identification," was something that many students voiced as a benefit to the intervention experience. As Ashton explained in great detail:

I felt like a lot of people that I watched just had these traits where I was like 'I totally relate to that' and it wasn't like one in particular that just like stood out to me. But like in

this tool I feel like you can relate with a lot of different people, and you don't pick your best friend as the first person you see, like 'that's going to be my best friend', you kind of wade through all the people that come to you so you can find the person that is your best friend, and this is like you have a huge array of people, they're similar in major except for like a few, but they're all different personalities and they all have different scope on life, so you can definitely find someone that relates more to you.[Ashton]

Sixth, independent of affordances related to the content of the videos, was the affordance of confidentiality both in terms of assurances to virtual mentors that their content would only be seen by specified participants, and secondly, the confidentiality of the study participants as they watched videos unsupervised. Specifically, some of the material presented was not of the kind that is commonly talked about, as Melville explains:

I didn't really hear a lot of this cause a lot of my friends don't really like to talk about their experiences, they're kind of just like let's just push that under the rug and get on with it. [Melville]

Confidentiality was important as a means of reaching out to introverted students, and those that wished to remain anonymous for fear of judgment concerning their struggles in engineering. As Collier stated, "*Stuff like this is ESSENTIAL, especially for introverts. If they can't go out and seek some personal help, these people talking to them in their room is the next best thing."* [Collier] Calera continued this thought when she said:

They give advice like in an accessible kind of way instead of saying 'come to this seminar' it's like you can sit in your own dormroom and watch these on your own time and still get reliable, decent, applicable advice on things. [Calera]

Confidentiality came up often.

Yeah well the thing is some people that need help don't want to admit that they need help. That's the biggest thing and I'd say this is probably one of the best answers for them, to watch videos. Cause then it's completely confidential, you're watching the video on your own. You have no one else judging you which is what I think they're afraid of, to be judged. And if they can just watch a video and get advice from it, then that's awesome. [Melville]

Besides affordances of the tool on its own merits, it was also compared to existing online tools used by participants. In a head-to-head comparison, this tool compared favorably to other online spaces. As Collier explains:

So they are going to learn about their courses but like on Koofers, rate my professor, no one says study habits, no one says clubs at [university], no one talks about how they distract themselves and cope with the rigor of their courses, that's what kids really need. [Collier]

The intervention tool went beyond simply rating a course's difficulty and the perception of a faculty member; it instead offers this information along with the corresponding individual who said it. This provision of context allows for a greater degree of depth that Collier also appreciated.

What you get out of this is it turns into a visual and auditory experience, so you're not only hearing what they are saying but you're seeing their emotional investment in the words that they are telling you. So you're getting both, so if you don't relate auditorily you get the visual sense, I get visual sense if I listen to someone talking I'm going to get maybe 50% of if I actually see it coming out of their mouth. [Collier]

Something not explicitly mentioned, but referenced implicitly was the benefit of being able to see and evaluate the individual contributing to the tool; this being contradictory to both tools

mentioned by Collier that relied on anonymous walls of text rather than videos to offer the content.

4.5.2 Drawbacks

Despite the number of positive affordances this intervention provided, one main drawback remained that was obvious to many participants. As Abbey simply stated, "*I can't talk back to them"*. As Collier put it, "*The one downfall I would say is that you cannot extend the video, like you can't say, it's not an open discussion, it's a closed discussion"*. This lack of a rebuttal was more important for some participants than others, but nonetheless, was the only major drawback identified.

In conclusion, this tool offered several positive affordances with one major drawback. This tool offered awareness of on-campus opportunities through participant testimonials, unique and multiple perspectives on a variety of topics through the provision of multiple diverse mentors, extended scope of assistance across multiple years, distributed identification with multiple mentors, and the confidentiality provided by the web-based videos to reach out to students who may not otherwise attend on-campus services. The breadth of available mentors was particularly well received by under-represented groups such as women and international students who had otherwise limited contact with students from their same social group. Lastly, although not a focus of this study, was the comparison to other currently available online tools. In this comparison, the quality of the intervention tool through the provision of mentors that offered a visual, auditory, and emotional experience of greater depth through video was seen favorably in comparison to the anonymous walls of text approach used by Koofers and ratemyprofessor.com. With the only drawback being an inability to continue the discussion with mentors, the affordances of this tool far outweighed the drawbacks as a potentially strong and influential mentoring tool.

4.6 Results Summary

In summary, participants' experience with the intervention videos involved a process that included choices, reactions, and outcomes. Additionally, perceptions of the affordances of the intervention tool were made and compared with existing alternatives. Participants made initial choices based on their perceptions of relatedness with the mentors, and the value of the content of their videos. As participants viewed each video, they reacted to the content, the virtual mentor, or both, in a way that encouraged reactive video choices, established collective identity beliefs, or empowered future intentions to act on the advice. The resultant interplay between these constructs is outlined in Figure 7 and discussed in more detail in Chapter 5.

Chapter 5 Discussion

5.1 Introduction

Using the results outlined in Chapter 4, this chapter presents answers to the research questions addressing how students engaged with virtual mentoring videos:

RQ 1 What criteria best explain students' viewing choices and preferences?

RQ 2 How do students react to virtual mentors and the contents of their videos?

RQ 3 What immediate outcomes result from engaging with this type of tool?

RQ 4 What affordances does this type of tool provide?

Together these questions can help inform the design of online mentoring video sites, including not only the content of the mentor interviews, but also the ways in which the site represents those videos to students. Answers to RQ 1 are important as they reveal participants' mentor and video content preferences in a virtual mentoring environment. The relevance of beliefs about mentor identity and perceived value of video content is important for the development of virtual mentoring efforts in the future, as well as on-campus programs seeking to attract "at-risk-for-attrition" students. Answers to RQ 2 were important as they showed how participants' separately evaluated mentors and the content of their videos. These evaluations, in turn, lead to reactive video choices and the emergence of collective identity beliefs. The findings regarding reactive video choices towards or away from mentors or content are important to understand how to better develop online video tools aimed at sustained viewing behaviors. Answers to RQ 3 showed the viability of video as a means of establishing collective identity beliefs and empowering future intentions of participants; and finally, answers to RQ 4 identified the affordances and drawbacks of video as an alternative mentoring tool to on-campus alternatives.

5.2 Answering the Research Questions

The answers to RQ1, RQ2, and RQ 3 relating to participants choices, reactions, and outcomes are outlined in Figure 7. The model includes several constructs from Eccles (2009) model of expectancy value theory as well as some emergent codes exclusive to this study. In particular, the model highlights the role of interest value and utility value of content, and the connections of identity-based beliefs between participants and the virtual mentors. As shown in the figure, subjective task value and identity-based beliefs guided participant video selections both initially and throughout the experience. The impact of identity connections between participants and mentors lead to emerging collective identity beliefs, and ultimately, future intentions based on the mentors' advice. RQ 4 did not fit into the model and is instead outlined as a list at the end of the chapter. A more detailed explanation of the answers to the research questions is in the sections that follow.

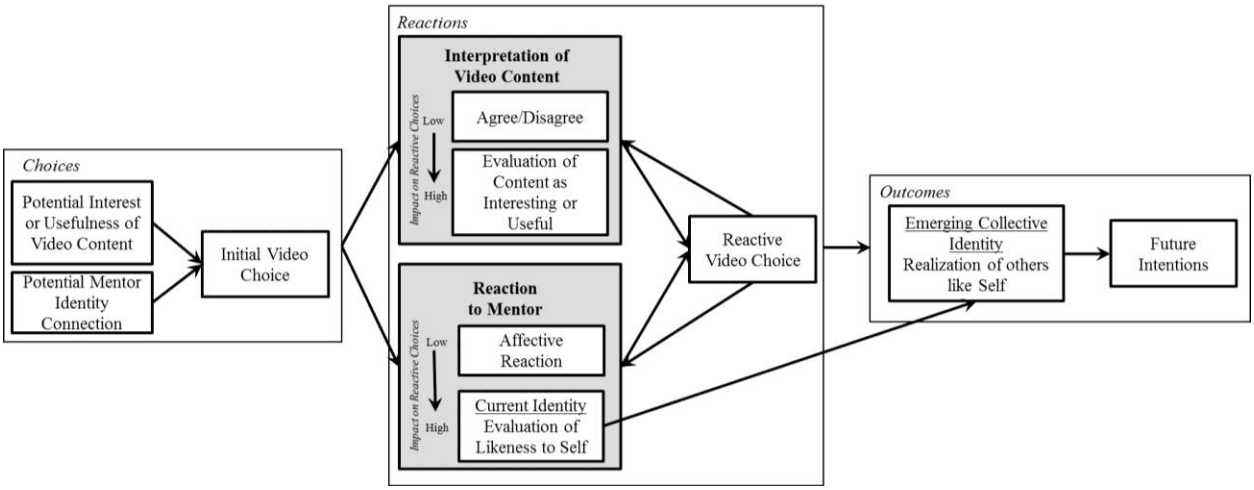

Figure 7 Virtual Socialization

5.2.1 Research Question 1: Choice

What criteria best explain students' viewing choices and preferences?

Understanding participant viewing choices was important as they revealed participants' mentor and video content preferences in a virtual mentoring environment. The relevance of beliefs about mentor

identity and perceived value of video content is important for the development of future virtual mentoring efforts, and on-campus programs seeking to attract “at-risk-for-attrition” students.

Student viewing choices represented an ongoing process. As participants made video selections, they reacted to what they saw and heard, and used these reactions to make follow-up choices; this process was ongoing throughout the hour of viewing for the study. For this section, only initial choices, or those choices made not in response to a video from the same mentor, will be discussed as reactive choices will be covered in the following section. Key in both cases was the salience of identity and subjective task value, specifically utility and interest. During the initial choice, these factors represent what participants *believed* would be true based on the video titles and mentor descriptors, whereas in reactions (Section 5.2.2), they were based on evaluation.

As illustrated in Chapter 4, participant choice behaviors were governed by two primary mechanisms. Either participants’ sought mentors that they could identify with or they sought content that was potentially useful or interesting. In choosing mentors based on identity (personal or collective), participants initially focused on the most obvious features of the mentors gathered through their pictures, descriptions, and video titles. This finding is consistent with previous research by Rosenberg-Kima (2008 & 2010), which found that without further information, participants tended to focus on the most obvious characteristics of virtual interface agents and then make judgments about their relevance and credibility based on their perception of the agent as an ingroup or outgroup member. The search for ingroup members is consistent with research that has shown ingroup members to be more trusted, respected, and influential than outgroup members (e.g. Ellemers, Spears, & Doosje 1999; Haslam 2001); and secondly, communication with in-group members is expected to be easier, more fluent, and constructive than with outgroup members (Morton, Wright, Peters, Reynolds, & Haslam 2012). By providing a photo, a list of descriptors, and a list of video titles, participants in this study were able to make assumptions about the membership of each mentor as either an ingroup or an outgroup member, and make their video selections accordingly. Through the provision of numerous identities (personal and collective) via the study

handouts, participants were able to select those identities most salient to them and watch mentors and videos that aligned with these beliefs.

In contrast to seeking mentors like themselves, which constituted an ingroup affiliation, mentors labelled as "A" students were oftentimes purposely avoided as unrelatable, and thus, seen as members of an outgroup. As Arista explained, "*I feel like people that have always done good I can't relate to because I haven't always done good, I need advice from people who have struggled and they know how to get through it*." The importance of ingroup and outgroup perceptions was consistent with previous research (i.e. Rosenberg-Kima, 2010; Ellmers, et al, 1999; Morton, et al. 2012), but in this study included additional characteristics beyond race, and sex such as GPA (struggling in engineering) and social issues that provided participants with a greater number of variables to connect with.

Regardless of whether students saw mentors as part of a common ingroup or outgroup the number of connections or disconnects was summative. Using Rocky as an example, he connected with Daniel on AOE (major), Galileo (on-campus group), philosophy class (shared past experience) and below 3.0 (GPA); the result was an increased perception of Daniel's credibility over other mentors. The idea of multiple levels of connection was similar to those seen in other studies (i.e. Moreno, & Flowerday, 2006).

Differences in search patterns by gender also emerged. In the interviews, male participants cited fewer criteria than females when explaining their choice behaviors and tended to focus more an academically-related content such as specific professors and courses than did females who were more concerned with the idea of balance between academics and social responsibilities. This finding aligns with research suggesting that men are more likely than women to exhibit a single-minded devotion to one particular goal, especially their occupational goal. In contrast, women are more likely to be involved in, and to value, competence in several activities simultaneously (Baruch, Barnett, & Rivers 1983; Maines 1983; Terman & Oden 1947).

In addition to using identity-based beliefs, participants made choices based on perceptions of the value of content related to interest and utility, both of which are components of Eccles' subjective task value construct (2009). Interest-based choices often intersected with personal and collective identity because for some participants, shared interests appeared to be directly associated with *who they were*, while others saw shared interests as something that *they do*, which, as described above, aligns with Eccles' interest construct. In addition to shared interests was the perception that a particular video's content could be interesting either through a unique perspective, previously unknown activity, or otherwise.

In addition to the perception of interest was the potential utility value of a video's content. Utility was perceived chronologically related to past events, immediacy, and future experiences that might be faced. This conceptualization adds to Eccles definition, which only references short- and long-term goals, by including validation utility of past experiences. While Eccles (2009) does include an evaluation of past experiences, she does not make direct reference to utility in this manner. As this study showed, an overlap between past experiences and utility through the dialogue of the mentors enabled participants to learn from the experience without experiencing the situation themselves. In this sense, finding utility through the experiences of others was done vicariously.

In conclusion, participants made choices based on identity and subjective task value, using the video index handout as the basis for these beliefs. Specifically, participants made choices based on the perception of the mentor being relatable through shared identity beliefs or the perceived value of the video's content; these results are displayed in Figure 8:

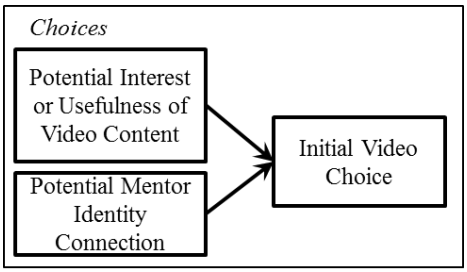

Figure 8 Choices

5.2.2 Research Question 2: Reactions

How do students react to virtual mentors and the contents of their videos?

Understanding how participants reacted to the virtual mentoring videos was important as they showed how participants' evaluated the mentors and the content of their videos separately. These evaluations, in turn, lead to reactive video choices and the emergence of collective identity beliefs. The findings regarding reactive video choices towards or away from mentors or content are important in understanding how to better develop online video tools aimed at sustained viewing behaviors.

Reactions to videos came in two forms; first, participants had reactions to virtual mentors, and second, interpreted the content of their videos. Reactions to virtual mentors ranged from emotional responses, to current identity connections. Interpretations of video content ranged from agree or disagreeing with content to the subjective-task value of utility or interest (see Figure 7).

Unlike Eccles (2009), affective reactions to mentors involved two constructs instead of one, and secondly, these constructs had different levels of impact on reactive choices and subsequent outcomes. While Eccles (2009) lists "affective reactions" and "emerging personal and collective identities" separately, this study showed them to be linked within the context of participants making connections with the virtual mentors. Of the two constructs, identity-based beliefs had the stronger impact on reactive video choices and were connected to the emergence of a collective identity outcome.

Eccles (2007) contains affective reactions to key socializers. Participants in this study showed affective emotional reactions to the mentors through an evaluation of their emotional investment and nonverbal communication through body language and the amount of thought put into answers. The evaluation of mentor's emotional investment resulted in either an empathy connection, a deterrent for participants who preferred content without emotional undertones, or a direct transfer of the emotions of the mentor to the participant. In this sense, Eccles definition of affective reactions to key socializers was supported in the findings of this study.

Beyond emotional reactions to mentors, many students saw some of themselves in the mentors based on their demeanor, "coolness", general appearance, directness, "having a lot to say", similar emotional responses to past events, reference to "being average", and issues balancing academic and social responsibilities, to name a few. Besides these categories, the "at-risk-for-attrition" students in this study made current personal identity connections most often in reference to past struggles in engineering and a desire to move on from these experiences. Additionally, current personal identity connections involved group-based affiliations such as age, sex, racial and cultural affiliations, and citizenship status. Current personal identity in this sense was consistent with Eccles' (2009) definitions of emerging personal and collective identity.

In addition to reactions grounded in identity, participants' reactions also included judgments about the subjective task value of the video's content. During the interpretation of video content, participant responses ranged from simply agree or disagreeing to valuing the content for either its interest or utility value. While agreeing or disagreeing with content was not captured in Eccles' EVT model (2009), the underlying reasons for these reactions were captured by other constructs.

Beyond simply agreeing or disagreeing with content, some participants found value in the content. Interest in content was affiliated with the advertising of previously unknown opportunities, and in content expressed through a unique perspective. In comparison to Eccles' (2007) construct of intrinsic

interest, which is the interest in engaging in a particular task or behavior, interest in this study focused on finding the content a particular video interesting, and thus, was quite similar.

Besides interest was value utility, which took many forms. Utility in this study expanded on Eccles definition (2007) to include the validation of past experience. In this study, the reasons that participants found content useful was in relation either solidifying their own thoughts on a particular topic, or reversing their perceptions about the topic through example. Similar to utility in choice behaviors, utility was again evaluated based on a chronological basis and was seen through the validation of a past experience, immediacy to a current situation, or foreboding of a potential experience.

Besides affective reactions to virtual mentors and the subjective task value of the video content, participants also reacted to video length, a factor not fully captured in EVT. As was shown in Chapter 4, opinions concerning the utility of a particular video were oftentimes related to its corresponding length. With a vast majority of videos ranging between 30-120 seconds, the preference seemed to be for videos between the 60-120 second range, shorter videos were devalued as declarations without advice, and longer videos were devalued because they went going off topic or dragged on. With the 60-120 videos, participants felt that there was enough time for the mentor to establish their credibility through their direct experience, reflect and evaluate this experience, and offer useful advice in the most efficient manner. In a way, once the participants started viewing the videos, length became an indicator of utility. This finding begins the discussion on the interplay of video length and study parameters.

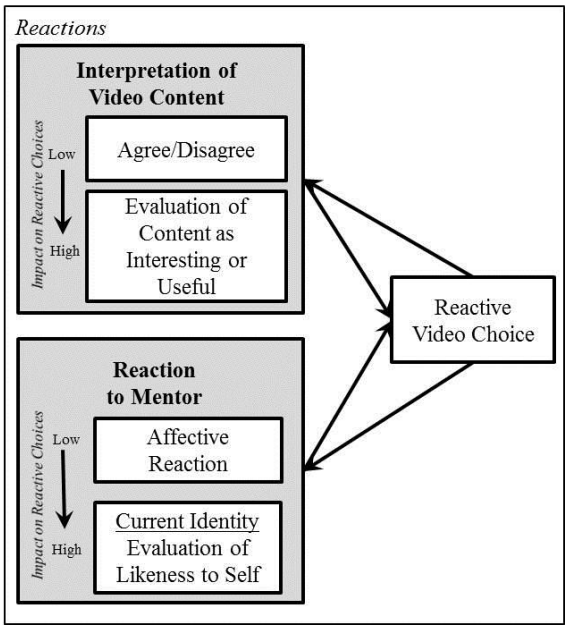

Figure 9 Reactions

5.2.3 Research Question 3: Outcomes

What immediate outcomes result from engaging with this type of tool?

The outcomes of engaging with the intervention tool illustrated the viability of video as a means of establishing collective identity beliefs and empowering future intentions of participants. As discussed in the Chapter 4, this intervention tool provided participants with an: 1) awareness of an emerging collective identity based around struggling in engineering and 2) empowered intentions to act based on the advice of the virtual mentors.

According to Eccles (2009), emerging collective identities are those valued parts of the self that strengthen one's ties to a valued social group. In her model, emerging collective identity is discussed as a precursor to the assignment of value for a given task, and that behavior is the physical enactment of the identity beliefs most salient for a given context. In contrast to Eccles' model and definition, this study illustrated the importance of *identity connection* between participants and mentors. The realization of an identity connection established the credibility of the mentors' advice and impacted future intentions of the participant based on this advice.

The issue of credibility of members from a shared collective identity has been sometimes referred to as ingroup members. Ingroup members in this study were those with whom participants shared a collective identity, while outgroup members were those whom participants did not share a collective identity. Ingroup members have been perceived in past studies as more trusted, respected, and influential than outgroup members (e.g. Ellemers, Spears, & Doosje 1999; Haslam 2001). The psychological distinction between "us" (ingroup) and "them" (outgroup) has clear implications for communication. Communication with ingroup members is expected to be (and consequently more likely to be) easier, more fluent and constructive than those with outgroup members (Morton, Wright, Peters, Reynolds, & Haslam 2012). These studies are consistent with the findings here that showed the establishment of a collective identity between the participants and their virtual mentors needed to be established *before* the participants intended to act of their advice.

In addition, the awareness of an emerging collective identity concerning struggling in engineering is consistent with research on overcoming pluralistic ignorance through the realization of an ingroup. Pluralistic ignorance is a phenomenon in which people misunderstand social norms through seeing others exhibit a consensus behavior that results in incorrect inferences about the underlying social norms (Miller & McFarland, 1987). Within this study, as participants viewed their struggles in engineering as unique in comparison to the social norms of their engineering peers; the realization that they were not alone in their struggles established a collective identity with their peers. As Illusiona discovered, "*No one goes through all of engineering without having a really hard time in something.*"

While many participants felt they were alone in their struggles in engineering, several admitted they had not previously discussed these struggles, and that their silence may have contributed to these beliefs. Additionally, participants mentioned not seeking out help for their social and academic concerns for fear of judgment by faculty and peers. The unwillingness to speak about failure and vulnerability is similar to Brene Brown's definition of shame (2012), which is the combination of silence and secrecy for fear of judgment by others.

Besides emerging collective identity, a second major outcome was participants' intentions to act on the advice of the virtual mentors. Future intentions were similar to Eccles (2009) constructs of "task, activities, and behavioral choices," but could not be verified for this study because following through on these intentions was outside the scope of this study. Intentions included following the advice of the virtual mentors to take action included strategies for academic success, techniques for balancing academic and social responsibilities, and others. A follow-up study could be conducted using the same participants to see if any of them followed-through with their intentions and whether or not the intervention experience had any longitudinal effects.

In this study, however, emerging collective identity was a precursor to future intentions to act because the establishment of a shared collective identity led to beliefs about the credibility of the video content. The outcomes of the study are outlined in Figure 10:

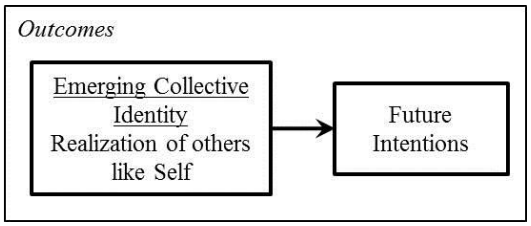

Figure 10 Outcomes

5.2.4 Research Question 4: Affordances

What affordances does this type of tool provide?

Understanding the affordances and drawbacks of video as an alternative mentoring tool to on-campus alternatives is important in seeking to address the drawbacks of current on-campus services and the social inhibitors to student attendance as outlined in Chapter 2. The affordances of the intervention tool included: 1) awareness of on-campus opportunities through mentor testimonials, 2) unique perspectives on topics from mentors from different social groups, 3) multiple mentor perspectives on the same topics, 4) extended scope of advice and support across multiple years of the curriculum, 5) distributed identification across multiple mentors, and 6) confidentiality to its users.

Awareness of on-campus opportunities through student testimonials, and offering advice across multiple years of the curriculum (extended scope) both align with the recommendations of Amenkhienan (2004).

In addition to expanding awareness and extending the scope of the advice, the provision of multiple mentors offered unique perspectives on issues, multiple perspectives on the same issues, and the ability for participants to identify across multiple mentors (a.k.a. distributed identification) that has not been previously discussed in the mentoring literature. The variety of mentors, with their corresponding experiences and perspectives, allowed for them to act not only as mentors, but also as role models through providing a visible future possible self for participants; this was particularly important for under-represented groups in engineering such as international students and women and supports previous claims made by Trenor (2008). All of these assertions lend credence to the claim that virtual socialization negates the costly practice of pairing mentors and mentees as in live alternatives as voiced by Mueller (2004).

Lastly, the issue of confidentiality was assured through the use of the internet rather than an on-campus facility. While not explicitly discussed in previous literature, confidentiality does address the concerns over judgment and other social inhibitors to attendance of on-campus services outlined by Amenkhienan (2004). Confidentiality was discussed as a benefit for introverted students, and in this sense, offers an answer as to *how* to reach out to these students that would otherwise not attend support services.

With the list of positive affordances of the intervention tool, only one major limitation was cited that was obvious at the onset of the study, namely, the lack of interaction. Without the ability of participants to speak directly with the mentors in the videos, the conversation was closed in nature and could not be extended beyond the length of the video. This single drawback was a calculated one for this

study and that which was done intentionally to analyze the question of whether or not interaction is necessary in a mentor-mentee relationship.

In summary, the answers to the researched questions posed for this study explained participants' experiences with the virtual mentoring videos. Specifically, the perception and evaluation of video content's interest or utility value along with identity-based connections between the participants and mentors ultimately established the credibility of the advice provided, and the intentions of participants to act on this advice.

Through an understanding of participant preferences for useful content from mentors with a shared collective identity, recommendations for how to create more effective virtual mentoring videos and improve on-campus services can be made. As participants evaluated the value of video content separately than the mentors themselves, recommendations for each in isolation can be made. Additionally, with an understanding the triggers to or away from mentors and content, recommendations can be made on how to better develop online video tools aimed at sustained viewing behaviors. Lastly, understanding the affordances and drawbacks of the tool enable comparisons with on-campus services, and ultimately determine the viability of video as a virtual mentoring tool.

Chapter 6: Contributions and Future Work

6.1 Theoretical Contributions

The theoretical contributions of this work are related to virtual socialization, the use of video to provide virtual mentoring and role modeling, means of addressing shame-based identity beliefs, and the redefinition of "mentor" for "at-risk-for-attrition" students.

6.1.1 Virtual Socialization

The theoretical contributions of this work consisted of the development of a model of virtual socialization based on the framework outlined by Eccles in 2009. The model in Figure 11 answered the first three research questions and explains the choices, reactions, and outcomes of student interaction with the virtual mentoring tool developed for this study.

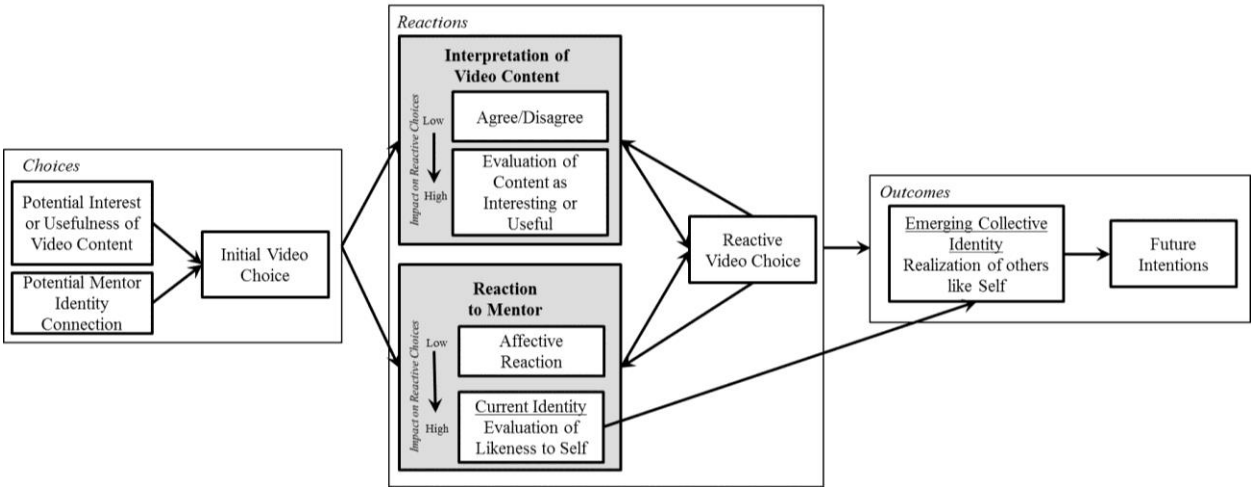

Figure 11 General Theory of Virtual Socialization

In comparison to Eccles' (2009) model below, Figure 11 is quite different. As this study focused on the socializer components of Eccles' model, several constructs have been removed including: "distal cultural milieu," "personal and proximal family characteristics," "emerging self and future goals," and "expectation for success."

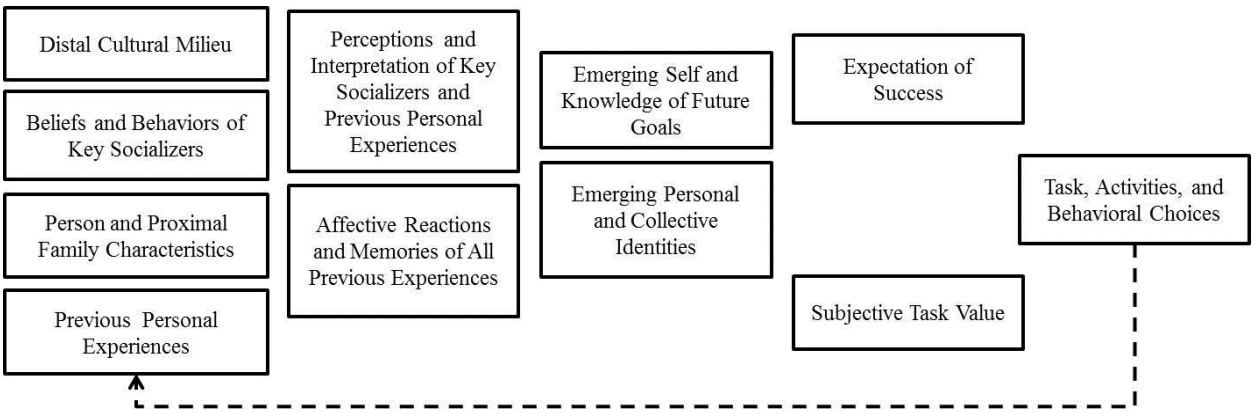

Figure 12 Abbreviated Expectancy-Value Theory Model adapted from Eccles' 2009

Besides the elimination of these constructs, several other constructs from Eccles' model were either relocated or combined. "Interpretation of key socializers" was combined with "affective reactions" in the reaction to mentor box, and" perceptions of beliefs and behaviors of socializers" and "subjective task value" were combined into the interpretation of video content. Additionally, while Eccles' model is cyclic in nature, connecting "task, activity, and behavioral choices" to "previous personal experiences," there wasn't a clear means of identifying all the complexities of this connection in this study.

To address the cyclic nature of video selection, Figure 11 lists the impact of interest and utility value along with identity-based beliefs during both initial video choice and the reactive video choice cycle. While Figure 11 captures most of the participant behaviors of this study, more research needs to be done to capture all facets of the cyclic nature of video selection in virtual mentoring environments.

Lastly, while Eccles' model has one major outcome, "task, activity, and behavioral choices," Figure 11 lists "future intentions" in its place and illustrates an additional outcome of "emerging collective identity" which clarifies the result of identity-based connections between participants and mentors. While a majority of Eccles' constructs remain salient in the virtual socialization model, Figure 11 articulates the socializer, subjective task value, and identity-based connections in greater detail specific to a virtual mentoring context.

6.1.2 Shame-Based Identity

A second key contribution involves the role of shame-based identities in engineering education. Based on the findings of Amenkhienan (2004), students GPA's between 2.00-2.99 in this study were also uncomfortable speaking about their struggles in engineering. With participants in this study referencing themselves as "B" and "C" students, this personal identity related to struggling academically in engineering impacted their hesitation to speak about their failures. These findings are consistent with Brene Brown's conceptualization of shame (2012), or the possession of silence, secrecy and fear of judgment regarding a particular part of the self. From an identity standpoint, shame-based identities are those that an individual wishes to hide. Specific to engineering, students struggling in engineering have been shown to be less likely to attend support services due to fear of judgment (Amenkhienan, 2000), and as expressed in this study, prefer to not speak about their struggles openly. The resultant effect is a feeling that students are the only with their struggles, and as a result, question their sense of belonging in engineering (Marra et al., 2012).

As Brown (2012) explains, "empathy is the antidote to shame," which is both what participants sought in mentors, and what was received through this experience. With many participants citing the fact that they felt they were the only one with their academic and social issues, the provision of several virtual mentors showed them that this was not the case. The process of overcoming pluralistic ignorance (Miller, & McFarland, 1987) in engineering education is an important step in the establishing of positive sense of belonging perceptions. As participants realized that struggling in engineering was a common occurrence, they took comfort in the fact that they were not alone, and thus, and a part of a larger social/collective identity of struggling engineering students. While the impact of awareness of a collective identity have been seen in other contexts (i.e. Cruwys, Haslam, Dingle, Haslam, & Jetten, 2014), this study highlighted its importance more explicitly in an engineering education context, and participants with respect to an identity that may not be valued or accepted.

6.1.3 Redefining "Mentor" for <3.0 Students

Finally, this study shifts the way we think about mentors for struggling students. As many students made reference to the search for mentors like themselves, and deliberately avoided mentors whom they perceived to be "A" students, it is necessary to reference the fact that participants were looking for a *model of transformation rather than a model of excellence*. As identity-beliefs are constantly changing with time, participants in this study were keen on improving their current position in engineering and wanted to hear from mentors who had previously been there before, and were now successful. Important to participants was the idea that the mentor understood their struggles through direct personal experience, and thus, could offer advice based on lessons learned through the experience. Having mentors who "had been there before", in reference to struggling in engineering, and were now successful, enabled them to be seen not only as mentors, but role models as well.

Given this realization, the terms "mentor" and "role model" need to be reconceptualized for <3.0 students in a way that acknowledges the audience in which they expect to enact these roles for. In the case of <3.0 students, this means the ability to understand what it is like to struggle in engineering, and to provide strategies for success and perseverance through direct personal experience. Only through this level of understanding of the emotional impacts on struggling in engineering could a potential mentor or role model relate in the most meaningful way for this group of students.

This desire to hear from students like themselves implies that recruiting strategies should be developed that attract students who have previously struggled in engineering as mentors and role models for those who are currently doing the same. One potential issue with this model is that students who have previously struggled may not see themselves as mentoring or role modelling material, and thus, inhibited from raising their hand to do so.

6.2 Recommendations

The findings suggest several recommendations for both creating mentoring videos and conducting further research.

6.2.1 Video Production

Although the study was exploratory, findings do suggest potential guidelines for mentoring videos. From my experience conducting this study as well as the findings of the study itself, I recommend that any research seeking to continue this type of research:

1. Recruit mentors who previously struggled in engineering, and are now doing well.
2. Advertise as many mentor identities as possible, as the identities that were most important to participants varied.
3. Recruit mentors from as many demographic groups as possible as certain students had a strong preference for mentors from their same social group.
4. Assign mentor descriptors carefully as participant expectations and video choices were made in direct reference to them. When participants made a video selection based on descriptors that were not mentioned in the videos, this deterred them from future viewing.
5. Phrase video titles carefully as the more provocative titles (i.e. "How Not to Study for an Exam") attracted more views then generically titles videos (i.e. "Joe on Statics).
6. Keep video lengths between 30-120 seconds in length.
7. For the most effective videos make sure mentors establish their credibility, explain their personal experience, and offer advice based on this experience (Table 7).

Table 8 Levels of Mentoring Video Impact

Level	Type	Example
Level 1	General Advice	"You should"
Level 2	Advice Based on Personal Experience	"I did so you should"
Level 3	Advice Based on Relatable Personal Experience	"I am like you, this is what I did, and this is why you should do the same"

8. Focus videos into either social or academic categories.
    a. Academic: Create videos about specific courses, professors, opportunities, and strategies for success.
    b. Social: Create videos about balancing academic and social responsibilities, and any other social issue that mentors are willing to discuss.
9. Create "Final Word of Advice" videos as done in this study as they showed to be particularly impactful on future intentions.
10. Make the videos searchable.

While further research, as describe in the next section, is necessary to fully validate these recommendations, the findings of this study provide a reasonable basis for these guidelines as a productive starting point for educational practice.

6.2.2 Research Study Design

In addition to recommendations on video content, I would like to also make some recommendations regarding the research study design.

1. Recruit mentors from more than two upper division classes to diversify the sample of mentors.
2. Seek participants during class rather than through email to increase response rates.
3. The pre-interview was not useful in answering the research questions for this study. I would recommend either not having a pre-interview, or creating a new instrument focused around constructs identified in this study.
4. The Participant Handout (Appendix D) was not useful in this study as students prefer to search video content within the website itself.

5. The Complete Video Index (Appendix E) should be replaced by more sophisticated tracking techniques through the website directly so that students can focus on watching rather than writing.
6. While the Participants Notebooks (Appendix F) were not used in this dissertation due to the variability is submission quality. Having students reflect on a video-by-video basis rather than waiting for the post-interview is recommended.
7. There was a lot of redundancy in the post-intervention interview protocol that was not necessary in order to answer the research questions posed. In particular, the post-intervention interview could have been much shorter and still captured the data needed.

From the original protocol, and updated version is provided in Figure 13 that features three new questions and removed others:

Constructs	**Questions**
Choices	1. What did you watch first? Where did you go next? 2. [NEW] Were you looking for any particular content in the videos? a. What was it? b. Did you find it? 3. [NEW] Did any of the students stand out to you? a. What stood out? 4. Was there any additional information that you would've liked to have had about the students in the videos? a. Probe: GPA, grade in course, year, professor?
Reactions	5. Was there any content in the videos that you found particularly useful? Not useful? Why? 6. [NEW] Was there any content in the videos that you found interesting? a. What was it? Why was it interesting? 7. Could you relate to any of the experiences that were discussed in the videos? 8. Did you see any of yourself in these students? a. What about these students could you relate to?

	9. Did watching these videos make you feel any particular way?
Affordances	10. Of the material discussed in the videos, approximately how much had you heard before? a. From whom? 11. How would you compare the experience of hearing the same information from someone you know or have interacted with, with hearing it through these videos?
Outcomes	12. What did the videos do for you, if anything? 13. Did you get any advice from these videos that you might try and implement? 14. [NEW] Was there anything in particular that you responded to that you felt would make you more likely to listen to advice voiced in the videos?
Closing Questions	15. What recommendations would you make to improve the tool in the future?

Figure 13 Recommended Post-Intervention Interview Protocol

Overall, several recommendations could be made regarding recruitment strategies, intervention layout, instrument development, and data collection strategies that could be improved to both increase the effectiveness and more tightly focus the bounds of future studies. As this was an exploratory study, it is the hope that these recommendations can be used to guide even more successful efforts in the future.

6.3 Limitations

The first major limitation to the study occurred during the recruitment of the virtual mentors and the lack of representation by historically under-represented groups in engineering. There were few if any mentors who were African-American, Asian, and Native American students to name a few. The disproportionately low representation of available mentors from these backgrounds was mentioned by the only international participant and should be noted.

After completion of the intervention tool, several other limitations emerged. While the focus on this study was on the development of an intervention and the testing of its impacts on at-risk-for-attrition students, several assumptions were made concerning the term at-risk-for-attrition that need to be validated

or redefined through further study. As the study recruited potential participants via an email inquiry, the subsequent behaviors of the participants was not necessarily consistent with students that would likely be at risk for leaving the major. In particular, participants read the email, responded in a professional manner, scheduled and attended two interviews, and completed a series of handouts all while tending to their other courses and responsibilities. This exhibition of time management skills and responsibility meant that the recruitment criteria or methods used in the recruitment of study participants did not necessarily capture the individuals that it targeted. While low GPAs have previously been connection with attrition from engineering (Marra et al., 2012), overall GPAs by themselves do not provide enough information to label students at-risk-for-attrition.

Another limitation was that participants were paid for their efforts. While pay did not seem to be the primary motivator for participation, the $50 allocated to each participant upon completion of the study was advertised upfront as part of the recruitment process. The impact of payment was not directly assessed but should be noted for those wishing to attempt a similar study.

Lastly, the fact that the time spent with the intervention videos was done without any supervision by the researchers, trust in the participants to conduct themselves in a manner as directed was assumed. Of the 13 participants that completed this study, one in particular spent a majority of his time simply viewing one mentor until a majority of his viewing hour was completed. The decision to not follow directions detracted from the explanatory power of his data and exhibited a potential side effect to paying participants. Moreover, the time requirement effectively forced participants to keep making choices to view more videos, so the reaction – choice cycle maybe artificially induced.

6.4 Future Work

While four data sources were collected for this study, this dissertation focused solely on the post-intervention interview transcripts as a means of answering the research questions posed. This was done intentionally as the impact of the intervention was most clearly illustrated through these interviews.

For future work, an analysis of the three data sources not used in this dissertation should be conducted. The pre-intervention interview transcripts can be analyzed to explain what led to participants' social and/or academic struggles during their first year, whether or not these issues have been addressed, and whether any new struggles had emerged during the transition to the participants' second year. The pre-intervention interviews also touched on self-socialization, satisfaction with peers and faculty interaction, and perceptions of on campus support services. A more rigorous analysis of the transcripts may reveal new insights into the process that led students to their current GPAs and explain their perceptions of belonging in engineering more clearly than the 1st year survey results used in their recruitment.

Next, the complete video index submissions should be analyzed as they represented a complete time log of all participants viewing that may highlight any unspoken trends that were not captured in the interviews or in the participants' notebooks. Specifically, these submissions may identify: specific videos that triggered participants away from future viewing, the number of videos required to reach saturation with a given mentor, and other viewing patterns not directly addressed during the post-intervention interviews.

The participant notebooks were the last data source that was not used in this dissertation and should be analyzed as some participants took note of things such as thoughts and reactions that in some cases were far more personal and detailed than were expressed in their corresponding interviews. The main reason for excluding the participant notebooks in this study was the erratic quality of the submissions received. In particular, the quality of submissions varied too greatly across participants to make any definitive claims about their contents. In future work, a greater emphasis on the participant notebook is highly recommended because it captured participant reactions as they happened with the videos rather than a reflective interview a week afterward.

In addition to an analysis of the data sources already collected, the findings of this study suggest additional areas that deserve attention. With the positive outcomes regarding the potential for virtual socialization as a means of offsetting the service-level concerns of on-campus services as well as the student-level issues related to attendance, future work related to on-campus services and virtual socialization is in order.

First, research needs to be conducted on recruiting students who previously struggled in engineering as mentors. As participants in this study voiced their opinions regarding their desire to be mentored by someone like themselves, the potential for an on-campus support service tailored to this specific type of mentor should be investigated. Similar, future research should explore whether the social inhibitors of non-attendees to support programs remain even if programs are staffed by relatable students.

Given the option of an on-campus support program tailed to providing this unique type of mentor, questions also remain regarding whether students in need would still prefer videos to live interactions with the mentors themselves. If students preferred videos, the question of shelf-life, or how often the videos need to be updated, is a concern, as well as the generalizability to other contexts outside of the host institution.

6.5 Summary

In the end, this study, and the potential for future work in virtual socialization and on-campus support was designed with the goal of helping any struggling engineering student regardless of who they are or their current circumstances. As many students view engineering as a difficult major, the disclosure their struggles and vulnerabilities is something that many students are not prepared to share. The hope for the future of this line of research is that students can realize that they are not alone in their struggles, and that through bringing people together through shared experience, they may find out not only that they belong in engineering, but through this realization, they might find the power to make changes for the better.

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Appendix A: Call for Virtual Mentoring Participants

Contact: Kevin Sevilla email: kevins83@vt.edu

Who: I am seeking third and fourth year engineering students to help me create video content aimed at helping 2nd year students. In particular, I am interested in recruiting students that feel comfortable talking about their past successes and failures at Virginia Tech.

What: Video-taped conversation lasting between 15 minutes to an hour. The length of the conversation will be dictated by the student.

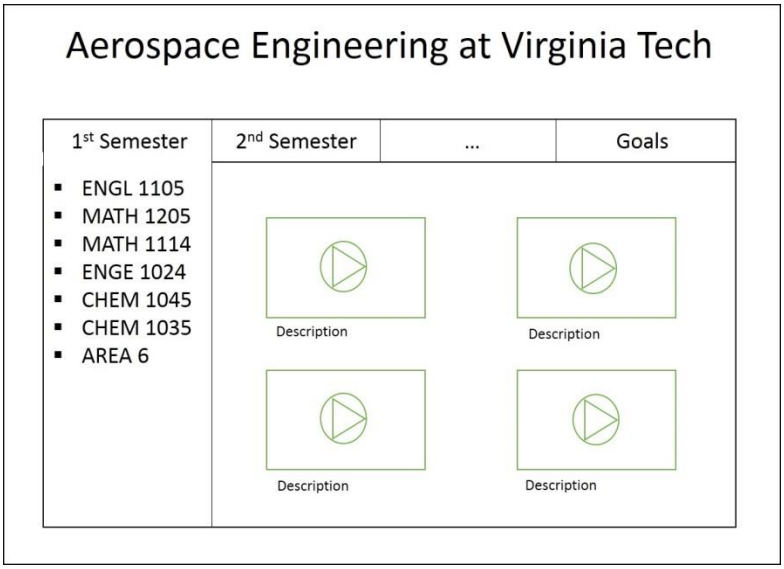
When: Videos will be recorded this week between Tuesday April 30th at 10:00am and Friday May 3rd at 4:30pm. If these times do not work, but you may still be interested in contributing, other arrangements can be made.

Where: Location to be determined based on participant preferences. Most likely the interview will take place in my office or the communication center located on the 6th floor of McBryde Hall.

Why: I am completing a dissertation in Engineering Education and wish to grow a library of video content to help engineering students get through their programs.

Format:

Participants will be provided with a list of topics which they may choose to speak on. The conversation will be recorded and edited to fit within the specified website sections.



Potential Incentives:

1. Participants may feel the intrinsic reward of passing on their expertise to the next generation of engineering students
2. Participants may request topics for future videos in areas that would be valuable to them (i.e. capstone project options, career decisions: graduate school vs. industry, input from TAs and faculty on various topics, etc.)
3. Participants will be provided with login information and may access all content on the website at any time (videos will continuously be uploaded throughout the year)
4. Participants will have access to myself and my:
    a. Contacts within the graduate school (I work in graduate recruiting and admissions)
    b. Contacts with other graduate programs through my work in the Engineering Education community
    c. Contacts in industry (i.e. former students, graduate student friends, etc.)

Appendix B: Recruitment Email

Dear (insert name),

My name is Dr. Marie Paretti and I am conducting a follow-up to my previous study analyzing the motivation of first year engineering students. This study will mainly be conducted by my student, Kevin Sevilla, who is seeking participants for his dissertation and is willing to compensate you $50 to complete two interviews (roughly 30-60 minutes in duration) and review of his website containing information pertinent to your major. If you would be interested in participating in the study please reply to kevins83@vt.edu and provide some example times that you might be able to meet for your first interview. If you have any questions please feel free to contact Kevin at your earliest convenience by email or phone. Thanks for your time.

Sincerely,
Dr. Marie Paretti

Appendix C: Informed Consent Form

INFORMED CONSENT FORM FOR SOCIAL BEHAVIORAL RESEARCH

Virginia Tech

Title of Project: Virtual Socialization in Engineering Education: Identifying the Impacts of a Socializer-Based Intervention on Second-Year Engineering Students

Principle Investigator: Marie Paretti
Engineering Education
McBryde Hall 660
Blacksburg, VA 24061
mparetti@vt.edu Phone: (540) 231-1812

Investigator: Kevin Sevilla
Engineering Education
McBryde Hall 660
Blacksburg, VA 24061
kevins83@vt.edu Phone: (714) 356-2619

Investigator: Andrea Goncher
Engineering Education
McBryde Hall 660
Blacksburg, VA 24061
andreagoncher@gmail.com Phone: (540) 231-6555

1. **Purpose of the Study:** The purpose of this research is to develop a video-based website and test its effects on student motivation. Specifically, the possibility of providing online mentoring will be explored as a potential medium to increase inclusivisenss and lessen social barriers often associated with certain academic support services.

2. **Proceedures:** The major data sources will be used during the project:
   - **Personal data** from the previous first-year motivation study, including GPA scores, will be used for this follow-up study.
   - **Interviews** of students lasting no more than 60 minutes each. These interviews will be audio recorded for accuracy of audio content.

   Personally identifying information will be stripped during transcription as described below.

3. **Discomforts and Risks:** There are no risks in participating in this research beyond those experienced in everyday life. The interview questions involve personal opinions and expressions of personal experience. Should you have questions or concerns with regard to your rights as a research subject, please contact Dr. David Moore, IRB Chair, at (540) 231-4991 or moored@vt.edu.

4. **Benefits:** Based on planned publications of the research results, participants and the broader research community might have a better idea of the challenges and benefits of this specific type of intervention and its impacts of student motivation within engineering education.

5. **Duration:** There will be two interviews, each lasting no longer than 60 minutes each.

6. **Statement of Confidentiality:** Your responses will be linked through an identification number. All data will be kept confidential and stored by ID number, rather than by name. All personal identifiers (names) will be stripped from responses as transcripts are created. Transcripts will be created and originals destroyed within one year. The list linking names to ID number will be kept separate from data and will be destroyed at the end of the funded project, no later than 2014. Only project researchers will have access to personal identifying information of the participants.

7. **Right to ask Questions:** You may ask questions about this research by contacting Kevin Sevilla, Graduate Student in Engineering Education, at 714-356-2619 or kevins83@vt.edu.

8. **Compensation:** Participants of interviews will be compensated for their time. For participants who complete the first and second interview, compensation in form of $50 will be awarded upon completion of the second interview. For participants who elect to complete the first interview, but decide to opt out of the study before returning for their follow-up interview, $10 will be awarded.

9. **Voluntary Participation:** Your decision to participate in this research is voluntary. You can stop at any time or skip any question or activity.

10. **Credit:** Your decision to participate will not impact your grade in any course and will not be communicated to any professor.

Keep this form for your records and future reference.

Participant's Permission

You must be 18 years old or older to take part in this research study. If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below.

_____ _____

Participant Signature Date

_____

Participant's Printed Name

_____ _____

Appendix D: Participant Handout

Virginia Tech Engineering on Vimeo

Directions to find the videos:

1. Sign in to your Vimeo account
2. Scroll over the tab labeled "Me" and a secondary menu will appear underneath
3. Click on "My Profile"
4. Once your profile page appears, look toward the center of the page and click on "Kevin Sevilla"
5. Click "+see all (number) videos"
6. Either click on your first video, or search using the small magnifying glass towards the center of the page
7. *Note: Do not use the larger magnifying glass at the top right of the page as this will search the entire Vimeo site rather than the specified channel for this study.

Directions on watching the videos:

Over the next 7-14 days, please:

- View at least 60 minutes of videos from the "vtengineering" Vimeo channel.
- Do so from at least 3 different students
- Do so on at least two different occasions.
- As you progress through the videos, please check the boxes of the videos you viewed, and identify the date and time that you watched the video.
- In addition, please write down any thoughts you have regarding your experience for every 5 videos that you watched on the attached worksheets.
- Once you have finished these tasks, please contact Kevin Sevilla at kevins83@vt.edu to schedule your follow-up interview.

Keyword Searches:

<u>Students</u>

Adhemar, Andrew, Callie, Caroline, Channing, Daniel, Ellen, Emily, Evan, Garrett, Jesse, Joe, John, Lexi, Mapp, Nadia, Sunny, Tom

<u>Searchable Courses:</u>

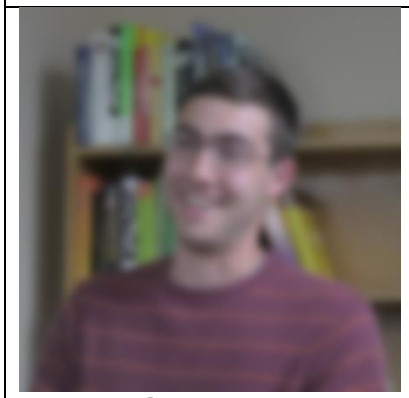
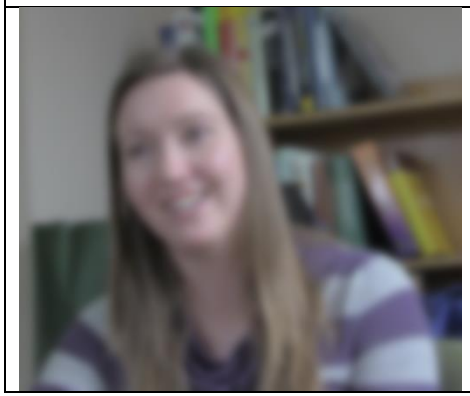
Department	Courses
AOE	Aerospace Materials, Aerospace Structures, Aero/Hydrodynamics, Aircraft Performance, Computational Methods, Intro to Aero, Thermodynamics
ECE	Electrical Theory
ENGE	ENGE Courses, ENGE 1024, ENGE 1114
ESM	ESM Courses, Statics, Deforms, Dynamics
ISE	Engineering Economy, Engineering Processes Lab, Design Operations Research (DOR)
MATH	Calculus, Differential Equations, Discrete Math, Multi-Variable Calculus
ME	Design and Economics, Engineering Problem Solving, Intro to Thermal Fluids, Manufacturing Processes Lab
MSE	Elements of Materials Engineering
PHYS	Physics 2305 (Physics I), Physics 2306 (Physics II)
STAT	Engineering Statistics

Other Searchable Terms:

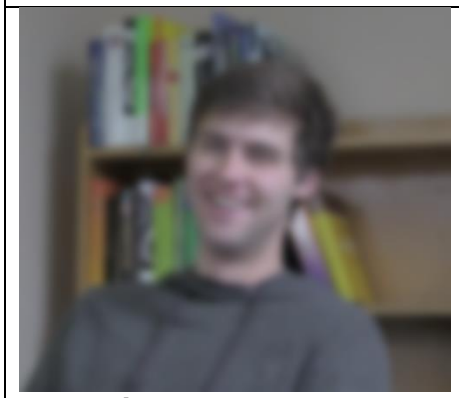
Term	**Description**
5 Year Plan	Thoughts on taking 5 years to graduate, how this decision was made, and the impacts on current academic performance
Asking Questions	Thoughts on when and how to ask questions and the benefits of doing so
Career Goals	Thoughts on what to do after graduation, jobs sought, etc.
Campus Resources	Thoughts on knowledge related to various campus social and academic resources
Changing Majors	Thoughts and experiences related to changing majors
Engineering Friends	Thoughts on the importance of having engineering friends, and the benefits related to social and academic support
Engineering Interests	Each student's particular interests in engineering be it subject area or potential employment
Faculty	Thoughts and experiences related to the importance of getting to know faculty as people, faculty during office hours, resources for career development, letters of recommendation, and graduate school work
Final Word of Advice	Each student's summative take-away message from all of their experiences as an engineering student
Group	Thoughts and experiences related to group work, study group formation, study groups in general: Barriers to forming groups, benefits of working in groups
Mentoring	Thoughts on general experiences as a mentor to other engineering students
Office Hours	Thoughts on the barriers and benefits to attendance faculty and TA office hours
Peer Interaction	Thoughts on the importance of interacting with peers within and outside of engineering
Procrastination	Thoughts on the drawbacks and impacts of procrastination
Summer School	Thoghts on the stigma, drawbacks, and what students liked about past summer school experiences
Stress Management	Thoughts on methods for dealing with all types of academic and socially-related stress

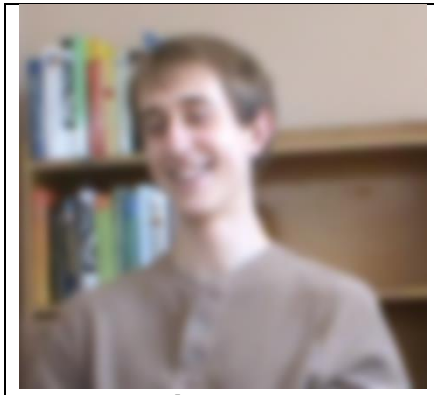
Appendix E: Complete Video Index

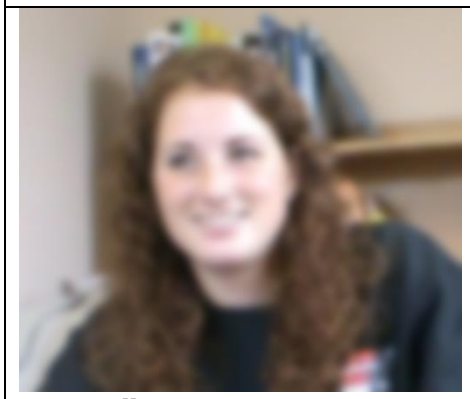
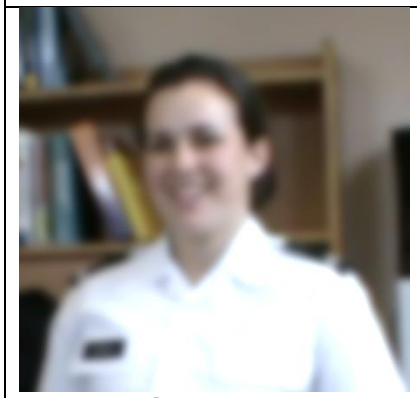
Student	Videos	Length	Date	Time
 Name: Adhemar From: Columbia, Northern Virginia Major: Aerospace Engineering Year: 3rd Misc: Soccer, Micro-Gravity Team	☐ Adhemar on 3rd Year Course Projects	[1:26]		
	☐ Adhemar on Aero & Hydrodynamics	[2:53]		
	☐ Adhemar on Aerospace Structures	[1:24]		
	☐ Adhemar on Aircraft Performance	[2:14]		
	☐ Adhemar on Asking Questions of Faculty	[0:38]		
	☐ Adhemar on Being the only Spanish Guy in Aerospace	[0:37]		
	☐ Adhemar on Checking Your Answers	[0:48]		
	☐ Adhemar on Choosing Aerospace Engineering	[2:15]		
	☐ Adhemar on Computational Methods	[3:09]		
	☐ Adhemar on Course Difficulty in Year 1 2 and 3	[0:10]		
	☐ Adhemar on Differential Equations	[2:49]		
	☐ Adhemar on ENGE 1114	[2:12]		
	☐ Adhemar on Engineering Friends and Asking Questions	[0:58]		
	☐ Adhemar on Experimental Methods	[1:35]		
	☐ Adhemar on Intro to Aero	[2:47]		
	☐ Adhemar on Intro to Aero Part 2	[1:23]		
	☐ Adhemar on Naval Architecture	[2:59]		
	☐ Adhemar on Networking for Class	[1:01]		
	☐ Adhemar on Procrastination	[0:09]		
	☐ Adhemar on Statics	[1:59]		
	☐ Adhemar on Junior Year	[1:06]		
	☐ Adhemar on the Micro-Gravity Project	[4:08]		
	☐ Adhemar on Thermodynamics and His First D+	[3:25]		
	☐ Adhemar on Time Management and Balancing Social Life	[1:43]		

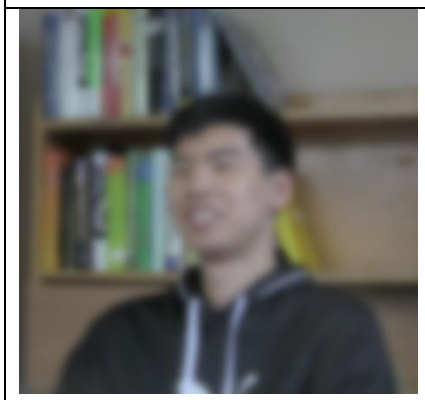
	with Academics □ Adhemar on Vector & Complex Analysis □ Adhemar on People Saying VT is Hard □ Adhemar's Career Goal □ Adhemar's Final Word of Advice 1 □ Adhemar's Final Word of Advice 2	 [1:22] [0:26] [1:54] [1:30] [2:22]		
 Name: Andrew From: Major: Mechanical Engineering Year: 3rd Misc: Home Brewing, Pi Tau Sigma	□ Andrew on C++ □ Andrew on Deforms □ Andrew on Design and Economics □ Andrew on Electrical Theory □ Andrew on ENGE 1024 □ Andrew on ENGE Courses □ Andrew on Engineering Statistics □ Andrew on Intro to Thermal Fluids □ Andrew on Linear Algebra □ Andrew on Multi-Variable Calculus □ Andrew on Studying Alone □ Andrew on the 5 Year Plan □ Andrew's Dream Job □ Andrew's Final Word of Advice	[1:40] [0:38] [3:00] [0:49] [0:41] [0:31] [0:14] [0:24] [1:09] [0:19] [0:52] [0:09] [0:34] [0:53]		
	□ Callie on her Experiences as a Galatia Leader □ Callie on Different Study Methods for Different Classes □ Callie on Actually Wanting to Learn □ Callie on Challenges Faced While Mentoring □ Callie on Differences between Male and Female Engineers' Upbringing □ Callie on Dr. Chang	[3:14] [0:23] [1:11] [1:18] [2:01] [0:58]		

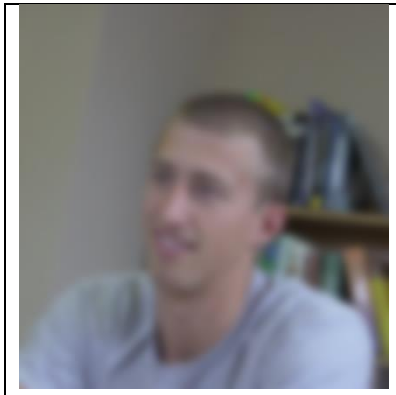
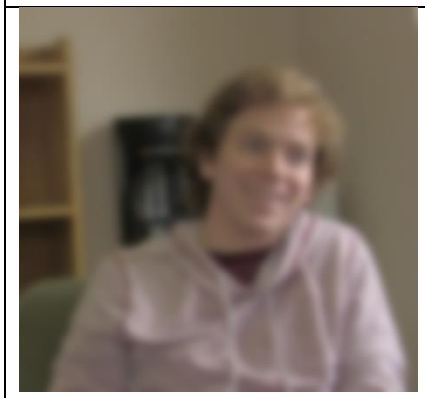
Name: Callie From: Major: Mechanical Engineering Year: 3rd Misc: CEED Mentor	☐ Callie on Encouraging Mentees to Attend Office Hours ☐ Callie on Getting to Know Faculty During Office Hours ☐ Callie on How Misery Loves Company ☐ Callie on How Professors are Different during Office Hours ☐ Callie on How to Learn From Homework and What Not to Do ☐ Callie on How to Make Effective Formula Sheets ☐ Callie on How to Prepare and Different Styles of Office Hours ☐ Callie on Reviewing Tests and Approaching Faculty Concerning Grades ☐ Callie on Stress Management ☐ Callie's Final Word of Advice	[1:43] [1:26] [1:04] [2:09] [2:28] [3:10] [1:10] [1:18] [2:10] [2:07]		
 Name: Caroline From: Suffolk, VA Major: Aerospace Engineering Year: 3rd Misc: Worked for the US Naval Research Lab, NASA Langley Research Center, and United Launch Alliance	☐ Caroline answers "Good professors are" ☐ Caroline on 3rd Semester Struggles ☐ Caroline on Aircraft Performance ☐ Caroline on Asking Questions ☐ Caroline on Barriers to Accessing Potential Mentors ☐ Caroline on Being Invited to a Study Group ☐ Caroline on Choosing Engineering ☐ Caroline on Computational Methods ☐ Caroline on Deforms and Dynamics with Dr. Chang ☐ Caroline on Differential Equations ☐ Caroline on Frustrating Lab Partners ☐ Caroline on Hypatia ☐ Caroline on Interest in Propulsions and the 1 Year M.S. ☐ Caroline on Intro to Aero	[0:42] [1:28] [0:34] [1:24] [0:36] [0:41] [0:32] [1:10] [1:03] [1:40] [1:52] [0:57] [1:57] [1:16]		

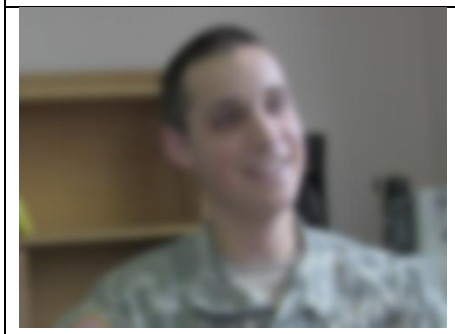
	☐ Caroline on Multi-Variable Calculus ☐ Caroline on Self-Regulation ☐ Caroline on Statics with Dr. Hendricks ☐ Caroline on the 5 Year Plan ☐ Caroline on the Third Year ☐ Caroline's Final Word of Advice	[0:54] [1:14] [2:38] [0:03] [0:51] [1:02]		
 Name: Channing From: Gretna, Virginia Major: Mechanical Engineering and Computer Science Year: 2nd Misc: Works for SWAT, Double Major, Robotics	☐ Channing on Calculus ☐ Channing on Career Plans ☐ Channing on Design and Economics ☐ Channing on Discrete Math ☐ Channing on Double Majoring ☐ Channing on Dropping Statics ☐ Channing on How to Make Friends ☐ Channing on Keeping Pace with Courses ☐ Channing on Life after Dropping Statics ☐ Channing on Manufacturing Processes Lab ☐ Channing on Physics 2305 ☐ Channing on Physics 2306 ☐ Channing on Promoting Mental Health ☐ Channing on Statics ☐ Channing on the 5 Year Plan ☐ Channing on the Differences Between Year 1 and Year 2 ☐ Channing on Why He Hasn't Attended Office Hours ☐ Channing on Working for SWAT ☐ Channing's Final Word of Advice	[0:56] [0:35] [1:55] [0:35] [1:24] [0:10] [0:11] [0:59] [0:26] [0:49] [0:50] [0:51] [0:32] [1:04] [0:25] [1:21] [0:20] [0:43] [0:38]		

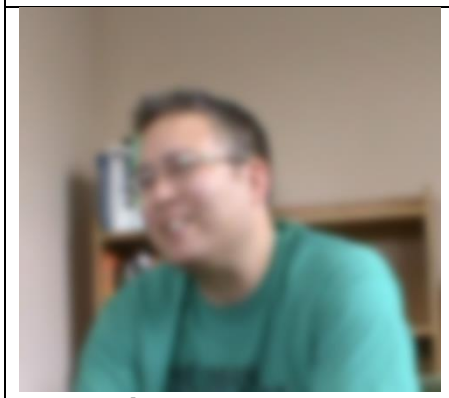
 Name: Daniel From: Deleware Major: Aerospace Engineering Year: 3rd Misc: Galileo, Outdoors Club, Interest in Philosophy	☐ Daniel on Asking Questions During Lecture ☐ Daniel on Choosing Virginia Tech ☐ Daniel on Declaring Engineering ☐ Daniel on Dynamics and Deforms with Dr. Chang ☐ Daniel on Falling Below a 3.0 and Rebounding ☐ Daniel on Freshman Year ☐ Daniel on Having the Right Mindset ☐ Daniel on How Not to Study for an Exam ☐ Daniel on Interest in Engineering ☐ Daniel on Intro to Aero ☐ Daniel on Misconceptions of Students in Engineering Classes ☐ Daniel on his Second Year Approach ☐ Daniel on Statics with Dr. Hendricks ☐ Daniel on Statics ☐ Daniel on Strategies for Success in ESM Courses ☐ Daniel on Struggling then Succeeding in Differental Equations ☐ Daniel on Taking “Fun” Courses ☐ Daniel on Taking Courses Outside Your Major ☐ Daniel on the 5 Year Plan ☐ Daniel on the Outdoors Club ☐ Daniel on Time Management and Sleep ☐ Daniel on Why he Attended Office Hours ☐ Daniel on Why he Doesn’t Recommend Taking 20 Credits ☐ Daniel on Why he Volunteered for This Project ☐ Daniel on World Regions	[0:16] [1:03] [1:19] [3:48] [2:37] [1:47] [2:19] [1:04] [0:32] [1:42] [2:39] [1:41] [4:14] [0:46] [3:02] [1:20] [1:12] [2:09] [2:01] [0:48] [1:34] [1:30] [2:39] [1:19] [0:50] [1:56] [1:08]		

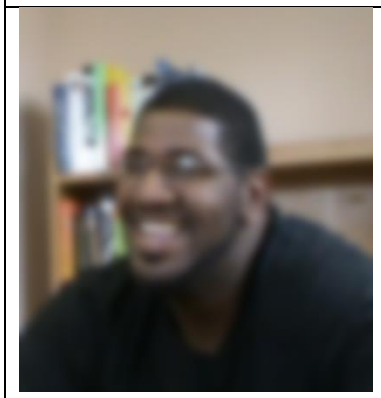
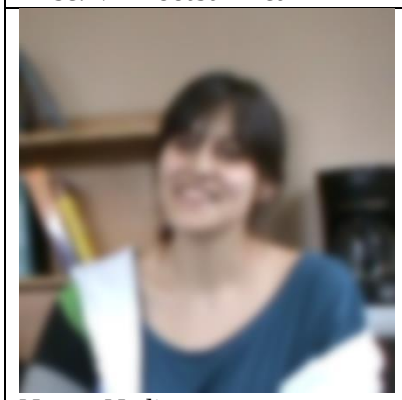
	☐ Daniel's Final Word of Advice ☐ Daniel's Final Word of Advice 2			
 Name: Ellen From: Howard County, Maryland Major: Civil Engineering Year: 2nd Misc: Field Hockey	☐ Ellen on Career Goals ☐ Ellen on Changing Majors from Architecture to Engineering ☐ Ellen on Concerns after Switching Majors ☐ Ellen on Credit by Exam ☐ Ellen on Drawbacks to Being in Engineering ☐ Ellen on ENGE Courses ☐ Ellen on her Struggles with Deforms ☐ Ellen on Multi-Variable Calculus ☐ Ellen on New Calculator Technologies ☐ Ellen on Statics Homework ☐ Ellen on Statics with Dr. Hendricks ☐ Ellen on the Fusion of her Social and Academic Life ☐ Ellon on What It's Like Being a Woman in Engineering ☐ Ellen's Final Word of Advice 1 ☐ Ellen's Final Word of Advice 2	[0:24] [0:46] [0:51] [2:10] [0:41] [1:41] [0:38] [1:27] [2:00] [0:28] [2:33] [1:22] [2:11] [1:00] [1:06]		
 Name: Emily From: Clarendon, VA Major: Aerospace Engineering Year: 2nd	☐ Emily on Computational Methods ☐ Emily on First Year Expectations ☐ Emily on Leadership and Ethics ☐ Emily on Military Bases and Naval Vessels ☐ Emily on Office Hours ☐ Emily on Physics II ☐ Emily on Plans After Graduation ☐ Emily on Retaking ENGE 1024 ☐ Emily on Retaking Multi-Variable Calculus with Dr. Robins ☐ Emily on Statics with Dr. Chang	[0:54] [0:59] [1:16] [0:59] [2:21] [1:55] [0:40] [0:33] [2:58] [2:25]		

Misc: Corp of Cadets, 5 Year Plan	☐ Emily on the 5 Year Plan ☐ Emily on the Importance of Teachers Who Care ☐ Emily on Time Spent Outside of Engineering ☐ Emily on Trying to Graduate in 4 Years ☐ Emily on What it Takes to be Successful in Engineering ☐ Emily on Why She Chose Engineering ☐ Emily on Working in Groups vs. Working Alone ☐ Emily's Introduction ☐ Emily's Final Word of Advice	[1:32] [0:16] [1:14] [0:20] [1:25] [0:48] [1:25] [0:53] [1:23]		
 Name: Evan From: Northern Virginia Major: Mechanical Engineering Year: 2nd Misc: Member of Asian Student Organizations, Christian Fellowship	☐ Evan on Dynamics Part 1 ☐ Evan on Dynamics Part 2 ☐ Evan on Expectations for Mechanical Engineering ☐ Evan on Manufacturing Processes Lab ☐ Evan on Multi-Variable Calculus ☐ Evan on Statics ☐ Evan on Unclear Career Plans ☐ Evan on Why Deforms Can Be Difficult ☐ Evan's Final Word of Advice ☐ Evan's Final Word of Advice 2	[0:24] [1:26] [0:42] [1:33] [1:19] [2:02] [0:44] [0:37] [3:43] [1:23]		

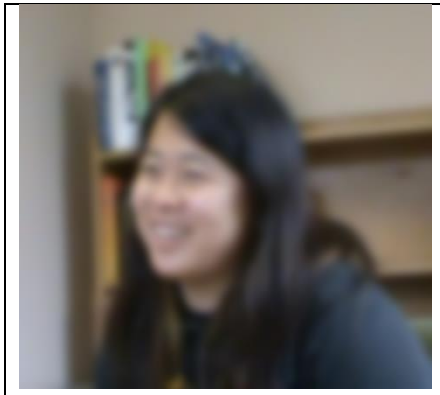
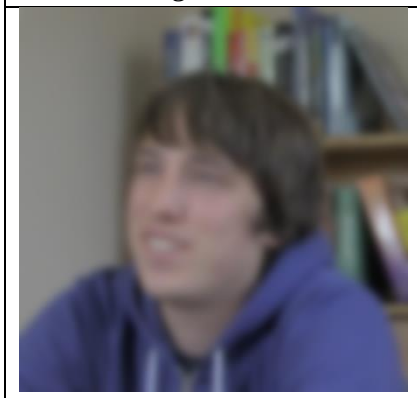
 Name: Garrett From: Pittsburgh, PA Major: Aerospace Engineering Year: 3rd Misc: VT Swim Team	☐ Garrett on Campus Resources ☐ Garrett on Mentoring through the Swim Team ☐ Garrett on Dynamics with Dr. Chang ☐ Garrett on ESM Course Strategies ☐ Garrett on the Importance of Getting to Know Faculty Members ☐ Garrett on Intro to Aero ☐ Garrett on Job Connections and SpaceX ☐ Garrett on the Most Useful First Year Courses ☐ Garret on the Stigma of Summer School and the 5th Year ☐ Garret on the Value of Office Hours ☐ Garrett on Overcoming Barriers to Attending Office Hours ☐ Garrett on Study Hall and Reading Ahead ☐ Garrett on Taking 18 Credit Hours ☐ Garrett on the Usefulness of First Year Coursework ☐ Garrett on Why His Friends Struggled During their 1st Year ☐ Garrett's Final Word of Advice	[0:10] [0:46] [1:51] [0:47] [2:06] [1:37] [1:32] [0:54] [0:40] [2:03] [1:02] [0:40] [0:45] [1:29] [0:14] [1:20]		
 Name: Jesse From: Northern Virgina Major: Aerospace Engineering Year: 2nd	☐ Jesse on Aerospace Materials ☐ Jesse on Declaring Aerospace Engineering ☐ Jesse on ESM Courses at Community College ☐ Jesse on Faculty Office Hours ☐ Jesse on How to Succeed in Aerospace Materials ☐ Jesse on Intro to Aero ☐ Jesse on the AOE Lab for Homework Help ☐ Jesse on Thin-Wall Structures ☐ Jesse on Time Management and Extracurricular Activities ☐ Jesse on Transitioning from Community College to VT	[2:53] [0:49] [1:34] [1:49] [1:36] [2:02] [1:26] [1:34] [1:36] [0:32]		

Misc: Campus Crusade, Transfer Student, Intramural Soccer	☐ Jesse on using Matlab and Mathematica ☐ Jesse on What Classes he Does Well In ☐ Jesse's Final Word of Advice	[0:27] [1:10] [0:55]		
 Name: Joe From: Virginia Major: Aerospace Engineering Year:2nd Misc: Crop of Cadets, Straight A Student	☐ Joe on 2nd Year Strategies for Success ☐ Joe on Being Diverse ☐ Joe on Communicating with Upper-Division Students ☐ Joe on Computational Methods ☐ Joe on Connecting Theory with Application ☐ Joe on Corp of Cadets Study Groups ☐ Joe on Differential Equations ☐ Joe on Dynamics Office Hours ☐ Joe on Dynamics ☐ Joe on Effort at the End of the Semester ☐ Joe on Elements of Materials Engineering ☐ Joe on ENGE 1024 ☐ Joe on Engineering Economy ☐ Joe on Engineering Interests and Career Plans ☐ Joe on Expectations from Being in the Corp ☐ Joe on Friends Regretting Leaving Engineering ☐ Joe on How to Form a Study Group ☐ Joe on Learning During Lecture ☐ Joe on Materials Engineering's Office Hours ☐ Joe on Math Links to Engineering Courses ☐ Joe on Multi-Variable Calculus ☐ Joe on Not Wanting to go to College ☐ Joe on Statics with Dr. Chang ☐ Joe on the 5 Year Plan	[0:29] [1:44] [1:06] [0:32] [1:24] [0:43] [0:29] [1:16] [2:45] [1:05] [2:33] [1:42] [0:41] [1:42] [0:45] [0:39] [1:15] [1:43] [0:28] [0:52] [0:56] [0:46] [1:24] [2:39]		

	☐ Joe on Time Management and Extracurricular Activities ☐ Joe on What it Takes to be a Straight A Student ☐ Joe on Where he Studies Best ☐ Joe on Why he Didn't Want to Attend Office Hours ☐ Joe's Final Word of Advice	[1:37] [3:17] [0:55] [1:52] [1:16]		
 Name: John From: Northern Virginia Major: Mechanical Engineering Year: 4th Misc: Campus Crusade, Failed out of Engineering	☐ John & Kevin on Being Forced to Leave Engineering ☐ John on Being the Oldest Student in Class ☐ John on Differential Equations ☐ John on Dynamics ☐ John on Group Work ☐ John on Interest in Engineering ☐ John on Statics ☐ John on Study Group Formation Differenced Between First 2 and Last 2 Years ☐ John on Summer School ☐ John on the 5 Year Plan ☐ John on Why he Volunteered for this Project ☐ John on Working in Groups vs. Working Alone ☐ John's Final Word of Advice ☐ John's Story	[3:35] [0:50] [0:53] [1:13] [1:02] [0:36] [1:30] [1:58] [0:33] [1:24] [1:28] [0:53] [1:56] [1:55]		
	☐ Lexi on Balancing Academic and Social Responsibilities ☐ Lexi on ESM Classes ☐ Lexi on Joining an American Sorority ☐ Lexi on Moving from Beijing to Blacksburg ☐ Lexi on Multi-Variable Calculus ☐ Lexi on How Statics Made Her Change Majors ☐ Lexi on Statics	[0:53] [0:21] [0:46] [1:16] [0:20] [0:28] [0:38]		

Name: Lexi From: Beijing, China Major: Chemical Engineering Year: 2nd Misc: Member of American Sorority	☐ Lexi on Thermodynamics ☐ Lexi on Why She Chose VT ☐ Lexi on Why Math is Easy for Chinese Students ☐ Lexi's Final Word of Advice	[1:26] [0:42] [1:03] [1:57]		
 Name: Mapp From: Eastern Shore, VA Major: Mechanical Engineering Year: 2nd Misc: VT Football Team	☐ Mapp on the "Being a Number" Rumor ☐ Mapp on Engineering Interests ☐ Mapp on Meeting Faculty During Office Hours ☐ Mapp on Motivation to Pick up a Notebook and Start Studying ☐ Mapp on Office Hours and Asking the Easy Question ☐ Mapp on Procrastination ☐ Mapp on Statics ☐ Mapp's Final Word of Advice	[1:11] [0:32] [1:30] [1:03] [1:14] [0:36] [0:38] [0:39]		
 Name: Nadia From: Virginia Major: Industrial Systems Engineering Year: 2nd Misc: Co-Op at Volvo	☐ Nadia on Anxiety ☐ Nadia on Becoming Jaded ☐ Nadia on Concerns over Accepting a One-Year Co-Op ☐ Nadia on Coping with Grade Realities ☐ Nadia on Differences Between Year 2 and Year 1 ☐ Nadia on DOR ☐ Nadia on Dr. Chang's Office Hours ☐ Nadia on Dynamics with Dr. Chang ☐ Nadia on Non-Academic Influences on Course Selection ☐ Nadia on Office Hours and Getting Needed Answers ☐ Nadia on Respecting Good Teachers ☐ Nadia on Self-Discipline During Lecture	[0:43] [2:08] [3:54] [1:39] [3:34] [4:59] [1:24] [1:16] [1:20] [1:16] [0:51] [0:30]		

	□ Nadia on Statics with Dr. Chang □ Nadia on Taking One Less Class □ Nadia on the Cook Counseling Center and Academic Relief □ Nadia on the Semester from Hell □ Nadia on the Stigma of Asking Questions in Class □ Nadia on the How and Why of Doing Example Problems □ Nadia's Final Word of Advice □ Nadia's Final Word of Advice 2	[4:58] [0:33] [3:27] [8:02] [0:22] [1:03] [1:36] [2:38]		

 Name: Sunny From: China Major: Chemical Engineering Year: 2nd Misc: Rowing Team	☐ Sunny's Introduction ☐ Sunny on Asking Questions ☐ Sunny on Changes Made Between Year 1 and Year 2 ☐ Sunny on Co-op vs. Research ☐ Sunny on Enjoying Hard Classes ☐ Sunny on Her First Withdraw ☐ Sunny on Mass and Energy ☐ Sunny on Physics 2306 ☐ Sunny on School in China ☐ Sunny on Studying with Friends ☐ Sunny's Final Word of Advice	[0:50] [0:32] [0:59] [0:41] [0:54] [3:00] [1:16] [0:53] [1:38] [0:54] [2:19]		
 Name: Tom From: New Jersey Major: Aerospace Engineering Year: 3rd Misc: Micro-Gravity Team	☐ Tom on First Year Experiences ☐ Tom on Graduate School ☐ Tom on Group Work 2 ☐ Tom on Intro to Aero ☐ Tom on Matlab ☐ Tom on Office Hours ☐ Tom on Statics ☐ Tom on Study Groups for Difficult Courses ☐ Tom on the 2nd Year ☐ Tom on the Micro-Gravity Team ☐ Tom on the Time Requirements to Excel in Engineering	[0:54] [0:09] [0:19] [1:10] [0:15] [0:28] [0:51] [0:33] [0:37] [1:18] [0:21]		

Appendix F: Participant Notebook

Directions: Please use the space provided below to take down any notes or thoughts you have concerning the videos as you progress through them. This will be collected and photo-copied when you return for your follow-up interview.

Videos 1-5

Videos 6-10

Videos 11-15

Videos 16-20

Videos 21-25

Videos 26-30

Participant Notebook

Videos 31-35

Videos 36-40

Additional notes:

Appendix G: Choice Codebook

Code	Theoretical Definition	Contextualized Definition	Inclusion Criteria	Example
Overall Choice Strategy *Emergent*	None	Statements identifying overall choice strategies related to navigation of the tool.	Reference to choices based on mentor photo, self-identified descriptors, video titles, or video length	"I watched Ellen's videos because of her picture. I was just, like, 'oh she looks pretty normal'" [Illusiona]
Personal Identity *A priori*	"Personal identities are those aspects of one's identity that serve the psychological function of making one feel unique… the most valued aspects of what James called the ME self – the self that one knows through observation of one's own behaviors and characteristics" (James 1892/1963 in Eccles 2009).	Choices made based on perceptions of personal uniqueness without reference to a larger group affiliation.	References comparing and/or relating virtual mentors, friends, and other social influences to the self	Self: "I'm looking for me" [Arista] Friends: "I went to people that I knew" [Arista] Other: "He's in one of my classes this semester, so I just wondered, what the heck." [Balcones]
Collective/Social Identity *A priori*	"Collective identities are those personally valued parts of the self that serve to strengthen one's ties to highly valued social groups and relationships" (Eccles 2009).	Choices made based on one's perceived affiliation with a specific group.	Reference to demographics, major, and other group affiliations with virtual mentors.	"I guess Adhemar cause he plays soccer and is foreign" [Balcones]
Utility Value *A priori*	The usefulness to engage in a task or activity towards the fulfilment of one's short and long-term goals (Eccles 2009).	Choices made based on the perception of the usefulness of content based on the virtual mentor's perspective or video title.	Reference to content related to past, current or future coursework, professor, or social concern. Specific reference to usefulness of content	"…watched almost every single multi-variable calculus video that there was… because I'm not doing very well in that class and wanted to see what everybody else had to say about it" [Calera]
Interest Value *A priori*	Intrinsic interest in a task (Eccles 2009).	Choices made based on potential interest in, or curiosity of, virtual mentor's perspective or the video content.	Reference to potential interest or curiosity in video content.	Interest: "I watched the not wanting to go to college one cause I thought that was really interesting cause I think it says on there "4.0 student" and it's like you didn't want to go to college but you have a 4.0, like that's amazing." [Starr] Curiosity: "I watched that one about his career goal so I just wanted to see where he was headed" [Collier]

Appendix H: Reaction Codebook

Code	Theoretical Definition	Contextualized Definition	Inclusion Criteria	Examples
Reaction to Mentor				
Affective Reaction *A priori*	The elicitation of an emotion response (Eccles et al., 1983).	A resultant objective or emotional response to virtual mentors	Reference to emotional responses (i.e. happiness, sadness, anxiety, etc.)	"Ellen said, oh engineering's all alcoholics. I found that really funny, so I was just, like, laughing in the library to myself. Or when that guy said engineering economy was the easiest class, I got really pissed off." [Illusiona] "I think the biggest proponent of this that benefited me and has the potential to benefit other people is the emotion investment and the visual response and being able to see that. Being able to see their hand movements, see their facial expressions, see their pauses when they think about something, that's even more intrinsic and relatable rather than just answers…so like seeing the way they react to the question and the response and the way their face changes basically as they go through what happened, it's pretty good." [Collier]
Current Personal Identity *A priori*	"Personal identities are those aspects of unique… the most valued aspects of what James called the ME self – the self that one knows through observation of one's own behaviors and characteristics" (James 1892/1963 in Eccles, 2009).one's identity that serve the psychological function of making one feel	The realization that a given virtual mentor is similar to the participant as they exist today.	Reference to similarity between a virtual mentor and self at the present time	"Andrew. Cause he got a C+ in C++. And he like you know doesn't do amazing but he does good, he tries and he does whatever he can do and like that's what I do." [Arista]
Current Personal Identity [Negative] *Emergent*	None	The realization that a virtual mentor is not similar to the participant's current self.	Reference to dissimilarity between a virtual mentor and self at the present time	"Ones that were like "Ah, I have a perfect life and I got a 4.0 and I liked aced every class" you know, cause that is not how my college life is going." [Padrona]
Interpretation of Content				
Agree/Disagree	None	Agreement or disagreement with the content of a particular video.	Direct reference to agreeing, or disagreeing with the contents of a video.	Agree: "She talked about how math is usually easier for her to work by herself whereas other classes are easier to work in group which I COMPELTELY agreed with." [Starr]. Disagree: "I can kind of relate to Caroline's stuff in a way like where I just disagree with it completely" [Melville]
Interest Value *A priori*	Intrinsic interest to engage in a task (Eccles, 2009).	The finding of video content to be interesting	Reference to finding a video's content	"You're going to fail a test, you're probably going to fail at least one test so I thought that was interesting cause she

			interesting.	obviously went through a lot of anxiety and a lot of stress so she's like a really good person to take as an example". [Starr]
Utility Value *A priori*	The usefulness of engaging in a task or activity towards the attainment of one's short and long-term goals (Eccles, 2009).	Resultant perception of the usefulness of a video's content in terms of the validation of past experience, immediacy, or future experiences that may be encountered	Reference to the usefulness or lack thereof of video content or statements about video length	"I watched a video on DOR, which I have to take next year, so I am not even in the class but it was cool about her opinion, cause there is only one professor like I'm going to have him and her opinions on him was cool to like get." [Padrona] Negative: "If they don't give a ton of detail or advice on it, then that might be kind of misleading but if they were like this is how I did my homework, this is when I talked to my professor, like this is HOW I succeeded, then that would make sense." [Starr] Video Length: You can tell if it's a really short video, a lot of them said what happened but they didn't really give advice… The main thing is like whenever they said something that happened that was bad to them, they didn't explain how they got through it. [Melville]

Appendix I: Outcomes and Affordances Codebook

Code	Theoretical Definition	Contextualized Definition	Inclusion Criteria	Example
Emerging Collective Identity *A priori*	None	The realization that one's perceptions of uniqueness in being or experience are not, in fact, unique.	References to not being alone or not being the only one through connections with virtual mentors and/or content.	"That I'm not the only one dealing with this kind of stuff. I'm not alone! It's just nice to know that other people go through the same stuff, like I'm not this one kid that's just like behind and everyone else is succeeding, stuff like that. It's cool." [Melville] "I'm going through the same exact thing and they're getting through it really well", so it's like inner connection basically. I'm like wow this is not uncommon I guess." [Rocky]
Future Intentions *A priori/Emergent*	None	An intention to act out a potential behavior resulting for viewing a particular video or set of videos.	Reference to potential action behaviors directly referenced in a particular video.	"Yeah I will definitely try to go to teacher's office hours even if I don't have questions just to get a better feel of the teacher and why they're teaching their way." [McKeel]
Affordances *Emergent*	None	Unique affordances of the tool in comparison to in-person alternatives.	Reference to the benefits of the tool	"…stuff like this is ESSENTIAL, especially for introverts. If they can't go out and seek some personal help, these people talking to them in their room is the next best thing." [Collier] "Yeah well the thing is some people that need help don't want to admit that they need help. That's the biggest thing. And I'd say this is probably one of the best answers for them, to watch videos. Cause then it's completely confidential, you're watching the video on your own. You have no one else judging you which is what I think they're afraid of, to be judged. And if they can just watch a video and get advice from it, then that's awesome." [Melville]
Drawbacks *Emergent*	None	The drawbacks of the tool compared to in-person interactions.	References to the drawbacks of the tool	"The one downfall I would say is that you cannot extend the video…it's not an open discussion, it's a closed discussion" [Collier] I feel that's the main difference. You can't interact with them which is the only drawback really, and it's kind of big." [Melville]