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University of Northern Colorado

Greeley, Colorado

STUDENT MOTIVATION IN EDUCATION: AN INTERVENTION IN REAL-TIME

A Thesis

Submitted in Partial

Fulfillment for Graduation with Honors Distinction and the
Degree of Bachelor of Arts

Maddison N. North

College of Educational and Behavioral Sciences

December 2019

STUDENT MOTIVATION IN EDUCATION: AN INTERVENTION IN REAL-TIME

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December / 1 / 2019

Abstract

Motivation and academic performance have been shown to be linked (Pintrich & DeGroot, 1990), so improvement in academic motivation or factors that influence it may have the potential to improve academic performance. Academic motivation can ebb and flow over a semester or even throughout a day. Even with these fluctuations, some students have the needed skills to remain motivated to study, attend class, and complete assignments in an academic environment. Yet, some do not and the college environment has many potential distractions, thus, strategies to help these students maintain motivation throughout the semester can have benefits for academic success. The main objective of this study was to understand whether a mobile intervention could be utilized to increase students' academic motivation, perception of educational value, and their use of more positive study strategies while potentially improving overall academic performance. Thirty-eight participants from the University of Northern Colorado were recruited to pilot a novel mobile-intervention, with 19 participants being randomized to both a control and intervention group. The intervention group received strategies to help them improve their use of study skills and increase their perception of educational value via prompts on a smartphone app over a two-week period. Using ecological momentary assessment (EMA), data was collected from both groups in their everyday lives, three times a day, over a two-week period. The EMA questions focused on how students approached their study sessions, how they studied, what strategies they used, their self-efficacy toward learning, and their level of motivation in that particular moment. Between group factors such as self-regulation, self-efficacy, and academic performance (e.g., semester GPA) are examined. The results of this study may have future

implications for improving academic motivation and overall academic performance in college students.

Acknowledgements

First and foremost, I would like to express my deep gratitude to Dr. Michael Phillips, my thesis advisor, for his patient guidance, enthusiastic encouragement, and useful critiques of this research work. His willingness to give his time so generously has been very much appreciated. I would also like to thank Dr. Kerry Duck for his advice and help in doing the data analysis for this project.

I would also like to extend my thanks to the personnel of the Honors program for their help in offering the resources needed for completing this study.

Finally, I wish to thank my parents and other family members for their support and encouragement throughout this project.

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Student Motivation in Education: An Intervention in Real-Time

While motivation is imperative for student success, it may be hard at times for students to adequately motivate themselves or know how to generate this action. A possible solution is to intervene with students (Hattie, Biggs, & Purdie, 1996) throughout the day so they become more attuned to what motivates them and generates greater self-regulation. Reaching students in their everyday lives is not an easy task when developing an educational intervention; however, with greater levels of mobile technology use, one way to interact with students is via their cell phones.

Cell phones are tools that can utilize ecological momentary assessment (EMA), a methodology used to gather information about individuals' daily lives. EMA has been adapted to develop interventions (ecological momentary interventions; EMIs), but has not been fully leveraged to intervene with students for educational outcomes. The current study has the potential to demonstrate how an intervention could be developed for students to intervene in real-time via the use of mobile technology, which may lead to improved student motivation. The purpose of this experimental study was to explore the effect of an educational EMI, which was developed to improve students' self-regulatory processes, self-efficacy, and motivation.

Literature Review

Social-Cognitive Perspective

Social-cognitive theory (SCT) states that an individual's ability to gain knowledge and information is directly impacted by the environment and context of the individual (Reeves, 2015). Based on SCT, motivation is not solely based on internal states but is also connected to the dialectical nature between the individual and their environment.

When an individual starts an activity, there are multiple factors that will impact their motivation (e.g., personal beliefs, emotions, etc.) along with their current contextual surroundings. The individual reacts to their environment which changes their behavior, which in turn will impact the environment, creating a reciprocal relationship (Stajkovic & Luthans, 2002). Motivation is socially influenced (Urdan & Schoenfelder, 2006), so in order to further understand motivation, it may be best to assess it while students are in their natural, social environment. This could also mean that the most effective way to help improve student motivation is to implement an intervention while the individual is in their natural setting as opposed to a lab or counseling setting. Inserting an intervention into students' daily lives that focuses on aspects such as increasing self-efficacy and self-regulation skills could be the key to helping students get and stay motivated academically.

Self-Efficacy. Self-efficacy refers to how an individual judges their own capabilities to execute an action and is important for motivation because it impacts actions taken, effort, and persistence (Schunk, 1985). Learning and achievement can be predicted by an individual's level of self-efficacy. People's performance will be affected by their perception of their ability to complete a goal. Beyond their performance, their willingness to grow and learn are also affected by self-efficacy. Individuals with high self-efficacy will engage with an activity and pursue it longer, which may lead to greater development of skills or learning, in comparison to those with lower self-efficacy (Schunk, Meece, & Pintrich, 2008). Within education, lower self-efficacy is related to less effort and task persistence (Schunk et al., 2008) while those with higher self-efficacy use more cognitive and self-regulatory learning strategies (Pintrich & De Groot, 1990).

While social comparison is a way in which self-efficacy may be strengthened or weakened, the factor that has the largest impact on an individual is their personal experiences or history with a particular learning task (Schunk, 1985). If students consistently fail in their education, they will no longer put effort forth to try and improve because they believe themselves to be incapable of success. Thus, it is crucial for students to have the skills and strategies to stay motivated and achieve as this tends to improve their self-efficacy, which then can predict the likelihood of them engaging with the content later in the future. It may be beneficial to give students an intervention that will give them the skills to succeed when the next opportunity arises.

Self-Regulation. In education, self-regulation is the process by which students control their behavior, emotions, and thoughts in order to work towards and achieve their academic goals (Schunk et al., 2008). If a student can see the benefit or value of a class, is interested in the material, or wants to earn a certain grade, they may initiate behaviors that will help them perform well in a class and remove distractions. Yet, it is important to note that while an individual may be influenced by the environment or those around them, it is still the student that must choose to engage in the necessary behaviors that will help them set and maintain a goal (Stajkovic & Luthans, 2010). Self-regulation in learning works in a cyclical loop (Zimmerman, 1990), starting with analyzing a task, setting a goal, and planning an approach. Goals and goal setting can largely impact performance by affecting direction, effort, and persistence needed to complete a task. Goal setting also enables an individual to view their overall progress in completing a certain task (Locke, 1996). Self-regulation continues as the plan is executed and monitored for effectiveness. After the task is completed, it is important to review

performance for successes and ways to improve. In education, this cycle continues repeatedly as the student engages in further learning.

Being able to adapt study behaviors to the demands of the learning task is a crucial aspect of self-regulation. Regulating behavior, such as staying motivated to study, may result in higher performance in a class. As noted (Creed & Kuncel, 2008), student's study motivation and study skills, not standardized tests scores, have stronger relationships to grades in individual classes and with overall cumulative GPAs (Robbins et al., 2004). Study skills refer to student's ability to use different strategies to manage time and accomplish different academic tasks (Crede & Kuncel, 2008). It appears that these skills and behaviors can be taught to students. Andrzejewski and colleagues (2006) investigated an intervention that focused on improving self-regulation strategies in high school students. Students in the intervention group would keep a log of their goals and self-regulatory behavior, which enabled them to reflect on their overall academic performance, from setting a goal to task completion. The researchers found it is possible to develop students' self-regulation skills in an academic setting, particularly for students of minority groups.

Ways of Improving Motivation

Setting Goals. Some strategies that have been utilized to improve motivation include aspects related to goal setting (Lazowski & Hulleman, 2016). Research studies that taught students how to set academic goals and take more responsibility for their learning (Morisano, Hirsch, Peterson, Pihl, & Shore, 2010; Tuckman, 2003) found that those given this intervention had a significant increase in motivation. Locke and Latham (2002) found that goals that are specific and difficult, yet attainable, create a task that the

student is committed to, which increases performance. Students may struggle to set effective goals for themselves, impacting their academic performance. Helping students improve their ability to set goals through an intervention may help increase overall self-regulation and academic performance as the student creates a direction in which to put their effort.

Shifting Value. Wolters (1998) found that students use different strategies to regulate their motivation including performance goals, extrinsic rewards, task value, interest, efficacy, environment, and attention. When students were dealing with subjects perceived not to be valuable, they would implement strategies that focused on extrinsic motivation as opposed to those that helped them process the information and learn at a deeper level. Students who used extrinsic motivators received higher grades, but these strategies were not linked to higher level learning and achievement. As noted, students can motivate themselves to receive the grade they want, but they may not be learning the material at a deeper level or at a higher quality (Wolters, 1998). Aside from just looking at what motivates students, it is important to know more about their motivational patterns. The learning quality is directly related to their learning goals or the perspectives they have about the information being presented to them.

Perceptions of value for education and the learning process can impact the level and quality of motivation (e.g., persistence in the face of failure). In order for a student to be motivated to do well and have a high quality of learning, the perspective of the student needs to be changed from relying on external motivators (e.g., grades; Valle et al., 2009). In one study, when students were able to make a connection between coursework and their lives, they had increased interest to learn the content. Additionally,

performance in their college courses was increased, particularly for lower performing students (Hulleman, Kosovich, Barron, & Daniel, 2017). Bolan, Goodboy, and Kelsey (2016) investigated the association of instructor clarity on performance but instead found student perception of class value to be of higher importance. This study demonstrated that even a clear instructor may fail to impact students' performance if they are not motivated to do well or if they do not find the lecture to have much value. While having a clear instructor is better than having one who is not clear, students' motivation plays a bigger role in how well they will learn the material. This finding is similar to the utility value interventions that have been evaluated. For example, when students were given the task to write about the utility value of their course, they received higher grades, continued on to the next course in the program, and kept their major (Canning et al., 2018). When an individual views a task or learning activity as not being valuable then they will have a difficult time being motivated to complete the task and do well (Engelschalk, Steuer & Dresel, 2016).

Interventions that have been shown to improve student performance do so by promoting the value of education and getting students to see the relevance of what they are learning to their lives (Hulleman, Godes, Hendricks, & Harackiewicz, 2010). The effects of an intervention may also be long lasting past the semester in which the intervention is delivered (Tibbetts et al., 2016). A student's perception of a class will impact their motivation, so improving student perception through an intervention may have the possibility to increase motivation. As Wolters (1998) demonstrated, students tend to rely on motivational strategies with extrinsic motivators which leads to poor learning and retention. If students can be motivated by increased perception of value,

goal setting, or future implications of their success in school, there may be improved academic performance and quality of learning.

Methodological Considerations of EMA

With motivation being ephemeral and tending to fluctuate throughout the day, week, or semester, it is important to consider and be able to use methodologies that allow for enough precision to study these changes. Ecological momentary assessment (EMA), or experience-sampling method (ESM) as it is sometimes referred to in educational studies, is a tool used to assess and study participants' feelings, thoughts, or activities in the moment as they go about their daily lives (Zirkel, 2015). The ease of EMA implementation has become more feasible due to advances in technology. The purpose of using EMA is to assess participants in the context of their lives to get information as close to the experienced phenomena in a natural setting, which provides greater precision for assessing changes. EMA allows for data collection through multiple means, such as written diaries, physiological sensors, telephone calls or text messages, or through a smartphone app (Shiffman, Stone, & Hufford, 2008). As smartphones have become more accessible and usable to a larger population (Kuntsche & Labhart, 2013), the potential for using EMA to collect data has also increased. Participants are often measured several times a day over a period of a few days to multiple weeks (Smyth & Stone, 2003; Beal & Weiss, 2003). Participants tend to be sent prompts to assess certain aspects of their lives. In the context of motivation in education, students may be asked throughout the day about their level of motivation (e.g., Phillips, Phillips, Lalonde, & Tormohlen, 2015). Researchers are able to examine how a certain aspect of an individual fluctuates or

changes throughout the day and pinpoint moments when this aspect is potentially at its highest or lowest.

Benefits. There are several benefits to using EMA for data collection. One is that EMA does not require a participant to come into a lab, they can be studied in any environment (such as the classroom). This allows access to information with greater precision in an easy manner. Researchers can analyze the data to find the specific moment that behaviors, feelings, and thoughts change as the participants go about their day, which may lead to answers and new questions. Participants tend to be measured several times daily over a certain period of time, which gives the researcher enough data to ensure enough power with a smaller sample size. Another benefit of using EMA is that the participants' responses do not have to be the same across the board. Researchers can still make use of participants who do not have a consistent response rate, while other methodologies may require that there be an equal number of reports from each participant to be valid (Zirkel, 2015). When participants are tested in a way that requires them to come into a lab, they have time to reflect on their experiences and insert some sort of bias, whether they realize it or not. EMA does not allow for recall bias to take place as easily because participants do not have as much time to reflect or rethink on their experience as they would when taking a survey in a lab (Stone et. al, 1998). Participants are forced to answer questions about their experience in the moment, which may mean that the data is more ecologically valid.

Implications for Use. The use of EMA has become more popular in recent years due to technological advancement. This tool is very accessible to participants because it can be used on a mobile device that is able to download apps. The potential for research

has increased through attainable technology as it is now possible to measure factors of individual's experiences that could not be measured before.

Due to the unique nature of EMA, researchers are able to take a deeper look into the daily behavior of their participants (Biddle, Gorely, Marshall, & Cameron, 2009; Dunton, Whalen, Jamner, & Floro, 2007; Rouse & Biddle, 2010; Wichers et al., 2012). Prior to the use of EMA, researchers would have to rely on self-reports which may be affected by recall bias or social desirability. EMA can give a more accurate picture of each individual's natural experience, which allows the researchers to explicitly map out the lives of their participants. Knowing participants real-life experiences could lead to the creation of an intervention, should there need to be one. Interventions through EMA will be discussed further on.

Another large area that has been studied using EMA is exercise (Spook, Paulussen, Kok, & Empelen, 2013; Kanning & Schlicht, 2010) and diet (Stein & Corte, 2003; Carels, Douglass, Cacciapaglia, & O'Brien, 2004; Spook et al., 2013). The findings of many of these studies correlates with studies completed in the past, but the use of EMA adds strength to the correlation because the data was collected in real-time. EMA can be used to add a significant strength to any relationship that may be studied. While these study areas are quite broad, EMA can be used to study more specific topics, such as fatigue in breast cancer patients (Curran, Beacham, & Andrykowski, 2004).

Even though EMA has been used more recently with the development of technology, there is still many places for this tool to go. This methodology is starting to emerge in the clinical sphere to monitor different psychological disorders (Trull & Ebner-Priemer, 2009) and will most likely expand quickly. Cohn, Hunter-Reel, Hagman, and

Mitchell (2011) assessed apps that are available to monitor alcohol-use. Cohn and colleagues believe EMA may be a viable way to change behavior, but since there has not been a lot of development, they are pushing for researchers to use EMA more. Ecological momentary assessment still needs to be developed further but it has the opportunity to be a limitlessly useful tool.

Runyan and colleagues (2013) set out to create an app that could be used to investigate phenomena that occur within everyday life as opposed to being studied in an artificial laboratory setting. Another reason they decided to create an app for smartphones was because EMA had been relying on technology, such as palmtop computers, that needed to be provided to the participants. The creation of the app made using EMA as a tool for collecting data more cost-effective as there was no need to invest in devices to collect the data as most individuals carry a smartphone. The effectiveness of this EMA program for collecting real-time data was tested with undergraduate college students to log their time. The researchers posited that an app would be effective in causing change within individuals and could create greater self-awareness toward a targeted behavior. The researchers gave participants a pre- and post-assessment to measure how self-aware participants were as to how they spent their time. Eighty percent of individuals in the experimental group who used the created app reported that they became more self-aware as to how they spent their time. This claim was supported as the researchers found that participants in the experimental group became more self-aware with how they spent their time based off of the post-assessment. The researchers believe that the results from this study indicates that EMA is a viable way to bring greater levels of self-awareness and potential changes within an undergraduate student population.

Potential Benefits of Using in-the-moment Educational Interventions

While EMA has been primarily used for assessing and collecting data, there has been a slow movement for using the technology to intervene with participants. The data collected from EMA can be viewed and structured in a way that shows how individuals may change over time. If an intervention is successful then the researcher can more easily locate the moment the intervention had an impact on an individual or if there is behavioral creep back towards the behavioral mean. As changes take place within the individual, researchers can look through their daily experiences to find where these shifts occur. Ecological momentary intervention (EMI) is similar to EMA as the goal is to gain access to participants in the moment, but differs in that it is trying to change behavior. EMI has all of the same benefits of EMA but it is necessary to reiterate some of those aspects. It is possible through technology that EMIs may be delivered on an electronic device such as a phone, which is portable and available at most times. This means an intervention may be implemented in the participants normal living environment which may be more beneficial than only being offered the intervention during a lab or office visit (Shiffman, Stone, & Hufford, 2008). Participants may be more likely to accept EMIs because the use of an electronic device is comforting and private to the individual (Heron & Smyth, 2010).

Heron and Smyth (2010) studied the benefits and efficacy of using ecological momentary interventions by analyzing 27 interventions that used EMIs to promote healthy outcomes for participants. EMIs have been found to be efficacious for a broad range of areas, including treatment for generalized anxiety disorder (GAD; Newman, Przeworski, Consoli, & Taylor, 2014), smoking cessation (Businelle et al, 2016), and

education (Mundi, Lorentz, Grothe, Kellogg, & Collazo-Clavell, 2015). There seems to be more success among studies that are focused on younger people due to their familiarity with the technology used, such as smartphones, for the EMI. This suggests that EMIs have a higher potential of being more accepted and successful than traditional treatments among certain age groups that have grown up with technology, as it potentially fits better with their lifestyle. After analyzing the studies, the researchers concluded that EMIs may be an option for treating different psychological and physical problems if implemented effectively (Heron & Smyth, 2010). As EMA has been successfully used to assess college students and predict performance (Wang, Harari, Hao, Zhou, & Campbell, 2015), the next step would be to try to alter or change behavior through an intervention for the benefit of the student.

Research Questions

The overall objective of this study was to explore students' in-the-moment study strategies and motivational patterns along with investigating an ecological momentary intervention used to try and influence students' motivation and study strategies in the moment.

Research Questions

- 1) Does motivation, time spent studying, and study strategies fluctuate throughout the day or week across the study's period? If so, how?
 - a. Are there in-the-moment differences based on demographic factors (e.g., gender, level in school, cumulative GPA)?

- 2) Does the use of the EMI for the intervention group improve motivation, self-efficacy, study strategies, and perceived value of education comparatively to the control group?
 - a. Which part, if any, of the intervention seems to be the most successful?

Methods

In order to investigate motivation in education and the potential benefits of an in-the-moment motivational intervention (EMI), an experimental design was utilized. Participants were randomly assigned to one of two groups, control or intervention. Ecological momentary assessment (EMA) data was collected three times per day across the two-week study period from both the control and intervention group via a smartphone app. The intervention group also received ecological momentary intervention (EMI) prompts delivered through the same smartphone app, which aimed to improve student motivation through prompting the use of study strategies and increasing perceived value of education. These prompts were delivered once per day in the morning, across the two-week period.

Participants

Thirty-eight participants (mean age = 19.24, $SD = 2.81$), who were predominantly Caucasian (65.8%) and female (68.4%), were recruited from the psychology participant research pool at UNC through the SONA system (demographic information in Table 1). In order for students to be eligible, they needed to meet the following criteria: 1) be 18 years or older, and 2) have access to a smartphone. They were asked questions when they arrived for the lab appointment to ensure eligibility.

Table 1. Demographic Information for Participants

Characteristics	
Age (M, SD)	19.24 (2.81)
Sex (n, %)	
<i>Male</i>	12 (31.6%)
<i>Female</i>	26 (68.4%)
Cumulative GPA (M, SD)	3.28 (0.45)
Race/Ethnicity (n, %)	
<i>Caucasian</i>	25 (65.8%)
<i>Hispanic/Latino</i>	4 (10.5%)
<i>African-American</i>	6 (15.8%)
<i>Pacific Islander</i>	2 (5.3%)
<i>American Indian</i>	1 (2.6%)

Research Compensation

Participants could receive up to 6 points of PSY 120 participation credit if they completed the full study. The 6 total credits were broken down based on the portions of the study completed: if a participant completed the initial pre-survey in the lab during the baseline session, they received 1 credit. With the EMA questions over the two-week period, if they completed more than 50% of the smartphone prompts, they received 4 credits. If their response rate fell below 50%, they received 2 credit points. And if they completed the last survey at the follow-up, they received 1 final credit for a potential total of 6 credits.

Procedures

Once participants presented to the lab for their baseline appointment time, they were provided with a description of the study and an informed consent form (see Appendix E). Consenting participants were then randomly assigned to the intervention or control group, but were blocked based on sex (male or female) to ensure equal numbers in each group.

All participants completed a baseline survey in the lab that included the Motivated Strategies for Learning Questionnaire (MSLQ), a Self-Efficacy for Self-Regulated Learning measure, and demographic information. After completing these initial baseline measures in the lab, all participants were trained on how to use the EMA smartphone app (LifeData), and allowed to ask questions regarding how to use it during the short training session. The initial baseline appointment took approximately 15-20 minutes.

After participants left the initial lab appointment, they began to receive EMA prompts the following day. Participants were prompted on their smartphones three times a day (randomly in the morning, afternoon, and evening) over a two-week time period. The intervention group also received an intervention prompt suggesting strategies in order to help them improve their perception of educational value and the use of study skills. These intervention prompts were administered once daily over the two-week period in the morning. Participants would receive a notification on their phone when a prompt was available and had one hour to respond before the prompt would close.

The EMA data collection lasted for a two-week period for both the intervention and control groups. Once the two-week EMA period was complete, students presented to the lab to complete a post-survey for the MSLQ. Participants' semester GPA was collected at the end of the semester in which they participated.

Data Sources

Baseline Measures. After providing informed consent, participants were presented with baseline survey measures in the lab. Data included participant demographics (e.g., age, sex/gender, ethnicity/race, college status, major, etc.) which are

listed in Appendix A, the Motivated Strategies for Learning Questionnaire (MSLQ), and a Self-Efficacy of Self-Regulated Learning measure.

Motivated Strategies Learning Questionnaire (MSLQ). Pintrich and DeGroot (1990) developed the MSLQ to assess student motivation, learning strategies, and performance (Duncan & McKeachie, 2005). It consists of 44 items with a 7-point rating scale as to how true the item relates to the behavior of the individual, such as “It is important for me to learn what is being taught in this class.” For this study, nine of the subscales were used. The measure is listed in Appendix B.

Self-Efficacy of Self-Regulated Learning Measure. Bandura (1996) created a measure designed to examine students’ self-efficacy for their self-regulated learning. Participants rate ten items on a scale from 0% to 100% regarding how confident they feel they can implement certain self-regulatory strategies such as finishing homework assignments by deadlines. The measure is listed in Appendix C.

EMA Protocol. Participants were assessed three times a day, randomly in the morning, afternoon, and evening over a two-week period. The items focused on their academic motivation, the amount of time they had spent studying, study strategies used, the social context when studying, confidence in their studying, perceived value, and potential activities that might have gotten in the way of studying (see Appendix D).

Ecological Momentary Intervention

The intervention focused on improving student’s use of positive study strategies and their perception of educational value. The participants in the intervention group received the EMI via the same smartphone app that the EMA questions were delivered through.

EMI Protocol. Participants in the intervention group received one of the following prompts randomly once per day:

1. Create a specific goal for your next study session. Define what you want to accomplish and how you will complete your goal. In addition to this screen, write this goal down in your planner or notebook to be reminded of it when you next study.
2. Think about a topic you have been learning and/or studying about this week. Reflect and write a short response (3 sentences) about how the material relates to your life in some way.
3. Think about yourself and your future goals. Now think about how those future goals are connected to your current courses and your learning. How does what you do now relate to your future self (and future goals)?
4. Do you have any future career goals? How do you plan on achieving those long-term goals?

Data Analysis

Baseline Analysis

After baseline data was collected from all participants, information from the demographic questions, results from the motivated strategies learning questionnaire (MSLQ) and self-efficacy of self-regulated learning measure were analyzed and compared participants between the two groups. When examining the demographic information and other baseline measures, no significant differences were found between participants in the two groups, suggesting the participants in each group were similar.

Content Analysis

In order to understand how students in this study were spending their time, a content analysis was conducted over responses to the question, “What are you currently doing right now?” A content analysis is often used to explore themes and patterns in qualitative data. For this question, 1,286 responses were received and coded. After reading all of the responses, different themes were created and then all of the responses were coded using these themes (Table 2).

Table 2. Content Analysis Themes

Code	Theme
1	Drugs/Alcohol
2	Work Related
3	Exercise
4	Eating
5	Errands/Chores/Personal Hygiene
6	In Transit
7	Sleeping
8	Relaxing
9	Socializing
10	Extracurricular Activities
11	Indiscernible
12	Class
13	Studying
14	Homework
15	Other School Related Activities

After themes were created, two independent coders read through and coded each response. Cohen's κ was calculated and it was determined that there was strong agreement between the raters' judgment, $\kappa = .884$, $p < .001$. The two raters reached 100% agreement on all responses after a consensus meeting. This data was then graphed to visually represent how student were spending their time when they were prompted. Data

was also assessed based on different categories (intervention vs. assessment, male vs. female, freshmen vs. upperclassmen) to explore any differences in the patterns of these themes.

Hierarchical Linear Modeling

Hierarchical linear modeling (HLM), sometimes referred to as multi-level modeling, is an analytical approach used when data information is nested within each other at varying levels (Woltman, Feldstain, MacKay, & Rochi, 2012). For example, research in education may examine students, which are nested within a classroom, which is nested within a school. Each of these variables is connected with each other; they are not completely independent. The research done in this particular study could be considered repeated measures research because data was collected at different times across multiple days. The data collected across time is nested within each study participant and their unique characteristics. Due to the complex nature of the data and the format in which it was collected from LifeData (the application used for this study), the data had to be restructured and transformed using the open source program R. Skip-logic questions had to be removed from analysis due to the complexity of restructuring the data. After the data was restructured into a usable format, a code was created within R to analyze the data using hierarchical linear modeling. The data was examined to determine if there was a difference between the two groups (intervention and control) with motivation, studying, confidence in future studying, and working.

Results

Pre- to Post-MSLQ

After completing the two-week study, participants returned to the lab and completed the MSLQ for a second time. One participant from the intervention group did not attend the follow-up so their post-MSLQ data could not be collected. A one-way MANOVA was conducted on variables from the pre- to post- MSLQ results for participants in the control and intervention groups. No significant differences were found on these variables for participants in the intervention and control groups.

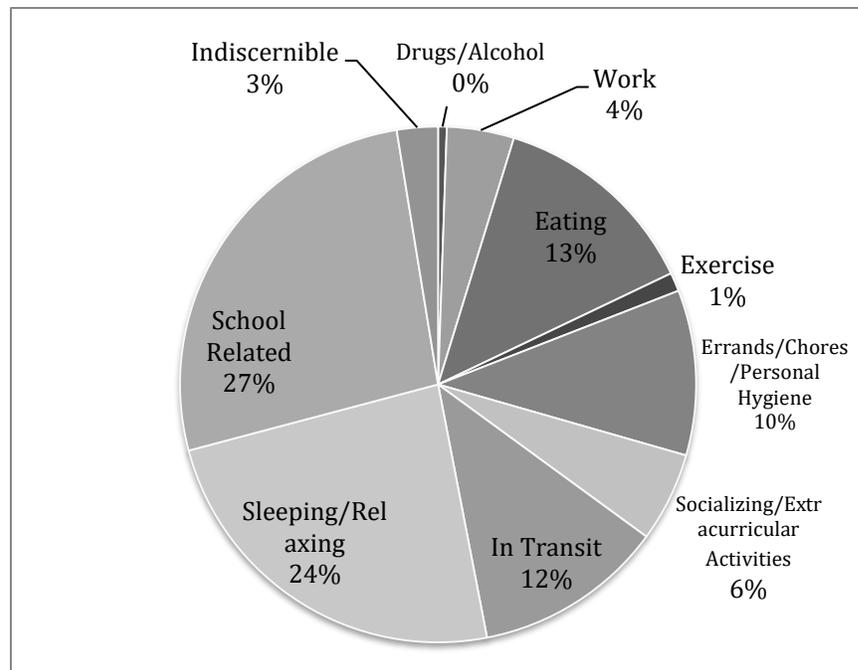
Response Rate

The average response rate for all participants was 80.7%, with participants' overall rates ranging from 33.3 to 97.6%. Participants in the assessment group on average had a higher response rate (85.7%) than participants in the intervention group (75.7%). The range of rates were 52.4 to 97.6% for the control group and 33.3 to 95.2% for the intervention group. Of the 266 intervention prompts sent to the intervention group over the course of the study, participants responded to 213 of them making a response rate of 80.1%. The range of responses of the participants to the intervention was 28.6 to 100%.

Content Analysis

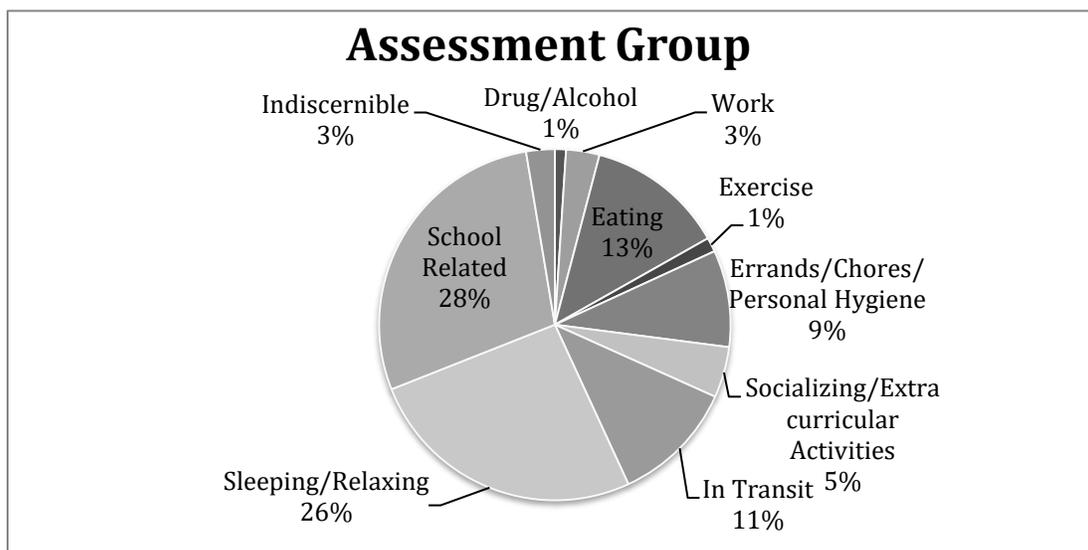
When examining how students spent their time, we found that 15 themes were too many to find anything visually; therefore, certain themes were collapsed: sleeping and relaxing were combined, socializing and extracurricular activities were combined; and all school related activities (class, studying, homework, and other school related activities) were combined into one theme. Graph 1 represents how participants spent their time when they were prompted. The dominant activity of participants was school related (27%), followed by sleeping/relaxing (25%) and eating (14%).

Graph 1. Participant activities in the moment.

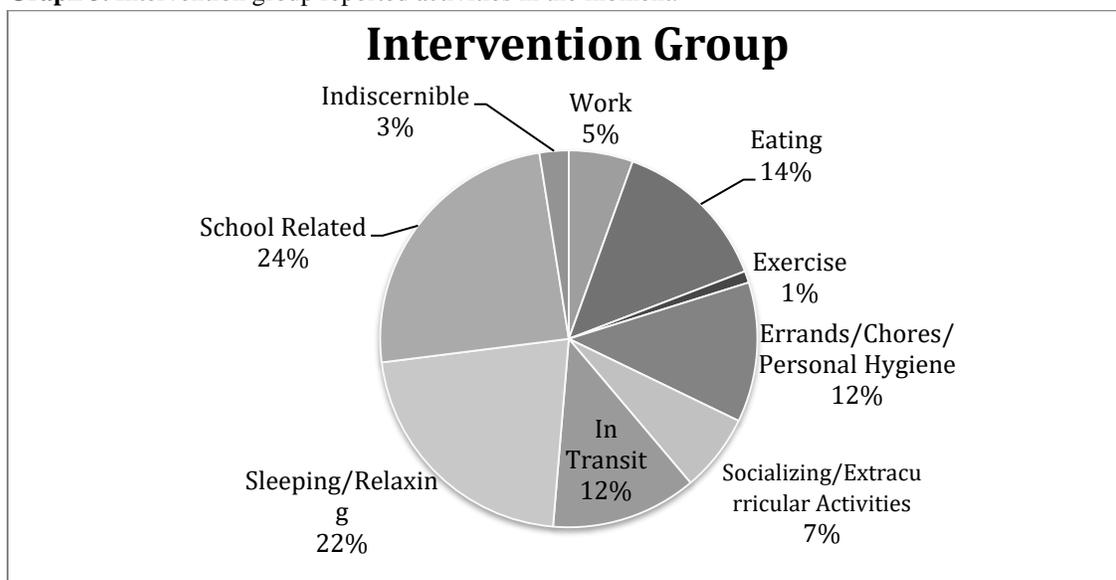


Assessment vs. Intervention Group. Using the collapsed themes, graphs were created for the assessment and intervention groups (graphs 2 and 3). While both groups dominant activity was school related, the assessment group reported a larger portion of the time as school related in comparison with the intervention group (28% and 24% respectively).

Graph 2. Assessment group reported activities in the moment.

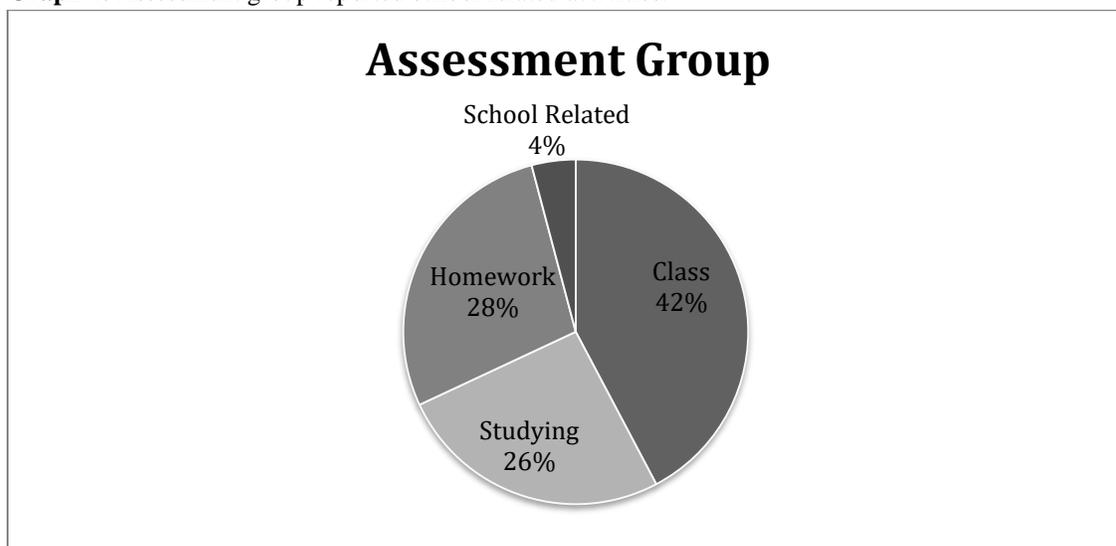


Graph 3. Intervention group reported activities in the moment.

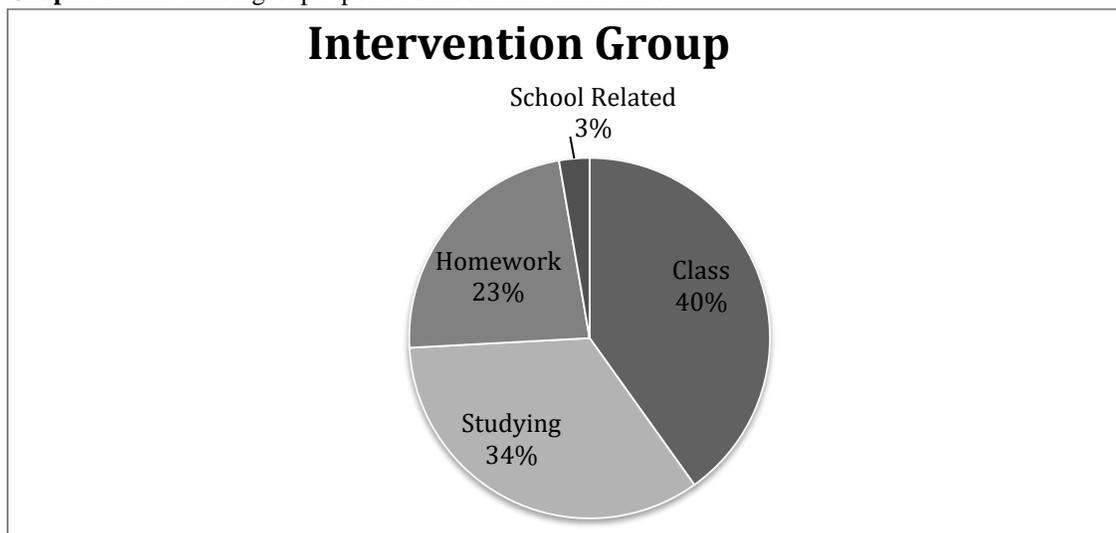


While it appears as those in the assessment group spent more of their time doing school related activities than the intervention group (Graphs 2 and 3), different patterns were found for the themes by each group when the “school related” theme was broken apart into class, homework, school, and other school related activities (see Graphs 4 and 5). When viewing this piece of the pie, those in the assessment group reported less time studying than the intervention group (26% and 34% respectively).

Graph 4. Assessment group reported school related activities.



Graph 5. Intervention group reported school related activities.



Group Comparisons

Using hierarchical linear modeling, the data was examined to see if there was a difference between the intervention and control groups with motivation, study behaviors, confidence in future studying, and working. The coding used to analyze and restructure the data in R found that there was no difference in motivation between the control and intervention groups. Other variables such as confidence and working condition were not significant. Analysis of the data did find a significant difference in that motivation was impacted whether students reported if they engaged in study behavior or not.

Discussion

The purpose of this study was to examine whether a novel mobile intervention delivered through a smartphone app could improve student motivation by increasing perceived value of education and the use of study strategies. Of the data analysis that could be done, the results suggest that the intervention did not increase the motivation of participants in the intervention group. Other elements of the research questions presented could not be answered here due to the complex nature of the data, which is discussed in the limitations section. An interesting finding from the content analysis was that participants in the intervention group reported more of their time studying than the assessment group. It is unknown whether the intervention contributed to this finding, but may be examined further in the future. It was also found that participant reports of studying did relate to their level of motivation.

Conclusion

Unfortunately, certain data collected for this study could not be reviewed for this thesis due to the constraints associated with timing and data restructuring and analysis. However, moving forward there is a lot of information from this study worth considering when viewing the data on motivation, self-efficacy, study strategies, and perceived value of education. One area worth exploring is the effect of how studying or not impacted participant motivation. It may be helpful to determine whether the intervention had any impact or if the assessment itself led to increased self-awareness which led to more studying and motivation or if another alternative answer exists in the data. Other interests that may be reviewed regarding the listed research questions include examining the study strategies used, whether study time increased over the course of the study for participants

in the intervention group, and whether perceived education value increased in students in the intervention group. It is possible to address these areas through the questions presented to the students via the EMA app. Something to consider moving forward is the ways in which the intervention itself may be improved and which portions of it were more or less effective. This includes reviewing whether participants were more receptive to different elements of the intervention (questions regarding perceived value vs. study strategies) and the impact of the prompting schedule on participant response to the app. Future work regarding the intervention may include the use of JITAI's or just-in-time adaptive interventions which can be used to intervene when participants need it most, such as when participants mark their motivation at a particularly low level. While the analysis that was completed for this thesis did not garner results that could answer the proposed research questions, further analysis will be conducted regarding the questions, interests, and future directions listed. The plethora of data collected here will be used and enable more information to be learned regarding college student motivation in education.

Limitations

While exciting advancements in technology offers new ways to conduct research, it is important to recognize that it is not infallible. There were some situations within this study where technology functioned outside of the set norms or failed to capture data. When reviewing response from participants, it was found that some responses were collected outside of the hour response window given. These responses were subsequently removed since they were outside of the bounds of the prompting window. It is also possible that some data from the participants is missing. Some participants may have

responded to a prompt, but that information failed to be recorded by the server used for this study.

A limitation of this study was that the sample of students was predominantly Caucasian. This prevents the possibility of presenting the information found here as generalizable to all populations. Future work following this study should include samples that are more reflective of the population.

Finally, with the complex nature of using EMA and EMI for data collection, it was not possible to complete all analyses desired for this study within the time frame, making it impossible to answer some of the research questions. However, data analysis will continue beyond this study and will be reviewed at a later time.

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Appendix A Demographics

1. Age: _____
2. Gender: Male, Female, Other
3. Ethnicity: Hispanic/Latino(a), White, Other
4. Race: American Indian or Alaska Native, Asian, Black or African American, Hispanic, Native Hawaiian or Other Pacific Islander, White, Biracial, Multiracial
5. Number of completed college credits _____
6. What is your major at UNC? _____
7. What is your minor at UNC (if you have one)? _____
8. Mother's Education Level: High School, GED, Some College, Associate's Degree, Bachelor's Degree, Master's Degree, Doctoral Degree, Unknown
9. Father's Education Level: High School, GED, Some College, Associate's Degree, Bachelor's Degree, Master's Degree, Doctoral Degree, Unknown
10. On average, how many hours per week are you working this semester?
 - a. I am not currently working
 - b. I work approximately ____ hours per week (fill in number of hours/week)
11. Hours Spent Studying Per Week on average: _____
12. Self-Reported Cumulative GPA: _____
13. How many classes are you taking this semester: _____
14. How many credit hours: _____
15. Usually I study (choose one): At the library, in my dorm room, apartment or house, at the UC, in a study lounge on campus, in a coffee shop or other restaurant, at a friend's home, Other: _____
16. In an average week, how many classes do you miss at UNC? (select one)
None, One Class, Two Classes, Three Classes, Four Classes, Other, please list the number of classes you miss: _____
17. What are your educational goals this semester at UNC?
18. How confident do you feel that you will be able to attain your educational goals for this semester? Rate your confidence on a scale of 0–9 below, with 0 being “not at all confident” and 9 being “extremely confident.”

0	1	2	3	4	5	6	7	8	9
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19. What are your long-term educational and career goals?
20. In your opinion, what do you think the value of higher education/college is for you?
21. Do you think there is a difference in how you think about the value of learning?

Appendix B

Motivated Strategies for Learning Questionnaire

Please rate the following items based on your behavior in this class. Your rating should be on a 7-point scale where 1= not at all true of me to 7=very true of me .

1. I prefer class work that is challenging so I can learn new things.
2. Compared with other students in this class I expect to do well
3. I am so nervous during a test that I cannot remember facts I have learned
4. It is important for me to learn what is being taught in this class
5. I like what I am learning in this class
6. I'm certain I can understand the ideas taught in this course
7. I think I will be able to use what I learn in this class in other classes
8. I expect to do very well in this class
9. Compared with others in this class, I think I'm a good student
10. I often choose paper topics I will learn something from even if they require more work
11. I am sure I can do an excellent job on the problems and tasks assigned for this class
12. I have an uneasy, upset feeling when I take a test
13. I think I will receive a good grade in this class
14. Even when I do poorly on a test I try to learn from my mistakes
15. I think that what I am learning in this class is useful for me to know
16. My study skills are excellent compared with others in this class
17. I think that what we are learning in this class is interesting
18. Compared with other students in this class I think I know a great deal about the subject
19. I know that I will be able to learn the material for this class
20. I worry a great deal about tests
21. Understanding this subject is important to me
22. When I take a test I think about how poorly I am doing
23. When I study for a test, I try to put together the information from class and from the book
24. When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly
25. I ask myself questions to make sure I know the material I have been studying
26. It is hard for me to decide what the main ideas are in what I read
27. When work is hard I either give up or study only the easy parts
28. When I study I put important ideas into my own words
29. I always try to understand what the teacher is saying even if it doesn't make sense.
30. When I study for a test I try to remember as many facts as I can
31. When studying, I copy my notes over to help me remember material
32. I work on practice exercises and answer end of chapter questions even when I don't have to
33. Even when study materials are dull and uninteresting, I keep working until I finish
34. When I study for a test I practice saying the important facts over and over to myself

35. Before I begin studying I think about the things I will need to do to learn
36. I use what I have learned from old homework assignments and the textbook to do new assignments
37. I often find that I have been reading for class but don't know what it is all about.
38. I find that when the teacher is talking I think of other things and don't really listen to what is being said
39. When I am studying a topic, I try to make everything fit together
40. When I'm reading I stop once in a while and go over what I have read
41. When I read materials for this class, I say the words over and over to myself to help me remember
42. I outline the chapters in my book to help me study
43. I work hard to get a good grade even when I don't like a class
44. When reading I try to connect the things I am reading about with what I already know.

Appendix C

Self-Efficacy for Self-Regulated Learning Measure

Please rate how certain you are that you can do each of the things described below by writing the appropriate number. Your answers will be kept strictly confidential and will not be identified by name. Rate your degree of confidence by recording a number from 0 to 100 using the scale given below:

Scale:

0% - Cannot do at all

10%

20%

30%

40%

50% Moderately can do

60%

70%

80%

90%

100% Highly certain can do

1. Finish my homework assignments by deadlines
2. Get myself to study when there are other interesting things to do
3. Always concentrate on school subjects during class
4. Take good notes during class instruction
5. Use the library to get information for class assignments
6. Plan my schoolwork for the day
7. Organize my schoolwork
8. Remember well information presented in class and textbooks
9. Arrange a place to study without distractions
10. Get myself to do school work

Appendix D
EMA Protocol

1. What are you currently doing right now? OPEN-ENDED
2. Please rate your current MOTIVATION to do SCHOOL WORK or STUDYING at this exact moment on a scale of 0-10, from “not at all” to “extremely” motivated.
3. Since the last time you responded to a prompt, have you studied? YES/NO
 - a. SKIP LOGIC→ If yes
 - i. Estimate how much TIME you spent doing SCHOOL WORK or STUDYING (e.g., reading, writing paper, or other assignments) since the last prompt? DIAL
 - ii. What STRATEGIES did you use?
CLICK ALL THAT APPLY:
 1. Read textbook for first time
 2. Read textbook for 2nd+ time
 3. Reviewed notes from class
 4. Reviewed past quizzes/tests
 5. Self-quizzed
 6. Worked with study partners
 7. Watched videos
 8. Reviewed class powerpoints
 9. Used study guides
 10. Reviewed past assignments
 11. Other: _____
 - iii. When you studied last, were you alone or with others?
ALONE/OTHERS
SKIP LOGIC→ For with others
 1. Please rate the following statement: Being with others was beneficial to my learning. RATING SCALE from Strongly Disagree to Strongly Agree
 - iv. Please rate how VALUABLE you felt your last study session was to your learning. RATING SCALE from Not At All Valuable to Very Valuable
 - v. Please rate how CONFIDENT you feel that your most recent study session will help you understand the material you studied.
RATING SCALE from Not At All Confident to Very Confident
 - b. SKIP LOGIC→ If no
 - i. What ACTIVITIES got in the way of your studying?
CLICK ALL THAT APPLY:
 1. Errands/Chores

2. Work
 3. University Club/Organization Activities
 4. Hobbies
 5. Exercise/Gym
 6. Spending Time with Friends/Family
 7. Sleep
 8. Watching Videos or Movies
 9. Other:_____
4. What goal(s) do you have for your next study session? OPEN-ENDED
 5. Please rate your CONFIDENCE in your ability to study and understand the material for your next study session. 0-100% on 10-point scale
 6. Since you last were prompted, have you put off any study tasks that you should have completed? YES/NO
 - a. SKIP LOGIC → if yes
 - i. What were they? OPEN-ENDED
 7. Have you worked at your job since you were last prompted? YES/NO
 - a. SKIP LOGIC → if yes
 - i. How many hours (round to the nearest 30 minutes) DIAL

Appendix E Informed Consent

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH University of Northern Colorado

Project Title - Student Motivation in Education: An Evaluation in Real-Time

Researcher: Maddison North
Phone: 303-916-7550
Email: nort9111@bears.unco.edu

Research Advisor: Michael Phillips, Ph.D.
Phone: 970-351-1296
Email: michael.phillips@unco.edu

We are interested in studying aspects of student habits, study strategies and motivation in educational contexts. In order to do this, we will start by having you complete a survey here in the lab and receiving training in regards to the smartphone app you will be using, which should take approximately 20-30 minutes. The next step will include having you respond to questions on the smartphone app for two weeks to collect information about how and when you study along with perceptions you have about your learning experiences. You will randomly receive 3-4 prompts a day over the 2-week period. The prompts typically take roughly 2-5 minutes to complete each time. Once you've completed the 2-week period of questions, you'll complete one last survey that will take approximately 10 minutes to complete. In total, your participation in this study will require approximately 3 hours of time.

Once informed consent forms have been completed, they will be locked in a secure file cabinet in McKee 72 (research advisor's lab) for three years based on IRB standards. Electronic data collected will be protected on a UNC server and/or password-protected computer at all times. The smartphone app you will be using is Health Insurance Portability and Accountability Act (HIPAA) and Family Educational Rights and Privacy Act (FERPA) compliant, which means your data will be protected at the highest level possible. Also, we will not associate your name with your responses at any time on any of the surveys or prompts. Upon completion of the study, all files will be deleted from the smartphone app server. While your participation will not be anonymous to the researchers, the information you provide will be kept completely confidential. Confidentiality means that the researchers will protect the privacy of the information, even though they know the source of where the information comes from.

Potential risks in this project are minimal. You may feel anxious when you receive a prompt to take the survey, but the assessment has no bearing on you or your grade in your PSY 120 course and your results will be kept confidential. The

2-week study period may seem like a lot of work, but each prompt and assessment should no more than five minutes. While participating in this study, you may benefit from becoming aware of your study habits and change in motivation throughout the weeks. Through participating in this study, you will also be completing the requirement of your PSY 120 course to participate in a research project and will receive up to a total of 6 participation credits through the SONA system. The credits are broken down for your time in the study. If you complete the initial survey here today in the lab you'll receive 1 credit, also you'll receive 1 credit for the post-survey. Lastly, if you complete more than 50% of the smartphone prompts you receive, you'll receive 4 credits of participation points. If your response rate falls below 50% you'll receive 2 credits of participation points. The majority of students will tend to receive all 6 credits for participating in this study.

Participation is voluntary. You may decide not to participate in this study and if you begin participation you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Having read the above and having had an opportunity to ask any questions, please sign below if you would like to participate in this research. A copy of this form will be given to you to retain for future reference. If you have any concerns about your selection or treatment as a research participant, please contact Nicole Morse at the Office of Research, Kepner Hall, University of Northern Colorado Greeley, CO 80639; 970-351-1910.

Participant's Signature

Date

Researcher's Signature

Date

Appendix F
IRB Approval Letter

Institutional Review Board

DATE: November 7, 2018
 TO: Maddison North
 FROM: University of Northern Colorado (UNCO) IRB

PROJECT TITLE: [1320939-2] Motivation in Education: An Evaluation in Real-Time
 SUBMISSION TYPE: Amendment/Modification

ACTION: MODIFICATION APPROVED/VERIFICATION OF EXEMPT STATUS

DECISION DATE: November 7, 2018
 EXPIRATION DATE: October 1, 2022

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB approves this project modification and verifies its continued status as EXEMPT according to federal IRB regulations.

Maddison –

Thank you for the clear and thorough amendments and documentation (FERPA release) to your IRB application. Your application is verified/approved exempt and you may proceed with these amended materials and protocols.

Best wishes with your research.

Sincerely, Dr. Megan Stellino, UNC IRB Co-Chair

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Nicole Morse at 970-351-1910 or nicole.morse@unco.edu. Please include your project title and reference number in all correspondence with this committee.