12-2020

Envisioning success: a naturalistic investigation into prospective memory performance, reminder use, and memory strategies in an academic context

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Envisioning Success: A Naturalistic Investigation into Prospective Memory Performance, Reminder Use, and Memory Strategies in an Academic Context

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Departmental Honors Thesis

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Examination Date: November 4, 2020

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TABLE OF CONTENTS

Abstract

Prospective memory encompasses the ability to remember to carry out future intentions. Prospective memory performance is essential for students. College students are expected to remember and complete a variety of assignments on a daily basis. In these naturalistic experiments taking place before and after COVID-19, college students were required to set academic goals for themselves for three consecutive days following specific guidelines. Each day, the participant identified a time specific academic goal and a non-time specific academic goal. Participants were randomizing assigned experimental or control condition. The experimental group performed an episodic future thinking exercise during encoding. Additionally, each time students submitted a goal, they also identified how they remembered to complete the goal, either with internal or external reminders. Results showed no significant correlation between episodic future thinking and academic goal performance. However, in both experiments a significant correlation was observed between external reminder use and academic goal completion. Moreover, participants in both experiments completed more non-time specific tasks than time-specific tasks and reported use of both external reminders and internal reminders. Thus, these experiments are suitable for providing evidence for the benefits of cognitive offloading for academic success. They also open a discussion for the effect of modality change on academic goal performance.

Literature Review

Prospective memory is remembering an intention in the future. This is in contrast to remembering something from the past; which is retrospective memory. There are several ways to classify a prospective memory task (Kvavilashvili & Ellis, 1996). To assess prospective memory, researchers can implement an event-based task or a time-based task (Conte & McBride, 2018). Event-based prospective memory tasks involve remembering an intention when a specific event acts as a cue (Sellen et al., 1997). Whereas time-based prospective memory tasks involve remembering to complete an intention at a predetermined time (Sellen et al., 1997). Event-based prospective memory occurs when an individual is at the grocery store and remembers the items he/she needs to purchase by seeing them in the aisle. Time-based prospective memory is executed when an individual makes an appointment to see a doctor three days in advance and then remembers to show up on that day at the confirmed time. A widely held theoretical view is that remembering time-based tasks is more effortful than remembering event-based tasks (Einstein et al., 1995; McDaniel & Einstein, 2007). Additionally, time-based goal execution tends to be worse relative to event-based, particularly for younger adults in naturalistic settings (Schnitzspahn et al., 2020). This study is interested in examining event-based and time-based prospective memory performance simultaneously in a naturalistic setting. Since the participants will all be college students, prospective memory performance will be observed in an academic context.

Prospective memory is essential for a college student's success. It is apparent that college students have a large amount of daily, monthly, and semester-long goals they consistently have to keep up with. However, with all the tasks that college students have to face, it is disturbing to see

the quality at which college students are able to set academic goals for themselves. Researchers that focused on teaching college students goal-setting techniques, found that even after their goal-coaching sessions, college students' abilities to set goals for themselves were still severely limited and lacked sufficient details to be effective (McCardle et al., 2017). Numerous studies have demonstrated the importance of college students being able to set and achieve goals for themselves. Self-efficacy, or the belief in one's own ability to perform well, is highly correlated with academic performance in college students. With the constant fluctuation of their personal goals, facilitating goal achievement is critical to bolster students' self-confidence in the academic realm and the workplace (Richardson et al., 2012; Joel, 2009). Therefore, an effective strategy that could improve prospective memory performance on academic goals would be of inestimable value to college students.

Over the years, researchers have explored ways to utilize goal strategies in order to improve performance in prospective memory tasks. Numerous studies have been conducted to investigate how an individual can successfully achieve one's own goals and what cognitive strategies are most conducive to personal achievement. The most widely studied goal execution strategy is referred to as implementation intentions (Chen et al., 2015; Gollwitzer & Brandstätter, 1997). According to Gollwitzer, implementation intentions generally take the form of a statement such as, "I intend to do goal-directed behavior Y when I encounter situation Z". Implementation intentions have been effective in increasing fruit and vegetable intake (Harris et al. 2014), reducing snacking habits (Sheeran et al., 2007), improving emotional regulation (Gallo et al. 2009), and even increasing attendance to psychotherapy sessions (Tam et al., 2010). In one meta-analysis conducted by Chen et al., researchers found that implementation intentions were able to

improve prospective memory performance in nearly all age brackets (Chen et al. 2015) . In older adults, however, event-based prospective memory performance was the only type of prospective memory that improved for individuals 60-75 years old. Within these studies regarding implementation intentions, however, imagery, or visually imagining one's goal, is a technique commonly mentioned as a part of the implementation intention procedure (McFarland & Glisky 2012). Indeed, research suggests that imagery on its own could have a positive effect on prospective memory tasks, a term often linked with the goal planning process (Penningroth & Scott 2013). Such findings highlight the potential benefits of "imagining the future context" of one's own goal, for successful goal attainment. It is this orientation towards the future that researchers Atance and O'Neill describe as episodic future thinking. In their words, episodic future thinking is, "...our ability to project our self into the future and pre-experience an event (Attance & O'Neill, 2001). Episodic future thinking is a process built off an individual's general knowledge gained from autobiographical memories (D'Argembeau & Mathy 2011). In order to envision the future, individuals utilize the memories of their own personal experiences and imagine future situations while considering potential outcomes based on said memories.

Another way for college students and young adults to increase prospective memory performance and academic goal execution is to utilize reminders. Reminders are typically cast into categories of either internal or external. Internal reminders can include mental rehearsal, association, or spontaneous recovery, whereas external can include cell phones, environmental cues, or simply writing things down somewhere. While both kinds of reminders can be used to improve prospective memory performance, individuals typically depend on external reminders in their environment versus utilizing internal reminders to remember what they need to accomplish

(Kvavilashvili & Fisher, 2007; Walker & Andrews, 2001; Intons-Peterson & Fournier, 1986). Additionally, individuals typically depend on external reminders even when internal reminders may be as effective (Kvavilashvili & Fisher, 2007; Landsiedel & Gilbert, 2014; Risco & Gilbert, 2016). As such, it is reasonable to suspect that cognitive offloading may help student prospective memory with regard to academic goal completion.

Lastly, this study has pre- and post- COVID-19 components. Prior to COVID-19, most, if not all, classes were offered in a face-to-face learning environment. However, after COVID-19 most, if not all, classes were offered in an online environment. It is interesting to note that, students in face-to-face higher education courses are generally more satisfied with the course than their online counterparts (Ebner & Gegenfurtner 2019; Tratnik et al. 2017). However, is remains unclear whether not, despite what satisfaction might illustrate, if the modality of the learning environment has significant impact on academic goal execution.

The Present Study

The present research provides an opportunity to investigate the relationships between prospective memory, academic goal performance, reminders, and episodic future thinking pre- and post- COVID-19. A novel naturalistic prospective memory task using academic goals has been created to assess these relationships. There are four main hypotheses being tested:

> $\underline{H_1}$: Episodic Future Thinking will lead to better performance on Prospective Memory tasks relative to a control group.
>
> $\underline{H_2}$: Better goal execution will be observed for non-time-specific relative to time-specific tasks.
>
> $\underline{H_3}$: Students will be more likely to use external reminders to support academic goal execution than internal reminders.

$\underline{H_4}$: Prospective memory tasks in the academic setting will be better executed pre- COVID-19; modality will have an effect on academic goal execution.

Experiment 1

Experiment 1 was conducted in the late fall of 2019 and the early spring of 2020, prior to the COVID-19 pandemic. As such goal elicitation and condition protocol were performed in the lab on campus.

Method

Participants and Design

Individuals participating in this study were undergraduate and graduate students at the University of Tennessee at Chattanooga (n=50). Participants were recruited utilizing the UTC SONA system and received extra credit in Psychology courses along with a $10 Amazon gift card following their participation in the study. Participants ranged in age from 18 to 39. All participants spoke English as their first language

This study followed a true experimental 2 x 2 mixed factor design, with goal planning protocol (Control/EFT protocol) as the between-participants factor and prospective memory task type (Time-Based/Event-Based) as the within participants factor. Additionally, the potential moderating variables that were assessed included academic motivation, internal reminder use, and external reminder use.

Materials

Working Memory Tasks: Participants within the study were first assessed on their working

memory by completing three working memory tasks within a computer setting in the laboratory. Tasks included a shortened and adapted version of a reading span task, an operation span task, and a modified lag task (Oswald et al., 2015; Shelton, Elliot, & Metzger, 2007) and were programmed using the E-Prime software (Schneider, Eschman, & Zuccolotto, 2002). For the reading span tasks, individuals were required to read phrases, assess how logical the phrases were, and recall the words of each phrase. In the operation span task, individuals had to both evaluate a math equation and read a word after each math operation. After a certain number of the pairings, participants underwent a recall test. Finally, in the modified lag test participants viewed a sequence of words, each by themselves, then were asked to recall one of the words from the list. After each trial, participants were asked what word was one back, two back, or three back. Each list of words presented to participants varied in number to avoid participant anticipating the order.

Goal Elicitation Procedure: After completing the working memory tasks, participants within the study were randomly assigned to either the episodic future thinking condition or the control condition. Participants within both conditions were responsible for generating a list of six task specific goals to complete, two a day, over the next three days. Participants were instructed that goals listed should be action-oriented, task specific, and measurable. These goals had to be separate from obligational tasks like class attendance, or vague tasks like making a good grade in the class. Of the goals listed within a day, participants were instructed to make one of their goals time-specific (Time-Based) and one non-time specific (Event-Based). It was explained that time specific tasks had to start at a certain time, but not necessarily be completed at a certain time. Finally, all goals listed had to fall under the category of educational and could feasibly be accomplished within a day. Once participants in both groups had chosen their specific tasks for

the week, they rated each goal in terms of goal importance on a scale of one to five; one being "not at all" and five being "extremely important". Participants were told that they were free to use any materials they needed in order to come up with their goals to ensure that individuals chose goals that were personally relevant to themselves. After defining their goals, participants within each condition were asked to repeat back the academic tasks they said they would complete. After naming a task and defining whether it was time-specific or non-time-specific, participants would undergo either a verbal fluency task (Control), or EFT Protocol (Experimental). Participation in both conditions were recorded.

Verbal Fluency Task: For the verbal fluency task, participants were to recount as many words as possible for one minute that started with a specific letter. Letters included T, J, B, L, P, and F. Participants were asked to close their eyes and proceed for one minute in order to equate the times for both conditions.

Episodic Future Thinking Protocol: Following prior research on episodic future thinking (EFT), participants were asked to close their eyes and imagine the various details surrounding each one of their chosen tasks. The purpose is to get the participant to attain a realistic first-person experience of their task-specific goal. Participants described the details of what they were imagining aloud for one minute. As participants envisioned their goal, they were asked to verbalize aloud the context regarding what they would experience. This context might include whatever one may see, hear, or feel, where one will be, what one might think, or what obstacles might keep one from attaining one's goal.

Academic Motivation Scale: Participants were given the College (CEGEP) version of the Academic Motivation Scale. The scale was composed of seven subscales which measured Extrinsic Motivation (external, introjected, and identified regulation), Intrinsic Motivation, and

Amotivation in students. While External motivation is generally described as doing an activity just to have it completed, Intrinsic motivation is defined as doing an activity for the sake of itself. Amotivation, on the other hand, occurs when an individual lacks an understanding of the connection between their actions and the outcomes of those actions (Vallerand, Blais, & Pelletier, 1989). Individuals are asked why they went to college and rated on a 7-point Likert scale how much their reasons for going to college corresponded with the following statements. An example is answering, "For the pleasure I'll feel while surpassing myself in my studies."

Demographic Form: Participants were given a demographic form which included questions regarding: age, gender, race, current occupation, hours worked in the week, credit hours enrolled in, first language spoken, hours slept per night, naps taken per week, and days exercising more than at least 15 minutes or longer.

After individuals in both conditions had completed their assigned protocols and scales, they were given a link to a Google form that contained the submission portals for their specific prospective memory tasks. Participants were instructed that the next portion of the study would need to be completed outside the lab. In order to participate in this portion of the study, participants submitted images of their goals on Google forms to the primary researchers. Images submitted had to be of the specified goals and could not contain an image of themselves. On the Google form there were separate submissions for time-specific and non-time specific goals each day. Apart from the submission portals, a general reminder use survey was also attached to the Google form which asked participants how they remembered to complete their goals. External reminders included: cell-phone reminders, environment reminders, or written reminders. Internal reminders included mentally repeated reminders, association reminders, or no reminders.

Procedure

The first half of this study was conducted in the Cognitive Aging, Learning, and Memory (CALM) lab, and took an average of one hour for participants to complete. Participants were expected to complete all three working memory tasks at a computer at the beginning of a session, however, results from these working memory tasks will not be discussed in this paper. Working memory tasks were followed by the goal elicitation procedure and goal encoding protocols based on the condition they had randomly been assigned to. Before initiating the session, participants were asked if they had a cellphone that had reliable access to the internet. Once confirmed, participants were asked to complete an informed consent form that explained both the in-person and out-of-lab portion of the study, and then were also asked to complete a demographic questionnaire. Participants were also informed that upon completion of the out-of-lab portion of the study they would receive a $10 gift card.

The three working memory tasks consisted of a reading span task, an operation span task, and a modified lag task. After participants had completed their working memory tasks, they were then asked to list six of their academic goals to the researcher. After each stated goal, the participant was asked to rate the importance of the goal. Once the researcher had recorded all the goals and the participant had specified which of the academic goals were time-specific and non-time-specific, the researcher proceeded to do an encoding check for each of the goals before each of the conditions' protocols. Participants in the control condition completed their assigned verbal fluency task, and participants in the experimental group completed the EFT protocol for each goal. Both conditions were equated in time, with the participant reciting a given goal and subsequently performing their condition protocol; both of which lasted for one minute after each goal. This would continue until all 6 goals have been recited and followed by

the condition protocol. After both protocols were finished, all participants were asked to complete the Academic Motivation Scale (Vallerand, Blais, & Pelletier, 1989).

At the end of the session participants were informed that the next part of the session was to be completed outside the lab in the form of Google form submissions of their goals. Participants were given the Google form link and walked through the submission portals and reminder use survey on the form. The session ended with participants being informed that they could do anything they would normally do to remember their goals. Activities such as checking their schedule, asking to have their goals repeated back to them, writing down or recording their goals in any way were noted by the researcher.

Once participants had submitted photographic evidence of their goal completion via the Google form link, data was collected via a secure Google Drive folder seen only by the researchers. Researchers then coded the pictures to see if the image related to the participants' original goals.

Results

Prospective Memory Performance

For this study, prospective memory performance was operationalized as the percentage of correct submissions out of three possible submissions uploaded for each prospective memory type. Pictures submitted for time-specified goals were restricted to a 15-minute window to count as a successful submission. When using a repeated-measures ANOVA with the Type 1 error rate was set at .05 to compare within-group variables, the mean scores for prospective memory were significantly different ($F(1,50) = 9.802$, $p = .003$, $\eta_p^2 = .189$: time-based $M = 37.12\%$, $SE = 5.505$, *95% CI* [26, 48.2] event-based $M = 55.30\%$, $SE = 6.523$, 95% *CI* [42.1,68.5] showing event-based goals were submitted at a higher rate than time-based goals. When comparing mean

scores for between-group variables (control/EFT protocol) mean scores of conditions were not significantly different ($F(1,50) = .328$ $p = .57$, $\eta_p^2 = .008$: control $M = 43.18\%$, $SE = 7.483$, *95% CI* [28.1,58.3], experimental $M = 49.24$, $SE = 7.483$, 95% *CI* [34.14, 64.34]. When evaluating prospective memory performance across condition, there was no significant interaction between the two, however, there was a goal type main effect: $F(1,50) = 9.90$, $p < .05$, $\eta_p^2 = .17$. *(See Figure 1).*

In addition to submitting prospective memory tasks, participants were also expected to complete an academic motivation scale. After doing a correlation analysis, there was no relationship found between academic motivation and time-based prospective memory performance in any of the three categories of intrinsic ($r = .025$, $p = .871$), extrinsic ($r = -1.81$, $p = .246$), or amotivation ($r = -.066$, $p = .673$). In addition, no relationship was found between event based prospective memory and intrinsic $r = .177$, $p = .255$, extrinsic $r = -.013$, $p = .934$, or amotivation $r = -.216$, $p = .164$, suggesting that academic motivation did not significantly impact prospective memory performance.

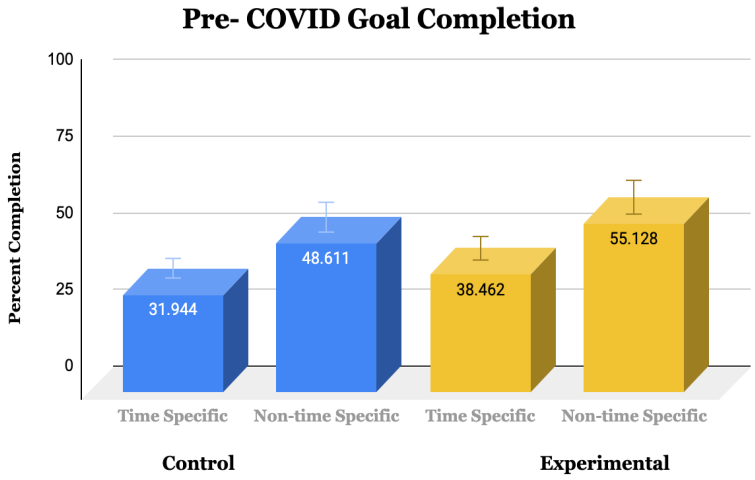

Figure 1. Prospective memory performance compared across goal-type and

condition.

Reminder Usage

Goal type and reminder usage were compared by comparing both variables in a correlation matrix. A significant correlation between overall goal submissions and external reminder usage was found for both event-based (r =.620, n = 43, p = <.000) and time-based goals (r = .524, n = 43, p = <.000). Finally, overall mean external reminder usage (M=.814, SD =.827) proved to be greater than mean internal reminder usage (M=.568. SD =.591). There was also a goal type main effect observed: $F(1,50) = 4.60$, $p < .05$, $\eta p2 = .09$. We included condition in these analyses but here we collapsed across this variable given no effect was observed. (*See Figure 2).*

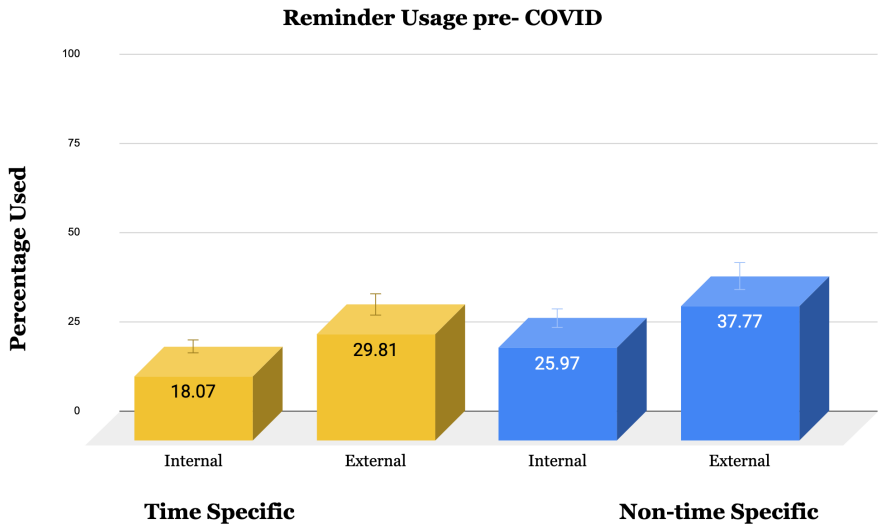

Figure 2. Reminder usage separated by goal-type.

Experiment 2

Experiment 2 was conducted in late Spring of 2020 and early Fall of 2020, after the COVID-19 pandemic and social distancing measures. As such, the goal elicitation and condition protocol took place over a Zoom conference call.

Participants and Design

Individuals participating in this study were undergraduate and graduate students at the University of Tennessee at Chattanooga (n=39). Participants were recruited utilizing the UTC SONA system and received increased extra credit in Psychology courses but did not receive a $10 Amazon gift card. Participants ranged in age from 18 to 39. All participants spoke English as their first language.

This experiment, like experiment 1, followed a true experimental 2 X 2 mixed factor design, with goal planning protocol (Control/EFT protocol) as the between-participants factor and prospective memory task type (Time-Based/Event-Based) as the within participants factor. Additionally, the potential moderating variables that were assessed included internal reminder use, and external reminder use, and COVID-19 concerns.

Materials

Goal Elicitation Procedure: Participants within the study were split into the episodic future thinking condition and the control condition. Participants within both conditions were responsible for generating a list of six task specific goals to complete, two a day, over the next three days. Participants were instructed that goals listed should be action-oriented, task specific, and measurable. These goals had to be separate from obligational tasks like class attendance, or vague tasks like making a good grade in the class. Of the goals listed within a day, participants were instructed to make one of their goals time-specific (Time-Based) and one non-time specific (Event-Based). It was explained that time specific tasks had to start at a certain time, but not necessarily be completed at a certain time. Finally, all goals listed had to fall under the category of educational and could feasibly be accomplished within a day. Once participants in both groups had chosen their specific tasks for the week, they rated each goal in terms of goal

importance and attainability on a scale of one to five. Participants were told that they were free to use any materials they needed in order to come up with their goals to ensure that individuals chose goals that were personally relevant to themselves. After defining their goals, participants within each condition were asked to repeat back the academic tasks they said they would complete. After naming a task and defining whether it was time-specific or non-time-specific, participants would undergo either a verbal fluency task (Control), or EFT Protocol (Experimental). Participation in both conditions were recorded.

Verbal Fluency Task: For the verbal fluency task, participants were to recount as many words as possible for one minute that started with a specific letter. Letters included T, J, B, L, P, and F. Participants were asked to close their eyes and proceed for one minute in order to equate the times for both conditions.

Episodic Future Thinking Protocol: Following prior research on episodic future thinking (EFT), participants were asked to close their eyes and imagine the various details surrounding each one of their chosen tasks in order to attain a realistic first-person experience of their task-specific goal. Participants described the details of what they were imagining aloud for one minute. As participants envisioned their goal, they were asked to verbalize aloud the context regarding what they would experience. This context might include: whatever one may see, hear, or feel, where one will be, what one might think, or what obstacles might keep one from attaining one's goal.

Demographic Form: Participants were sent a demographic form which included questions regarding: age, gender, race, current occupation, hours worked in the week, credit hours enrolled in, first language spoken, hours slept per night, naps taken per week, and days exercising more than at least 15 minutes or longer.

COVID-19 Questionnaire: Participants were sent a COVID-19 questionnaire containing six questions measured by a likert scale, and eight free response questions. The questionnaire and free response questions largely concern perceived changes since COVID-19. There are also questions regarding the type of classes that are being taken this semester (100% online, 100% face-to-face, and hybrid), as well as questions regarding overall concerns and concerns regarding academic goal completion specifically.

Submission Form: After individuals in both conditions had completed their assigned protocols, forms, and scales, they were given a link to a Google form that contained the submission portals for their specific prospective memory tasks. Participants were instructed that the next portion of the study would need to be completed outside the lab. In order to participate in this portion of the study, participants submitted images of their goals on Google forms to the primary researchers. Images submitted had to be of the specified goals and could not contain an image of themselves. On the Google form there were separate submissions for time-specific and non-time specific goals each day. Apart from the submission portals, a general reminder use survey was also attached to the Google form which asked participants how they remembered to complete their goals. External reminders included: cell-phone reminders, environment reminders, or written reminders. Internal reminders included mentally repeated reminders, association reminders, or no reminders.

Procedure

Participants signed up for the experiment through the SONA system. Once signed up, participants wait until the day of the experiment to receive further instruction. Approximately thirty minutes prior to the scheduled experiment time, participants receive an email from the researcher with instructions to complete all forms, scales, and questionnaires via a QuestionPro

link; this includes the informed consent, demographic form, and COVID-19 questionnaire. In this email, participants will also be given a Zoom link for the experiment with instructions to complete all documents in the QuestionPro link before joining the experiment.

Once the participant joined the Zoom session, the researcher completed a webcam check. If the participant was unable to access a webcam they were informed they would be unable to complete the study. Once the researcher was able to see the participant, the researcher asked the participant if they had completed all assigned documents. If the participant had not completed the documents they were instructed to complete the documents then return to the meeting to begin the experiment.

Once the participant was ready to begin, the researcher introduced the participant to the study and began the experiment. The researcher completed the goal elicitation with the participant then proceeded to go through the assigned protocol depending on the condition assigned to the participant via random number generator. After the condition protocol, the participant was informed that the Zoom portion of the study had concluded. The participant was then given instructions on how to complete the remainder of the study by submitting images of the elicited goals to a provided link over the following three days. The participant was required to open the link during the Zoom session to ensure that the participant had the link and was able to access the link. Once the link was verified to have been successfully assessed by the participant, the researcher reminded the participant that they would be getting seven (7) SONA credits and concluded the Zoom session.

Results

Prospective Memory Performance

For this study, prospective memory performance was operationalized as the percentage of correct submissions out of three possible submissions uploaded for each prospective memory type. Pictures submitted for time-specified goals were restricted to a plus or minus 15-minute window to count as a successful submission. Event-based completion was successful if the picture was of the correct goal on the correct day. When using a repeated-measures ANOVA to compare within-group variables, the mean scores for prospective memory were significantly different, showing a main effect for greater completion of event-based goals than time-based goals: $F(1,39) = 6.14$, $p < .05$, $\eta_p^2 = .14$. When comparing mean scores for between-group variables (control/EFT protocol) mean scores of conditions were not significantly different ($F(1,39) = .328$ $p = .57$, $\eta_p^2 = .008$: control $M = 43.18\%$, $SE = 7.483$, *95% CI* [28.1,58.3], experimental $M = 49.24$, $SE = 7.483$, *95% CI* [34.14, 64.34]. When evaluating prospective memory performance across condition, there was no significant interaction between the two: 6.14, $p < .05$, $\eta_p^2 = .14$. (*See figure 3*)

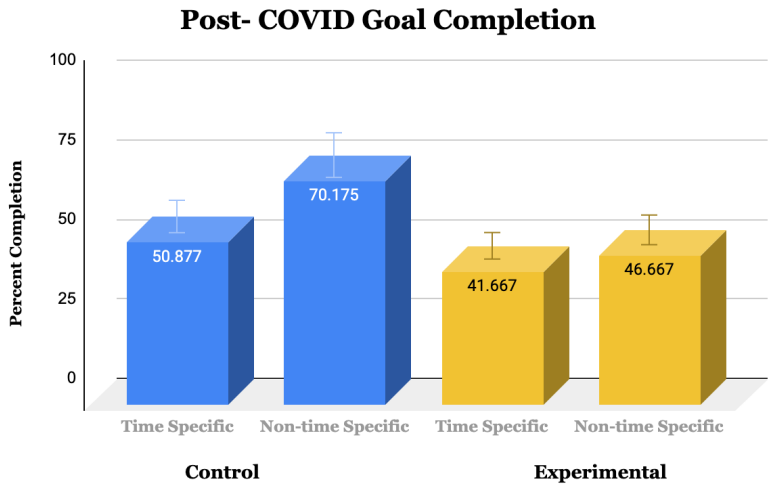

Figure 3. Prospective memory performance compared across goal-type and condition.

Reminder Usage

Goal type and reminder usage were compared by comparing both variables in a correlation matrix. A significant correlation between overall goal submissions and external reminder usage was found for both event-based (r =.721, n = 39, p = <.000) and time-based goals (r = .539, n = 39, p = <.000). Mean internal reminder usage (M=.772, SD =.803) proved to be greater than mean external reminder usage (M=.714. SD =.583). A repeated-measures ANOVA also revealed there was a reminder use goal-type x reminder-type interaction: $F(1,39) = 5.16$, $p < .05$, $\eta_p^2 = .12$. *(See figure 4).* Additionally, when a repeated-measures ANOVA was run looking at reminder usage across both experiments, a main effect was found: $F(1,89) = 6.11$, $p < .05$, $\eta_p^2 = .07$. (*See figure 5*). Overall, mean external reminder usage (M=.697, SD =.561) proved to be greater than mean internal reminder usage (M=.569, SD =.459). (*See figure 5*).

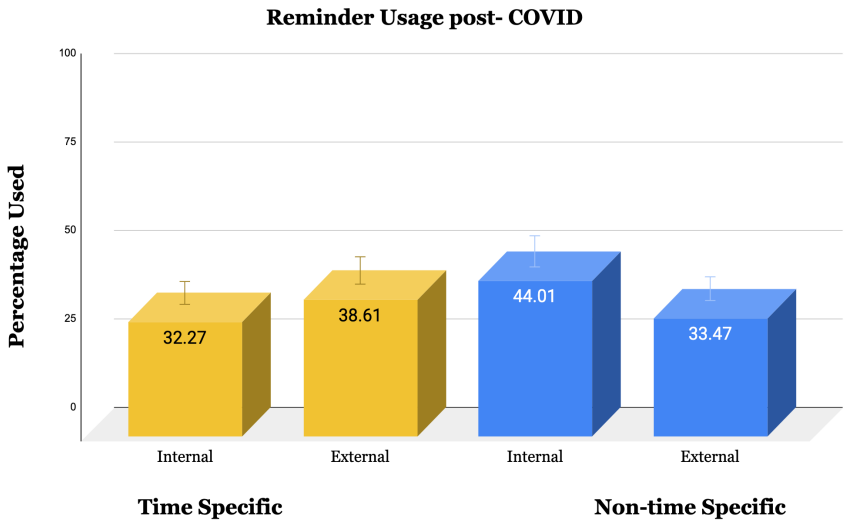

Figure 4. Reminder usage separated by goal-type in Experiment 2.

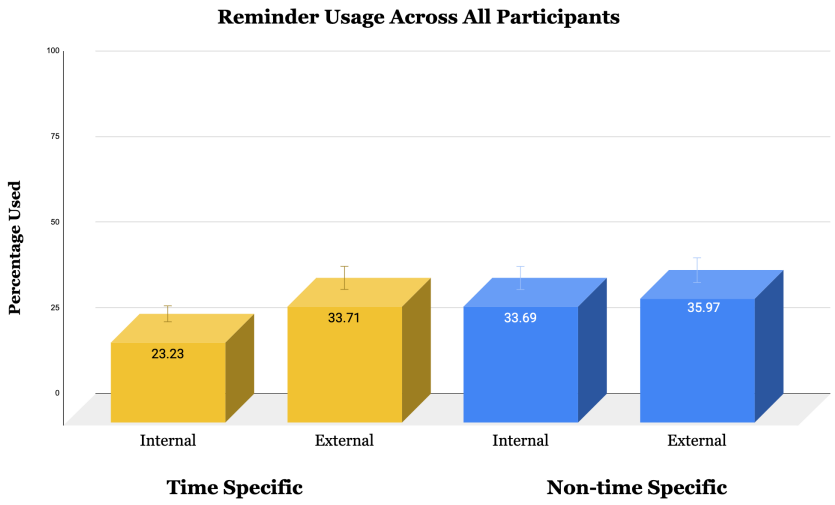

Figure 5. Reminder usage separated by goal-type for all participants.

Prospective Memory Performance Pre- and Post- COVID-19

A repeated-measures ANOVA was used to look at total goal completion across both experiments and a goal type main effect was discovered: $F(1,87) = 15.05$, $p < .001$, $\eta_p^2 = .15$. Additionally, there was not a significant difference between academic goal completion pre- and post- COVID-19. Overall mean event-based (M=.551, SD =.605) proved to have a greater completion percentage than mean time-based tasks. (M=.397, SD =.473). (*See figure 5*).

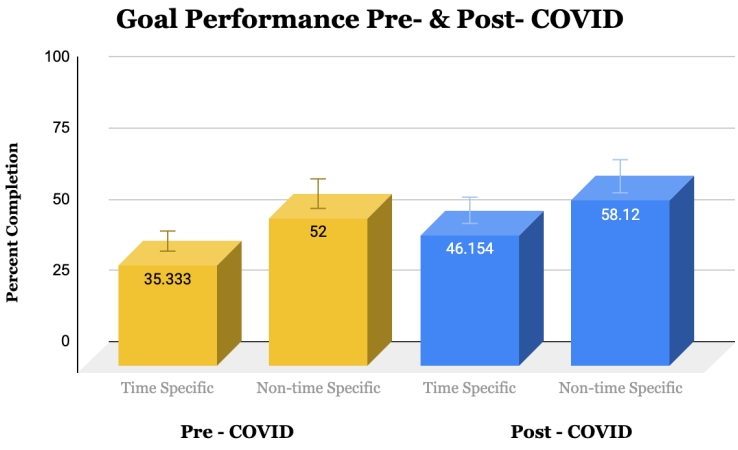

Figure 5. Prospective Memory completion compared between experiment 1 and 2.

Discussion

Findings demonstrated the utility of reminders in naturalistic prospective memory tasks. There was a significant correlation found with prospective memory performance and both internal and external reminders. This finding corresponds with previous research and suggests that cognitive offloading, or the use of physical action to change the information processing demands of a task to reduce cognitive strain, may be a very effective strategy for college students (Risco & Gilbert, 2016). For students to use cognitive offloading effectively as a strategy for academic goal performance, parameters would need to be tested and established. For instance further research could examine the benefits and limitations of cognitive offloading, as well as when the amount of cognitive offloading used becomes detrimental rather than beneficial.

An unintended, but rather interesting feature of this study is the pre- and post-COVID-19 component. This component features participants completing the same naturalistic prospective memory tasks, only while participating in learning in a different environment. Despite the change to an online learning environment that is reported to be less satisfactory than a face-to-face learning environment, academic goal completion did not decrease. In fact, there were nominal increases in both event-based and time-based goals. This is an interesting finding, particularly because most higher education courses have changed a majority of face-to-face classes to online classes. Despite how student students may feel about this change in modality in terms of satisfaction, learning objectives could very well still be achieved. It is uncertain what the future holds for COVID-19, as well as other pandemics that may arise. However, higher-education facilities could still be able to meet learning objectives in an online learning environment. Of course, further research on the subject of academic goal completion and

learning modality is needed. Additionally, this study shows that students struggle more with time-based tasks as opposed to event-based tasks regardless of learning environment. There is a widely held theoretical view that remembering time-based tasks is more difficult than remembering event-based tasks (Einstein et al., 1995; McDaniel & Einstein, 2007). Not only did this study yield a finding that is consistent with the literature, it extended this work to an academic setting. The consequences of of time-based goal errors in higher education are serious and may result in lower grades or course failure. This study illuminates the need for measures to be taken to increase time-based task performance in an academic setting. Future studies may investigate more memory strategies that may increase naturalistic time-based tasks in the academic setting.

This study produced a viable means of assessing event-based and time-based prospective memory in a naturalistic context. Participants effectively used the Google Forms link to upload pictures of their goals with little to no technological difficulty. Moreover, there are currently few studies that have sought to examine event-based and time-based prospective memory performance simultaneously in a naturalistic context; this is a major strength of the study. This novel means of assessing prospective memory opens doors for future researchers interested in looking at prospective memory performance holistically outside a lab.

This study revealed that despite that fact that time-based tasks are viewed as more difficult to remember and college students struggle more with their completion, college students reported greater use of reminders for event-based tasks. If event-based tasks are regarded as less difficult to remember, the question is why are college students using more reminders for event-based tasks and fewer reminders for time-based tasks when students are less successful at time-based completion. A future study could look at how students choose to set reminders for various

academic tasks as well as what teachers and educators alike could do to improve time-based task completion. For instance, the frequency of reminder to task could be examined to see if greater frequency of reminders for a single task improves that tasks completion.

In contrast to previous findings suggesting episodic future thinking benefits goal pursuit (Ernst, Phillipe, & D'argembeau, 2018), individuals that underwent the episodic future thinking protocol in the present study had no significant increase in prospective memory performance when compared to the participants in the control group. Although there was a nominal increase in event-based submissions for the experimental group, the difference was not statistically significant. Research suggests that one possible reason for episodic future thinking having a larger effect on event-based submission, is because articulating the visuo-spatial context might assist in remembering the specific task where that context clue is encountered. Time-based prospective memory tasks, on the other hand, requires one to initiate retrieval unprompted (Altgassen et al., 2015) ; Paraskevaides et al., 2010). Another potential reason for the lack of effect in episodic future thinking may be because episodic future thinking, when used as an encoding strategy, only works in the short-term. For this study, participants started submitting their self-set goals the day after the protocol. In one episodic future thinking study, participants were required to come in on two consecutive days to complete prospective memory tasks. In one condition, participants received the same prospective memory task they were instructed to imagine the day before, while another group received a different prospective memory task on the second day than what they were told. Although participants received instruction for both days, researchers found that participants performed significantly better when they had already imagined the task the day before (Neroni, Gamboz, & Brandimonte, 2014). Although overall goal submission was low, there was a noted difference in submission amount by day. There may

also be a possibility that participants were lacking adequate detail when verbalizing the context of their goals in the EFT protocol. Although participants were asked to undergo the EFT protocol with an example in order to ensure clarity, oftentimes participants described purely procedural aspects of their goal rather than the autobiographical information, visuo-spatial details, and feelings of experiencing that are usually present for an episodic future thinking occurrence (D'Argembeau et al., 2010). One key difference in this study in comparison to other episodic future thinking studies was that participants were not asked to rate their level of belief in occurrence for their desired goal, which is believed to play a pivotal role in evaluating to what extent individuals truly "experienced" their future events (Ernst & D'Argembeau, 2017; Scoboria, Mazzoni, Ernst, D'argembeau, 2020). Instead participants were asked to identify the subjective importance of the goal. Although audio of the episodic future thinking protocol was recorded for each participant, the participant's level of episodic detail has not yet been rated by researchers, as seen in past literature (D'Argembeau et al., 2010). Additional analysis has to assess the level of episodic detail for each participant in order to measure the extent that individuals envisioned the future and truly pre-experienced their goals.

There are a few important limitations to note about the episodic future protocol. While the protocol accounted for the major three aspects of episodic future thinking (visuo-spatial context, feelings of experience, autobiographical relevance), it is still a novel protocol. Future studies could build off of the current protocol and include instructions that would facilitate more detailed aspects of episodic future thinking. Some future thinking researchers suggest that imagining a future event, based off of past experiences, requires several attempts to draft a well thought out experience (D'argembeau et al. 2010; Williams et al., 1996). One potential change might be to extend the amount of time participants are engaging in the protocol in order to

allow for a more realistic and detailed version of the future situation. Future researchers might also attempt to increase the sample size of the study in order to improve the validity of findings. One might also consider expanding into allowing students to self-set more than just academically related goals, in order to ascertain more personally relevant goals for students. Future researchers should also consider transcribing and theming goals mentioned and the episodic future thinking protocol in order to understand the level of episodic details that participants had.

In summary, this study adds to a relatively new body of episodic future thinking literature and provides a potential framework for not only testing an episodic future thinking protocol, but also a framework for testing prospective memory performance in a naturalistic context. To date, there are minimal studies that compare time-based and event-based prospective memory tasks in such a naturalistic setting, especially with tasks that are of personal importance to the participants. In addition, this study also informs prospective memory research as it relates to reminder use. By understanding how external cues relate to prospective memory performance, and often take the form of cell phone reminders, we are able to gain insight into the ways that students remember to complete their academic goals. On a broader scale, the information from this study might be used to inform new ways to teach college students how to not only set goals for themselves, but also teach them how to utilize techniques that might help them complete the tasks necessary for achieving their desired goals.

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Appendix A

Condition Specific Protocol

Control Protocol (Verbal Fluency): "Please close your eyes and repeat back the six academic tasks you said you will complete. Be sure to state which day you will complete each task noting which tasks are time-specific versus non time-specific. After you state each task, I will ask you
to go through a mental exercise for one-minute that requires you to come up with all the words you can think of that start with a particular letter. For example, saying all the words that you can think of which start with the letter 'r', Do you have any questions?"

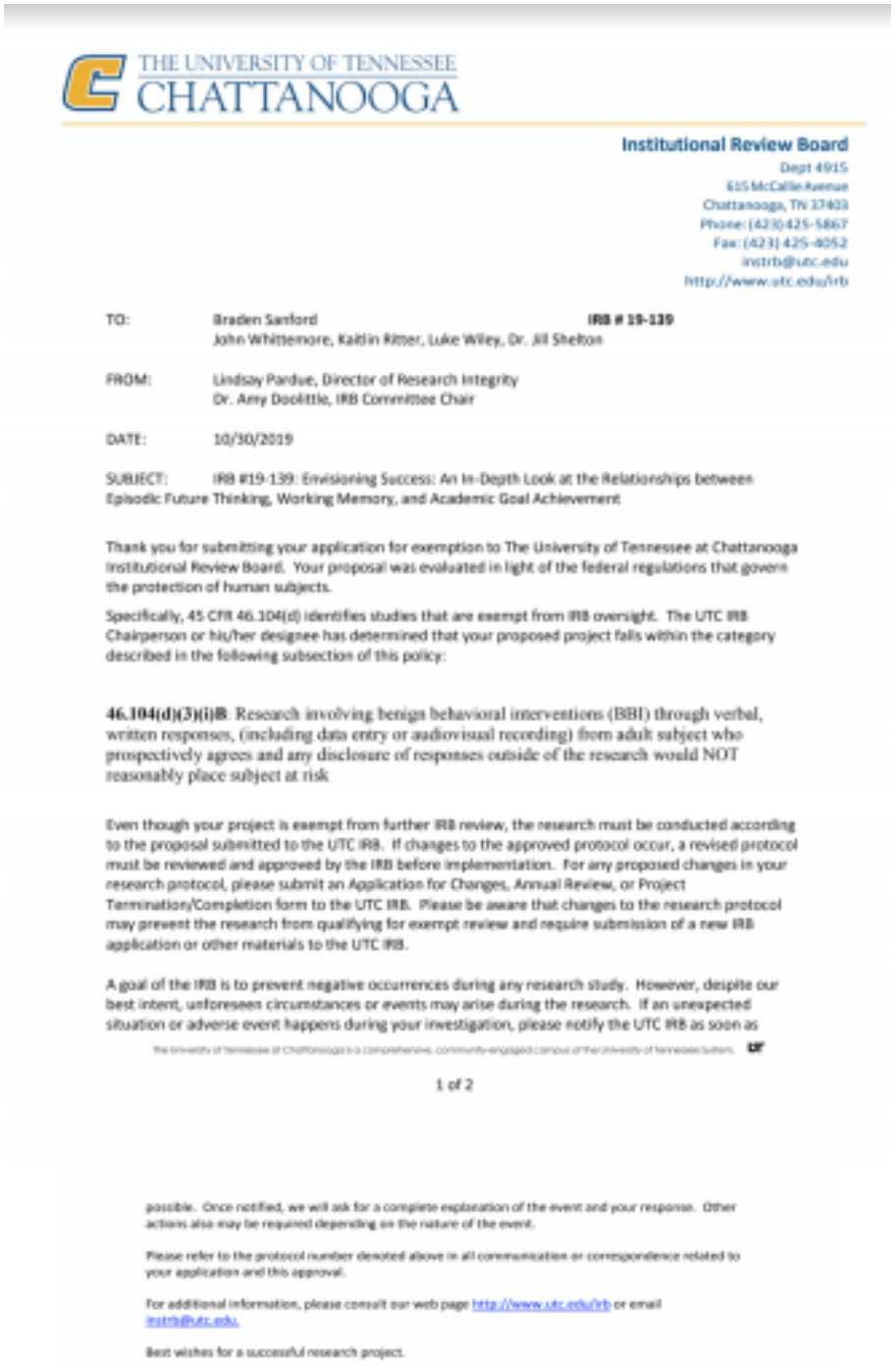
"What's your first task for the first day?"
"Is this time-specific or not? If so, what time will you start the task?"
"Please recount as many words as you can for one minute that starts with the letter __. (1st Goal = T) (2nd Goal = J) (3rd Goal = B) (4th Goal = L) (5th Goal = P) (6th Goal = F)

Episodic Future Thinking Protocol: "We will now be moving on to the next phase of our study, which will require you to envision details regarding your specific goals over the next three days. Please repeat back the six academic tasks you said you will complete. Be sure to state which day you will complete each task noting which tasks are time-specific versus non time specific. Importantly, you should close your eyes and envision yourself completing your goal specific task in as much detail as possible. As you envision your goal, please verbalize aloud the context regarding what you would experience. This context might include: whatever you may see, hear, or feel, where you will be, what you might think or what obstacles might keep you from attaining your goal. You will have one minute to describe each goal in as much detail as possible. I will alert you when your time is up, and we will proceed to envisioning the next goal. We will start with one example to determine if you understand the instructions.

"Imagine you are turning in a project for history class. Spend one-minute envisioning and verbalizing as many details surrounding the context of this action including whatever you may see, hear, or feel, where you will be, what you might think or what might keep you from attaining your goal. Do you have any questions?"

Appendix B

IRB Approval Letter



THE UNIVERSITY OF TENNESSEE CHATTANOOGA

Institutional Review Board
Dept 4915
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Chattanooga, TN 37403
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instrb@utc.edu
http://www.utc.edu/irb

TO: Braden Sanford **IRB # 19-139**
John Whittemore, Kaitlin Ritter, Luke Wiley, Dr. Jill Shelton

FROM: Lindsay Pardue, Director of Research Integrity
Dr. Amy Doolittle, IRB Committee Chair

DATE: 10/30/2019

SUBJECT: IRB #19-139: Envisioning Success: An In-Depth Look at the Relationships between Episodic Future Thinking, Working Memory, and Academic Goal Achievement

Thank you for submitting your application for exemption to The University of Tennessee at Chattanooga Institutional Review Board. Your proposal was evaluated in light of the federal regulations that govern the protection of human subjects.

Specifically, 45 CFR 46.104(d) identifies studies that are exempt from IRB oversight. The UTC IRB Chairperson or his/her designee has determined that your proposed project falls within the category described in the following subsection of this policy:

46.104(d)(3)(i)B: Research involving benign behavioral interventions (BBI) through verbal, written responses, (including data entry or audiovisual recording) from adult subject who prospectively agrees and any disclosure of responses outside of the research would NOT reasonably place subject at risk

Even though your project is exempt from further IRB review, the research must be conducted according to the proposal submitted to the UTC IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an Application for Changes, Annual Review, or Project Termination/Completion form to the UTC IRB. Please be aware that changes to the research protocol may prevent the research from qualifying for exempt review and require submission of a new IRB application or other materials to the UTC IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the UTC IRB as soon as

possible. Once notified, we will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval.

For additional information, please consult our web page http://www.utc.edu/irb or email instrb@utc.edu.

Best wishes for a successful research project.

Appendix C

Demographic Form

Please fill out this form to the best of your abilities. If there is any information you do not wish to provide, feel free to leave it blank.

Age: _____

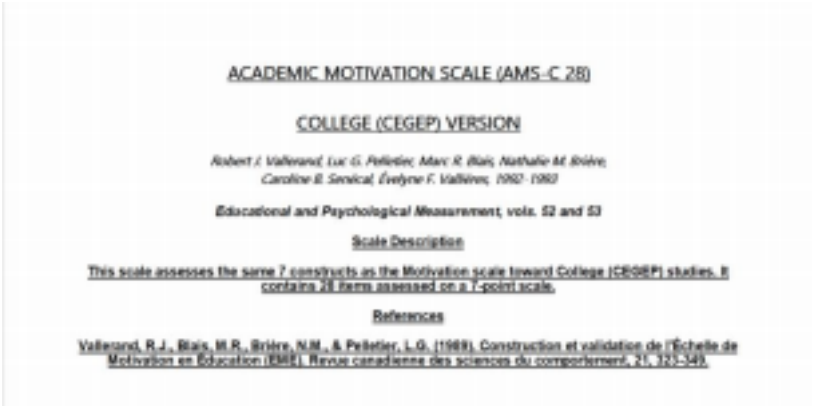
Gender: _____

Race: _____ Current Occupation (if any): _____ **How many hours do you work each week if employed? _____ How many credit hours are you enrolled in this semester? _____ Is English your first language? _____**

How many Hours do you Sleep per night (on average)? _____ How many naps do you take per week (on average)? _____ How many days per week do you exercise for 15 minutes or longer? _____

Appendix D

Academic Motivation Scale



ACADEMIC MOTIVATION SCALE (AMS-C 28)

COLLEGE (CEGEP) VERSION

Robert J. Vallerand, Luc G. Pelletier, Marc R. Blais, Nathalie M. Brière, Caroline B. Senécal, Évelyne F. Vallières, 1992- 1993

***Educational and Psychological Measurement*, vols. 52 and 53**

Scale Description

This scale assesses the same 7 constructs as the Motivation scale toward College (CEGEP) studies. It contains 28 items assessed on a 7-point scale.

References

Vallerand, R.J., Blais, M.R., Brière, N.M., & Pelletier, L.G. (1989). Construction et validation de l'Échelle de Motivation en Éducation (EME). Revue canadienne des sciences du comportement, 21, 323-349.

WHY DO YOU GO TO COLLEGE (CEGEP) ?

Using the scale below, indicate to what extent each of the following items presently corresponds to one of the reasons why you go to college (CEGEP).

Does not correspond at all		Corresponds a little		Corresponds moderately		Corresponds a lot		Corresponds exactly
1	2	3	4	5	6	7		

WHY DO YOU GO TO COLLEGE (CEGEP) ?

1. Because with only a high-school degree I would not find a high-paying job later on.	1	2	3	4	5	6	7
2. Because I experience pleasure and satisfaction while learning new things.	1	2	3	4	5	6	7
3. Because I think that a college (CEGEP) education will help me better prepare for the career I have chosen.	1	2	3	4	5	6	7
4. For the intense feelings I experience when I am communicating my own ideas to others.	1	2	3	4	5	6	7
5. Honestly, I don't know; I really feel that I am wasting my time in school.	1	2	3	4	5	6	7
6. For the pleasure I experience while surpassing myself in my studies.	1	2	3	4	5	6	7
7. To prove to myself that I am capable of completing my college (CEGEP) degree.	1	2	3	4	5	6	7
8. In order to obtain a more prestigious job later on.	1	2	3	4	5	6	7
9. For the pleasure I experience when I discover new things never seen before.	1	2	3	4	5	6	7
10. Because eventually it will enable me to enter the job market in a field that I like.	1	2	3	4	5	6	7
11. For the pleasure that I experience when I read interesting authors.	1	2	3	4	5	6	7
12. I once had good reasons for going to college (CEGEP); however, now I wonder whether I should continue.	1	2	3	4	5	6	7
13. For the pleasure that I experience while I am surpassing myself in one of my personal accomplishments.	1	2	3	4	5	6	7
14. Because of the fact that when I succeed in college (CEGEP) I feel important.	1	2	3	4	5	6	7
15. Because I want to have "the good life" later on.	1	2	3	4	5	6	7

Does not correspond at all		Corresponds a little		Corresponds moderately		Corresponds a lot		Corresponds exactly
1	2	3	4	5	6	7		

WHY DO YOU GO TO COLLEGE (CEGEP) ?

16. For the pleasure that I experience in broadening my knowledge about subjects which appeal to me.	1	2	3	4	5	6	7
17. Because this will help me make a better choice regarding my career orientation.	1	2	3	4	5	6	7
18. For the pleasure that I experience when I feel completely absorbed by what certain authors have written.	1	2	3	4	5	6	7
19. I can't see why I go to college (CEGEP) and frankly, I couldn't care less.	1	2	3	4	5	6	7
20. For the satisfaction I feel when I am in the process of accomplishing difficult academic activities.	1	2	3	4	5	6	7
21. To show myself that I am an intelligent person.	1	2	3	4	5	6	7
22. In order to have a better salary later on.	1	2	3	4	5	6	7
23. Because my studies allow me to continue to learn about many things that interest me.	1	2	3	4	5	6	7
24. Because I believe that a few additional years of education will improve my competence as a worker.	1	2	3	4	5	6	7
25. For the "high" feeling that I experience while reading about various interesting subjects.	1	2	3	4	5	6	7
26. I don't know; I can't understand what I am doing in school.	1	2	3	4	5	6	7
27. Because college (CEGEP) allows me to experience a personal satisfaction in my quest for excellence in my studies.	1	2	3	4	5	6	7
28. Because I want to show myself that I can succeed in my studies.	1	2	3	4	5	6	7

KEY FOR AMS-28

 # 2, 9, 16, 23 Intrinsic motivation - to know

 # 6, 13, 20, 27 Intrinsic motivation - toward accomplishment

 # 4, 11, 18, 25 Intrinsic motivation - to experience stimulation

 # 3, 10, 17, 24 Extrinsic motivation - identified

 # 7, 14, 21, 28 Extrinsic motivation - introjected

 # 1, 8, 15, 22 Extrinsic motivation - external regulation

 # 5, 12, 19, 26 Amotivation

Appendix E

Sample Form

SAMPLE FORM

Please fill out the information below.

1. **Event-Based Submission**
   Files submitted:

2. **Time-Based Submission**
   Files submitted:

3. **How did you remember?**
   Check all that apply.

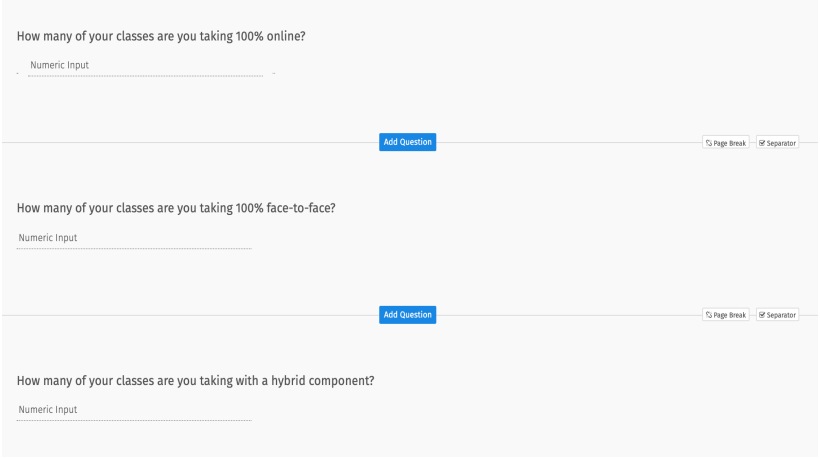
   - [ ] I did not use anything to remember things; the tasks usually pop into my mind.
   - [ ] I waited for external cues in my environment to remind me of things.
   - [ ] I mentally repeated things to myself that I needed to remember.
   - [ ] I used a cell phone or other electrical device to help me remember things.
   - [ ] I wrote things down on my hand or put things in special places to remember things.
   - [ ] I remembered things by associating them with other events (like "right after breakfast" or "before bed")

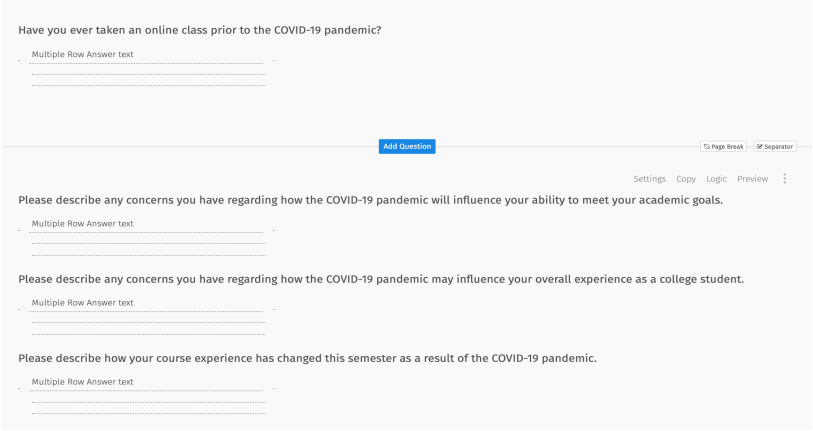
Appendix F

COVID-19 Questionnaire

On a scale of 1-7 please indicate your response to the following questions:

	1 (Strongly Disagree)	2 (Disagree)	3 (Somewhat Disagree)	4 (Neither Agree or Disagree)	5 (Somewhat Agree)	6 (Agree)	7 (Strongly Agree)
I am concerned that university changes related to the COVID-19 pandemic will negatively influence my ability to meet my academic goals.	☐	☐	☐	☐	☐	☐	☐
I am concerned that university changes related to the COVID-19 pandemic will negatively influence my overall experience as a college student.	☐	☐	☐	☐	☐	☐	☐
My courses have had to be adjusted this semester as a result of the COVID-19 pandemic.	☐	☐	☐	☐	☐	☐	☐
My typical academic routine has changed as a result of the COVID-19 pandemic.	☐	☐	☐	☐	☐	☐	☐
My academic goals for the semester have changed as a result of the COVID-19 pandemic.	☐	☐	☐	☐	☐	☐	☐
My academic workload has increased as a result of the COVID-19 pandemic.	☐	☐	☐	☐	☐	☐	☐




Have you ever taken an online class prior to the COVID-19 pandemic?
Multiple Row Answer text
Add Question
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Please describe any concerns you have regarding how the COVID-19 pandemic will influence your ability to meet your academic goals.
Multiple Row Answer text
Please describe any concerns you have regarding how the COVID-19 pandemic may influence your overall experience as a college student.
Multiple Row Answer text
Please describe how your course experience has changed this semester as a result of the COVID-19 pandemic.
Multiple Row Answer text