THE EFFECT OF 'TEACH AN LA' ON SELF-REPORTED MEASURES OF STUDENT SELF-EFFICACY

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ABSTRACT

A growing body of research shows that an individual's perceived self-efficacy plays a large role in performance concerning a number of areas, including future thinking, stress reduction, problem solving, and academic success. These links continue to be thoroughly studied, but research on how to influence perceptions of self-efficacy remains limited and lacks generalizability. This study examines the effects of a peer instruction program named, "Teach a learning assistant", hereafter, "Teach an LA", on University of Colorado Boulder cognitive psychology students' reports of perceived self-efficacy. Statistical analysis shows significant differences between classes with "Teach an LA" programs and controls' changes in reports of academic self-efficacy across the semester. This research suggests that programs like "Teach an LA" may provide cost-effective methods to aid in positively influencing students' perception of their academic self-efficacy.

THE EFFECT OF 'TEACH AN LA' ON SELF-REPORTED MEASURES OF STUDENT SELF-EFFICACY

There are beliefs that certain key traits of a child's personality can predict success (Casey & Somerville et al., 2011; Moffit & Arsenault et al., 2011); but the question remains, can these various traits be deliberately influenced to improve life outcomes? Research suggests that one of these traits is self-efficacy, and that yes, it can be influenced. Belief in oneself is an important motivational force. Few individuals set about on endeavors with the intentions of spending large chunks of time and money on them when they believe that those efforts will inevitably fail. An individual's belief about their capabilities to produce results and exercise influence over their life is what Albert Bandura defined as Perceived Self-Efficacy (Bandura, 1977; Bandura, 1986). Our progression through school provides us with opportunities to develop in a number of ways. We are faced with problems and taught new ways to solve them, like the rules that allow us to work through algebraic equations. We are taught to construct grammatically correct sentences so that others can properly ascertain our meaning; we are surrounded with social learning opportunities that aid us in learning how to navigate difficult topics and communicate effectively with authority figures; and, we gain insight into our strengths and weaknesses, our cognitive capabilities, and our interests. Bandura hypothesized that our perception of our self-efficacy plays a role in these cognitive, motivational, affective, and selective processes (Bandura, 1994). It was his belief that during our most formative years as a child, school acts as the primary environment for the development and activation of self-efficacy.

Since Bandura, an immense body of research has been constructed discussing the role that self-efficacy plays in our present and future lives. How perceptions of our capabilities develop has been shown to have a critical impact on purchasing decisions and to play a role in

choices made by athletes during competitive sports (Reed, et al., 2012; Bullock-Yowell et al., 2014; Musculus et al., 2018; Helper & Chase, 2008). What might be more telling however, is the influence that specific perceptions of self-efficacy can have over the selection of one's college major (Betz & Hackett, 1983; Porter & Umbach, 2006; Whitley, 2017); and, that the effects of these perceptions seem to continue long after that choice has been made. In their 2008 book, "Motivation in Education," Dale Schunk, Paul Pintrich, and Judith Meece provide ample support for the idea that self-efficacy acts as a positive predictor of academic success. Sinkavich (1995) found evidence that students with better performance on tests also had higher confidence on individual test items, and Hacker et al. (2000), found significant differences between low and high performing students' ability to predict their outcomes prior to taking tests. Studies have been conducted since then asking just how much of a role perceived self-efficacy plays in academic outcomes (Crede & Phillips, 2011; DeFreitas & Bravo Jr., 2012). These studies provide evidence that perceptions of self-efficacy do play a significant role in mediating a student's journey towards success, but how they manage to do so remains undefined.

There are many who posit that the main role of self-efficacy is in developing motivation and increasing habits associated with Self-Regulated Learning (SRL) (Isaacson & Fujita, 2006; Puteh & Ibrahim, 2010; Zusho & Edwards, 2011). Self-Regulated Learning, as defined by Pintrich and De Groot (1990), can be broken down into three main components including students' metacognitive strategies for planning, monitoring, and modifying their cognition; their management and control of their effort on classroom academic tasks; and, the cognitive strategies that students use to learn, understand, and remember material. In their study, Pintrich and De Groot set out to determine how components of motivation and SRL were used to succeed in classroom efforts using a general expectancy-value model of motivation (Eccles, 1983;

Pintrich, 1988; Pintrich 1989). The general expectancy-value model of motivation includes three elements: expectancy, value, and affect. Using self-reported answers of a 54-question version of the Motivated Strategies of Learning Questioning (MSLQ) (Pintrich et al., 1991), they found self-regulation, self-efficacy, and test anxiety acted as significant predictors of academic performance (Pintrich & De Groot, 1990).

Following this line of reasoning concerning the relationship between self-efficacy and achievement, Doménech-Betoret, Abellán-Roselló, & Gómez-Artiga (2017) looked at students' expectancy-value motivational beliefs. Pintrich and De Groot (1990) claimed these beliefs play a role in mediating Self-Regulated Learning. Doménech-Betoret's results found that these expectancy-value beliefs played a significant role in mediating the self-efficacy/academic achievement relationship; however, statistical analysis found that general academic self-efficacy continued to associate positively with academic achievement above and beyond the mediation. In addition to the plethora of research investigating the positive values of self-efficacy on grades, a number of researchers also discuss the importance of addressing how self-efficacy otherwise affects students (Schunk, 1991; Artino Jr., 2012; Hsieh, Sullivan, & Guerra, 2007; Linnenbrink, & Pintrich, 2003) and the impact self-efficacy can have on students' persistence, adjustment, and future plans while in university programs (Marra, Rodgers, Shen, & Bogue, 2009; Peterson-Graziose, Bryer, & Nikolaidou, 2013; Chemers, Hu, & Garcia, 2001).

Despite such a vast pool of support for the value of self-efficacy within academia, research outlining successful methods to increase student perceptions of self-efficacy remains underwhelming. The reasons for this may lie in the fact that increasing perceptions of self-efficacy appears to be a rather difficult thing to do. Talsma, Schüz, Schwarzer & Norris (2018) call the issue a chicken and egg conundrum, referring to Pajares & Schunk's (2001) presentation

of the controversy between the two major orientation camps. The camp of self-enhancement argues belief in one's ability to succeed leads to increased performance, while the skill-development camp argues that success and feedback showing improvement lead to increased perceptions of self-efficacy. Using a meta-analytic, cross-lagged, panel analysis, Talsma et al. provide evidence that both sides make valid claims. Their study found that academic success and self-efficacy are inevitably intertwined in a positive feedback loop, with any increase in either of the two areas leading to improvements in the other; yet, they too provide no practical methods of interjection (Talsma et al., 2018).

In "Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions," Ellen Usher and Frank Pajares detail four primary influencers of self-efficacy that could theoretically be targeted for enhancement (Usher & Pajares, 2008). They are mastery experience, vicarious experience, social persuasion, and physiological state, "in order of 'relative potency'" (Usher & Pajares, 2008, p. 11). Although Usher & Pajares detail these predictive sources of self-efficacy, they too offer little in the way of practical teaching or learning applications to enhance perceptions of self-efficacy in students. There are however, a few notable sources of research that discuss possible intervention strategies.

The primary discussion surrounding intervention strategies we found lies in the initial chapter of Wigfield & Eccles' 2002 book, "Development of Achievement Motivation," entitled "The Development of Academic Self-Efficacy" (Schunk & Pajares, 2002). Here Schunk and Pajares take a deep dive into the effects of instructional practices on self-efficacy. They show that using "specific learning goals, strategy instruction and strategy verbalization, social models, performance and attributional feedback, and performance-contingent rewards," may lead to changes in self-efficacy (Schunk & Pajares, 2002, p. 27). They spend a good portion of their time

pointing out the commonalities among these practices, showing that they all regularly inform students of their learning progress, which then motivates students to continue to perform.

In all, two studies were located reporting details of programs used to increase self-efficacy. The first, follows concepts championed by Schunk & Pajares (2002). Siegle and McCoach (2007) show evidence of success in increasing 5th grade students' mathematics self-efficacy through teacher training prioritizing three primary learning intervention -- "Goal setting, which included activities designed to draw students' attention toward their successful performances; teacher feedback, which included complimenting students on the specific skills they had acquired; and modeling, which involved students observing fellow students successfully implementing learning tasks" (Siegle & McCoach, 2007, p. 13 & 14). Banfield & Wilkerson (2014) found that classes which were taught through the implementation of a gamified form of experiential learning theory (ELT) reported significantly higher self-efficacy on computer-networking subject-matter, as well as class satisfaction, when compared to controls in a class featuring a commonly used didactic teaching method.

These studies provide additional support that specific learning goals, strategy instruction, performance feedback, and reward systems can lead to enhanced self-efficacy; but, we are choosing to focus on issues with classrooms that are in a post-secondary environment, are larger class sizes (greater than 100 students) in which a small number of cumulative exams are heavily weighted in the course grade. These studies also looked at self-efficacy specifically relating to the class in question rather than general academic self-efficacy. This paper aims to use the foundation of research above to aid in filling in the existing gaps concerning the enhancement of general academic self-efficacy in large post-secondary classrooms where regular one-on-one teacher-to-student attention is simply not possible. To do so, we highlight the value of a piloted

teaching intervention on University of Colorado Boulder Cognitive Psychology Students that leverages the university's prominent position in the creation of learning assistants (LAs).

To maintain quality learning environments in large STEM classrooms, the University of Colorado Boulder first implemented the learning assistant Program in 2001 (Colorado.edu, 2019). Since its inception, universities across the country have replicated the program, utilizing learning assistants (LAs) to improve education (Talbot et al., 2015). According to the University of Colorado Boulder learning assistant Program website, "Learning assistants are undergraduate students who, through the guidance of weekly preparation sessions and a pedagogy course, facilitate discussions among groups of students in a variety of classroom settings that encourage active engagement" (Colorado.edu, 2019, "Background"). The value and effectiveness of student LAs in the classroom has been thoroughly documented (Pollock, 2009; Otero, Pollock, & Finkelstein, 2010; Sellami et al., 2017; Talbot et al., 2015). By opening new communicative pathways between student and teacher and allowing for additional active learning opportunities, LAs are a powerful tool for student engagement in the classroom. In a normal secondary education environment, there is no feasible way to give individual learning attention to each student in a class of over 100 students; however, the addition of LAs to a classroom makes individual attention possible.

Taking full advantage of the learning assistant program, Dr. R. McKell Carter has championed the "Teach an LA" program -- a 'teach-to-learn' style program centered around learning assistant guidance. Learning by teaching has long been shown to have a positive impact on persistent learning gains and aid student 'teachers' in strengthening their understanding of the material taught (Cohen, Kulik, & Kulik, 1982; Fiorella & Mayer, 2013; Koh, Lee, & Lim, 2018). The "Teach an LA" program has students teach topics from the course to learning assistants, who

then ask probing questions that critique specific mistakes made or identify gaps in presented knowledge. Value has been previously established through research on academic gains provided by teach-to-learn programs like those above; but, we are currently unaware of any research concerning teach-to-learn style instruction's impact on reported academic self-efficacy and hope to answer some of those questions within this study. In concordance with the theories and research on teaching interventions used to increase academic self-efficacy highlighted above, I hypothesized that students involved in the "Teach an LA" program would report larger increases in academic self-efficacy over the course of their semester than controls in a normal didactic teaching method class with LAs.

Methods

Overview

The "Teach an LA" program was implemented at the University of Colorado Boulder within Dr. R. McKell Carter's PSYC 2145 Introductory Cognitive Psychology class in three consecutive spring semesters -- 2016, 2017, and 2018. A standard didactic teaching method popular across universities including lecturing, video examples, and group learning exercises, was used across all years. During our control year, 2016, there was no implementation of "Teach an LA" interventions. During the first treatment year, 2017, "Teach an LA" programs were implemented involving students having a weekly session in which they attempted to effectively teach learning assistants various cognitive psychology topics (See Appendix A for example topics). During the 2017 treatment year, in each six-to-ten-minute teaching session LAs identified gaps in subject matter knowledge for the student teacher, asking students questions designed to draw out important details and identify gaps in knowledge consistent with deliberate practice. In 2018, "Teach an LA" interventions gave students the option to meet as pairs, to

effectively teach each other various subject matter under the guidance of learning assistants, or watch each other teach the LA, for 10-minute, weekly sessions. Following each teaching session, learning assistants identified gaps in subject matter knowledge for the student teacher, giving the student teacher specific knowledge goals for deliberate practice. The LAs also sought to increase peer involvement by guiding questioning from the student being taught toward the teaching student.

Data Collection

To track the effects of our "Teach an LA" interventions, all students within the classes were asked to take both beginning of course (pre) and end of course (post) tests. For the sake of this study, these tests were used to create quantifiable measures of self-reports concerning individual perceived self-efficacy and student cognitive psychology knowledge. These tests included a 35 question "Randomized Introductory Cognitive Psychology Knowledge Assessment," and a 54-question subset of the Motivated Strategies for Learning Questionnaire (MSLQ). Tests were administered successively on the University of Colorado Boulder Desire to Learn (D2L) online platform as part of a pre/post course questionnaire. Demographic data was not collected.

Randomized Introductory Cognitive Psychology Knowledge Assessment:

The pre/post randomized introductory cognitive psychology knowledge assessment, which was used to measure academic performance within the course, included 35 questions and focused on seven core areas of cognitive psychology: 1. Methods 2. Perception 3. Attention 4. Memory 5. Language 6. Knowledge 7. Higher-order cognition (See Appendix A). Five questions were selected randomly from pools of ten within each of these areas. Questions were selected independently for pre and post course assessments, with replacement. Random selection was

done with the intention of reducing memorization of pre-test questions for post-course performance, providing a more general measure of learning. Questions were either novel questions generated for the course or questions taken from the Norton Cognition textbook (6th edition) test-question bank. Students were informed the knowledge assessment would be graded for completion, but not for correctness. Students were instructed to do their best without making use of outside materials, preserving incentive to complete the test and perform well on it without creating the potentially corrupting influence of grading for accuracy.

Motivated Strategies for Learning Questionnaire (MSLQ)

Perceived self-efficacy was measured using the self-reports of the full 8-question "Self-Efficacy for Learning and Performance," scale originally developed as part of the 81-question Motivated Strategies for Learning Questionnaire (MSLQ) developed by Paul Pintrich, David Smith, Teresa Garcia, and Wilbert McKeachie, released in 1991 (See Appendix B). The full "Self-Efficacy for Learning and Performance" scale is meant to appraise one's perceived ability to master tasks, with a rather high internal consistency ($\alpha = .93$). The MSLQ we used is a 54-question subset of the original 81, and all questions are delivered as a seven-point Likert-style scale. For the "Self-Efficacy for Learning and Performance" component, a score of seven represents full belief in one's ability to learn and perform in an academic setting and a score of one represents an individual's complete lack of belief in their ability to learn and perform in an academic setting.

Participants

All students within the Introductory Cognitive Psychology Classes were offered the pre and post assessments as part of the standard course development. All students within the 2017 and 2018 years of the PSYC 2145 classes were offered the "Teach an LA" program intervention.

Demographics were not collected; but, according to The University of Colorado Boulder's public data recording concerning diversity of degrees granted, The University of Colorado Boulder's Department of Psychology and Neuroscience conferred approximately 1349 undergraduate degrees between 2016 and 2018. According to these statistics, degree earners gender was 72% Female and 28% Male. Degree earners race breakdown was 74% White, 12% Hispanic, 6% Asian, 3% International, 2% African American, 2% American Indian/Alaskan Native, 1% Pacific Islander, and 1% unknown. Age breakdown was unavailable. Since our research was conducted in a spring semester, required, introductory psychology class primarily composed of freshmen students within the psychology department, we assume that demographic data falls in line with all available department statistics.

Data was only analyzed from students who gave official consent to have their data from this course analyzed and reported as part of the "Teach an LA" research project (N=303). All students were offered course points for completion of the surveys, but no additional incentives were offered for consenting students. Credit was not contingent on research participation. This research study was delivered through D2L. Data collection was part of a larger researcher project involving an intervention designed to encourage self-testing. The project was reviewed by the University of Colorado Boulder's Institutional Review Board in 2016, 2017, and 2018.

Procedures

Self-efficacy changes were tracked via subject self-reports over the course of a 16-week semester. Measurements were taken during the first week of class and again during the last week of class, prior to finals. Analysis was done with R, in RStudio version 1.1.423 and 1.1463, using the package lme4, which fits linear and generalized linear mixed-effects models. (See Supplemental Data for analysis). F, Error df, and p-values were found using Kenward-Roger

approximation. We controlled for knowledge assessment scores to aid in assessing the specific influence of "Teach an LA" on self-efficacy.

Results

To investigate the effects of the "Teach an LA" program on self-efficacy, we examined the differences in our class completion factor of pre-post scores between control and experimental years, while controlling for individual knowledge assessment scores within the semester. We conducted an analysis of covariance (ANCOVA) of the 2 levels of pre/post used to measure individual change over the course of a single semester x the 3 different years, to include the control year of 2016 and the combined implementation years of 2017 and 2018, with knowledge assessment scores as a covariate (For measures of central tendency, see Table 1 and Supplemental Table).

As expected, results showed that academic assessment scores were positively related to one's self-efficacy scores ($\beta = .20$), $F(1, 531.7) = 12.63$, $p < .001$. We found a significant main effect of pre/post as a decrease in self-efficacy upon class completion while controlling for knowledge assessment scores, ($\beta = -1.02$), $F(1, 377.2) = 18.82$, $p < .001$. Averaging across pre/post evaluations and controlling for knowledge assessment scores found no significant main effect of implementation on overall self-efficacy score. The results also showed a significant interaction effect between pre and post self-efficacy assessment scores due to "Teach an LA" implementation when controlling for knowledge assessment scores, ($\beta = .39$), $F(1, 300) = 9.44$, $p < .01$. In other words, when measuring the specific influence of the program, the interaction between pre vs. post and program implementation showed significant differences in self-efficacy changes throughout a semester between the control year of 2016, and a single level combination of implementation years 2017 and 2018 when controlling for knowledge assessment scores.

Discussion

We found compelling evidence in this study to support the hypothesis that CU Boulder's piloted "Teach an LA" program had a beneficial effect on student's perceptions of self-efficacy. Changes that occurred according to student self-reports within program intervention years over the course of their semester were significantly less negative when compared to controls in an otherwise similar introductory cognitive psychology class. As shown by the wealth of research concerning the value of self-efficacy above, self-efficacy can be very beneficial, creating a cascade of positive effects; including: reductions in stress and PTSD, improved future-thinking, improved academic success, persistence in the face of adversity, enhanced adjustment, and more. Additionally, students who report higher confidence in their abilities to succeed in their classes have been shown to do significantly better than their lower confidence classmates (Chemers, Hu, & Garcia, 2001). This study provides further support for these claims, demonstrating that academic self-efficacy has a significant relationship with academic success. A cost-effective teaching program that can positively influence students' self-efficacy provides clear value to educational program development, making further research on the "Teach an LA" program a useful venture.

Certain components of the "Teach an La" program must be considered in order to identify what specifically is positively influencing self-efficacy. Per the body of research highlighted above, we believe the major mechanisms playing a role in improving changes to self-efficacy to be: 1. Modeling; 2. Direct Feedback, 3. Peer Learning and Scaffolding; and, 4. Deliberate Practice for Mastery Acquisition. In the upcoming final sections, we review the relationship each of these have to self-efficacy in our study, discuss how to test their role as

potential underlying factors driving our observed changes, and comment on the existing limitations and drawbacks of the study.

Components and Future Research

Modeling is posited by Schunk & Zimmerman (2007) to be a major influencer of children's self-efficacy and self-regulation. Schunk (1987) defines modeling as the process in which observers pattern their thoughts, beliefs, and behaviors, after those displayed by one or more models. Schunk (2001) further demonstrates how models can inform as well as motivate others, leading to the absorption of knowledge and skill. Any university classroom's professor ideally provides students the epitome of an academic model, but "Teach an LA" gives students an opportunity to experiment with patterning their behavior based on this model's example as they combine the knowledge they've gained from their books and other materials. This does not replace the need for a quality teacher, but instead augments and enhances a teacher's efforts, which could in theory lead to better than normal student gains. Future research might consider modes of tracking student modeling efforts using additional self-reports concerning students' opinions of their teacher, their teaching methods, and questions focused on identifying whether the student models learning and teaching behaviors on professor representations.

Positive feedback, especially concerning successful demonstration of skill acquisition, has been repeatedly noted as critical to self-efficacy development (Schunk & Pajares, 2002; Siegle & McCoach, 2007). Research about the impact of academic success on self-efficacy shows that achieving quality exam grades can often increase reports of self-efficacy in students (Talsma et al., 2018). In many university classrooms, grades act as the only feedback received by students. Unfortunately, especially in the case of exams, intense weighting of a single grade over 'success' leaves many students facing anxiety that can hamper capabilities and reduce quality of

work. The "Teach an LA" program offers students a chance to demonstrate acquired knowledge with one-on-one attention, and to have these efforts followed by direct feedback, without the anxiety caused by grading.

Directed responses also provide students with references that they can use to track progression and shortcomings. These guideposts help students to identify specific gaps in knowledge so that they can make timely use of study efforts by aiming at clearly defined targets. This form of academic "scaffolding" offers students numerous opportunities to fix knowledge bases and build upon them further, offering the student intermittent successes throughout the semester in which they can find accomplishment. Future designs may consider including an augmented program in which learning assistants simply provide regular one-on-one feedback concerning students' exams and coursework. Comparing these outcomes with normal "Teach an LA" and control groups would aid in teasing apart the value of increased feedback from the rest of the program mechanisms.

The concepts outlined above mimic many of the group and peer learning ideas championed by Lev Vygotsky in his developmental conceptualization of scaffolding (Restated in Woolfolk, 2004). The nature of secondary education rests upon foundation setting in which a student learns basic pieces of knowledge that are then used in the comprehension of more complex ideas. These higher-level ideas are in turn compounded further for truly advanced conceptual understanding. The feedback provided through "Teach an LA" allows students to metaphorically consult the blueprints with which they are building foundations, comparing their current understanding, to ensure they are being constructed properly. By making certain that their own foundation is solid and accurate, further knowledge can be grasped more quickly and clearly, with less personal feelings of inadequacy, easing student anxieties and building

confidence in their abilities to properly learn. Future research might find value in exploring the effects of the program without any form of feedback within "Teach an LA". This might be done by instructing students to teach themselves in the mirror, or with the popular software debugging method of rubber ducking, in which programmers find flaws in their code by explaining their code line by line to a rubber duck. These attempts at mental modeling should offer similar values to "learning-by-teaching" (Cohen, Kulik, & Kulik, 1982; Fiorella & Mayer, 2013; Koh, Lee, & Lim, 2018), while removing the peer learning and feedback aspects of the program.

There seems to be little discussion at current concerning the specifics of how mastery acquisition influences reports of self-efficacy; however, mastery is clearly found through large amounts of time spent harvesting successes towards the target skill. As demonstrated by nearly every study above, deliberate efforts that lead towards successful acquisition of mastery and feedback should provide value to self-efficacy through informed improvement. Mastery learning has been well-documented to occur within simulations and through deliberate practice (Ericsson, 2006; Cahill Clark 2008; Reedy, 2015; Gonzalez & Kardong-Edgren, 2017); however, it is important to note that numerous published studies have found evidence that deliberate practice alone is not sufficiently able to explain the acquisition of mastery (Hambrick et al., 2014; Macnamar, Hambrick, & Oswald, 2014). Despite other possible factors leading to mastery, repeated simulations to demonstrate knowledge provided by the "Teach an LA" program allow students take part in deliberate practice that has been shown to assist in mastery acquisition. Future research may consider using a study design including specific, repeatable study methods, meant to engage students in deliberate practice, compounded with self-monitored demonstrations of mastery acquisition. This would allow for the removal of the influences of feedback and peer-learning, but these efforts may still find confounds within the realms of modeling and

scaffolding. Teasing apart the multiple variables influencing self-efficacy would prove rather difficult, which may be why research on the subject is rather limited.

Limitations

There were also limitations within this study that should be addressed by any further research. First, although the hypothesis was confirmed by the beneficial value of the "Teach an LA" program, it is important to note that the self-efficacy changes that occurred did not act in accordance with our initial beliefs. The year 2018 acted as the only year so far recorded with increases in pre to post self-efficacy, and these changes were not significant as discussed in the results section above. Instead our data seems to suggest that the program simply acted as a buffer, reducing the otherwise negative impact on self-efficacy seen within the 2016 control year. This brings up multiple questions concerning the effects of college in general on students' self-efficacy. Usher and Pajares (2008) mention a need for a closer look at the movement of self-efficacy along the transitional periods from elementary to middle school, and middle to high school for a variety of reasons. It seems reasonable to posit that these same points should be applied to the transitional stage found in college. It also seems possible that time in college takes a negative toll on the average student's self-efficacy, perhaps due to the large jump in difficulty from high school, the influence of the average student also moving away from home, or due to many other circumstances that a student may be faced with over that time. An attempt to find research documenting changes in self-efficacy over the course of a college career, or even before and after a single college semester left us nearly empty handed; but, direct contact with Dale Schunk returned some information.

Through Dr. Schunk we were able to contact Dr. Ayeesha Hankins, who's dissertation and current research focuses on self-efficacy in adults and college students. Dr. Hankins found

through her dissertation research that certain subgroups of students, based around gender, race, and first-generation status, showed general decreases in self-efficacy over the course of college semesters. It is impossible to make claims about the influence of college on the average student's perception of self-efficacy with such limited data; but, as it seems that our research and Dr. Hankins dissertation may be two of the only studies to document changes in post-secondary students' reports of self-efficacy across a semester, a negative influence of college on self-efficacy seems plausible and warrants further research.

There were further potential interpretation issues as well. It's important to note that the 2018 post-scores were lower than the 2016 pre-scores. This might suggest a rather wide and general random variance in self-reporting scores. Until further points of data are available, it's difficult to make any solidified claims, causing our current research to act less as a statement of the impacts of college or our program on self-efficacy, and rather a clear justification and reason for more research. Additionally, our lack of demographic data has negatively removed the ability to track possible gender or ethnicity-based details regarding efficacy changes. Several of the studies mentioned above have discussed the possible effects of gender, race, and first-generational status on academic self-efficacy. A 2012 meta-analysis suggests that males demonstrate slight but significantly higher academic self-efficacy scores overall (Huang, 2012). Considering that psychology is a primarily female major in universities, our data may suggest that the "Teach an LA" program might help neutralize such a gap, but specific gender demographics are necessary to analyze such a claim. Further research should be sure to obtain demographic data to determine whether gender, age, ethnicity, or major (in the event of wider reaching surveying) may play a significant role.

Better tracking of specific "Teach an LA" sessions, to include material covered, individual progress, and a mid-semester evaluation of self-efficacy is also advised. Additional data points would allow for a more developed picture of the value provided by the "Teach an LA" program, assisting in identifying and controlling for possible confounds. Our lack of data points throughout and following the semester limits the scope of analysis available to our current study. Additional longitudinal tracking of individuals involved in the "Teach an LA" program would also aid in identifying whether or not the program has lasting effects, or if self-efficacy regularly returns to pre-test baselines at the beginning of semesters. Again however, without knowledge of the general effects of college on self-efficacy over time, these data points may not accurately represent intended analysis.

Our last limitation has to do with the 2018 year's testing procedures. In this class, students were given an additional midterm worth a large portion of the class grade. This mid-term took place, and grades were returned, prior to the post assessment. If previous research concerning academic success holds true, it is within reason to question if this ordering might influence responses concerning self-efficacy. Students who received quality marks on this exam would be likely to rate their self-efficacy higher due to their successes; however, it's important to note that overall average GPA differences within classes has not been seen. Students in this year did perform significantly better than other years on post-test assessments though. It's likely that students in this semester studied harder, earlier, due to this midterm, where most students in the previous years waited until finals week to complete the majority of their studying. This would create noticeable increases in cognitive psychology knowledge prior to post-test exam, boosting scores. Although the impacts of this testing change are evident, it's important to note that our analytical procedures have shown that there was an impact to self-efficacy over and above that of

the effect of knowledge assessment scores. This taking place despite the large increase in knowledge assessment scores suggests that a significant portion of the positive influences on self-efficacy are due to program implementation.

Conclusion

The data in this study provides evidence that the implementation of "Teach an LA" positively influences changes in students' self-efficacy over a semester. Future research is required to determine whether findings stay constant, to understand which mechanisms of the program play a critical role in self-efficacy enhancement, and to address insufficiencies in the current design. It is this author's belief that the "Teach an LA" program is successful due to its excellent interweaving of the numerous mechanisms listed above. In summation, "Teach an LA" provides an ungraded peer-learning experience in which a student gives a simulated demonstration of their knowledge acquisition by teaching in a method demonstrated by their class model and is given direct feedback from learning assistants in return. This feedback provides scaffolding which the student can then use to guide effective learning. This experience allows for a unique encapsulation of four well-documented methods for learning and skill development, which provides opportunities to positively enhance perceptions of self-efficacy, as supported by our data. The "Teach an LA" program is an incredibly easy to implement, cost-effective method for positively influencing post-secondary students' reports of perceived self-efficacy, a personal characteristic that a thorough body of research has shown is a powerful attribute to harvest for numerous reasons. It goes without saying that a program that may contain these qualities deserves the attention of future research, and that the children and students of tomorrow could benefit greatly by the refinement and application of "Teach an LA".

Supplemental Data

Using R studio version 1.1463 with additional package lme4

lmer(formula = SelfEfficacyScore ~ PREPOST + C1_16_1718 + C2_17_18 +
C1_16_1718:PREPOST + C2_17_18:PREPOST + totalQuizScore + (1 | PARTICIPANT) +
0 + PREPOST | PARTICIPANT) + (0 + totalQuizScore | PARTICIPANT)), data =
edSE, REML = TRUE)

Observations: 606; Groups: PARTICIPANT, 303

Linear mixed model fit by REML

Fixed Effects:

	Estimate	SE	F	error df	Pr(>F)
(Intercept)	38.721275	1.073857	1.284e+03	517.5	< 2e-16 ***
PREPOST	-1.023333	0.235272	1.882e+01	377.2	1.84e-05 ***
C1_16_1718	0.006054	0.281753	4.587e-04	301.3	0.982927
C2_17_18	0.332718	0.544921	3.706e-01	298.8	0.543133
totalQuizScore	0.195409	0.054581	1.263e+01	531.7	0.000413 ***
PREPOST:C1_16_1718	0.385836	0.125364	9.443e+00	300.0	0.002314 **
PREPOST:C2_17_18	0.275857	0.244082	1.273e+00	301.9	0.260007

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

NOTE: F, error df, and p-values from Kenward-Roger approximation

Random Effects:

Groups	Name	Std.Dev.
PARTICIPANT	(Intercept)	7.1363
PARTICIPANT.1	PREPOST	3.0767
PARTICIPANT.2	totalQuizScore	0.0000
Residual		1.2548

AIC: 4064.5; BIC: 4113.0; logLik: -2021.2; Deviance: 4042.5

SelfEfficacyScore = Pre and Post Self-Efficacy Scores
PREPOST = Pre vs Post Coding (Pre = -0.5 vs Post = 0.5)
C1_16_1718 = Control year (2016 = -0.66) vs Combined Implementation Years
(2017 = 0.33 & 2018 = 0.33)
C2_17_18 = Implementation Year (2017 = -0.5) vs Implementation Year (2018 =
0.5)(2016 coded out = 0)
totalQuizScore = Pre and Post quiz scores
PARTICIPANT = Unique Participant Identifier

Tables

Table 1: Self-Efficacy

Year	n	Pre	Post	Mean Difference	Effect Size
2016	125	M = 43.44 SD = 7.80	M = 40.75 SD = 8.32	-2.69	d= .33
2017	76	M = 42.45 SD = 7.73	M = 41.50 SD = 7.60	-0.95	d= .12
2018	102	M = 42.43 SD = 8.33	M = 42.97 SD = 8.01	0.54	d= .07
2017 & 2018	178	M = 42.44 SD = 8.05	M = 42.24 SD = 7.85	-0.20	d= .03

Supplemental Tables

Supplemental Table 1: Knowledge assessment scores

Year	n	Pre	Post	Mean Difference	Effect Size
2016	125	M = 15.02 SD = 4.68	M = 19.64 SD = 6.62	4.62	d= .81
2017	76	M = 16.07 SD = 4.37	M = 20.57 SD = 6.27	4.50	d= .83
2018	102	M = 15.40 SD = 4.70	M = 21.86 SD = 5.27	6.46	d= 1.29
2017 & 2018	178	M = 15.69 SD = 4.56	M = 21.31 SD = 5.73	5.62	d= 1.09

Figures

Figure 1
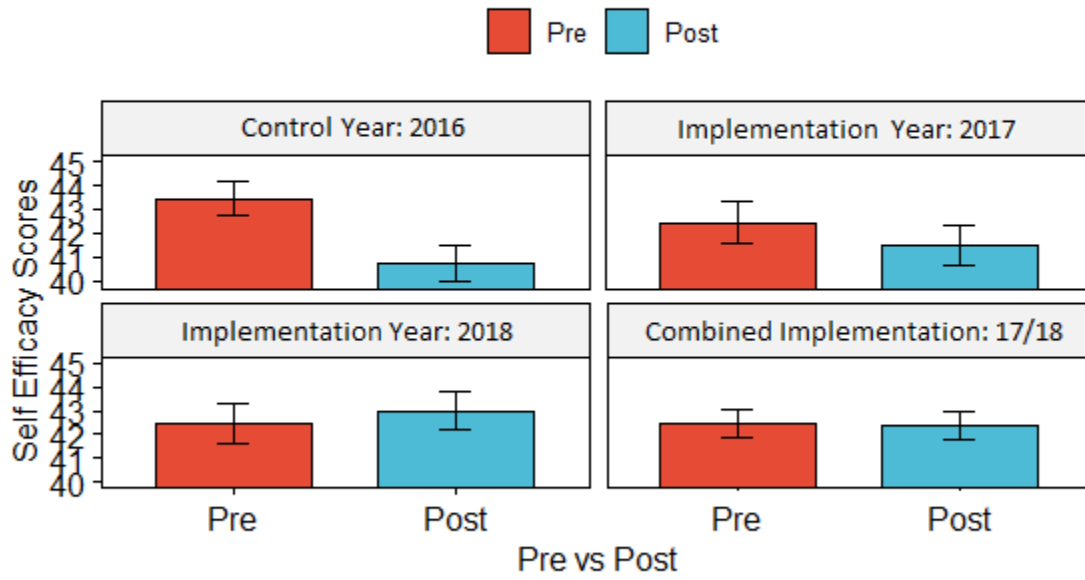
Appendix A

Cognitive Psychology Methods

1. Why was Analytical Introspection abandoned as a method to study the mind?
   a. Results from introspection were highly variable and hard to test.
   b. It seemed silly to train people to say what they were thinking.
   c. It yielded no useful insights.
   d. Because introspection focused on behavior rather than consciousness.
2. What is an action potential?
   a. Propagated electrical potential responsible for transmitting neural information along a neuron.
   b. A chemical that is released at the synapse.
   c. Processing that occurs in a progression from lower to higher areas of the brain.
   d. Activity that spreads out along any link in a semantic network that is connected to an activated node.
3. Which of the following is most likely to yield reliable information about human cognition?
   a. Experiments at multiple levels using multiple techniques.
   b. Behavioral experiments targeting reproducible observations.
   c. Physiological experiments that precisely describe the firing of neurons.
   d. Introspection from a trained professional on how a particular behavior began and how it could be modified.
4. Match the cognitive neuroscience method to its example.
   a. A lesion to Broca's area causes speech loss.
      i. Neuropsychology
      ii. Neurophysiology
      iii. Neuroimaging
   b. 97 percent of neurons in one brain area respond to faces.
      i. Neuropsychology
      ii. Neurophysiology
      iii. Neuroimaging
   c. Images of bodies activate an area on the side of the brain (extrastriate body area).
      i. Neuropsychology
      ii. Neurophysiology
      iii. Neuroimaging
5. Which of the following statements about introspection is FALSE?
   a. It is based on opinions, not facts.
   b. It is subjective.
   c. It provides strong evidence for hypothesis-testing.
   d. It was an early form of evidence.
6. Behaviorists study organisms'…
   a. expectations.
   b. desires and motivations.

c. dreams.
d. responses.
7. One important difference between classical behaviorism and cognitive psychology is that cognitive psychology
    a. argues that unobservable mental states can be scientifically studied.
    b. rejects the use of human participants.
    c. insists on studying topics that can be directly and objectively observed.
    d. emphasizes the evolutionary roots of human behavior.
8. Which lobe or cortex is farthest from the cerebellum?
    a. frontal
    b. parietal
    c. occipital
    d. temporal
9. Dr. Hout has fMRI evidence about the role of the FFA in visual processing. What should he do next?
    a. acquire evidence from another method, like CT or TMS
    b. assume that the role of the FFA is completely understood
    c. nothing; one source of evidence is sufficient.
    d. assume his results are flawed and do another fMRI study
10. The primary motor projection area is located
    a. in the cerebellum.
    b. in the occipital cortex.
    c. toward the rear of the frontal lobe.
    d. in the midbrain.

Perception

11. Neurons that respond to specific aspects of stimuli, such as orientation, movement, and length, are called:
    a. Feature detectors
    b. Sensory coders
    c. Retinal neurons
    d. Golgi receptors
12. Which of the following chains of feature detectors is NOT an example of hierarchical processing?
    a. Fingers, face, hand, head
    b. Line, edge, outline, object
    c. Brightness, color, object, grip width
    d. Outline, depth, face, expression
13. The placebo effect and seeing an image on a piece of toast (as opposed to just toast) are both examples of how expectations and experience shape our perceptions through:
    a. Top-down processing
    b. The inverse projection problem.
    c. Category error.

     d.   Invariance.

14. A monkey that has a lesion in the dorsal visual stream will have trouble doing what?
     a.   Determining an object's location.
     b.   Identifying an object.
     c.   Seeing an object.
     d.   Eating.

15. The ventral visual stream is involved in which of the following:
     a.   Vision for perception, object recognition.
     b.   Vision for action, movement to a goal.
     c.   Echolocation of objects.
     d.   Vision for grasping.

16. A researcher wishes to define the receptive field for a particular neuron in the visual cortex. To do this, the researcher will need to specify…
     a.   the portion of the neuron that receives input from neighboring neurons.
     b.   an area within the visual field wherein the cell will fire if the target appears.
     c.   where the neuron is located within the visual cortex.
     d.   the brain area from which the neuron is receiving its input.

17. Some people have sustained brain damage and lost the ability to identify color. Other people sustained damage to a different area of the brain and lost the ability to detect motion. What does this indicate about our visual system?
     a.   Identifying color is more important than identifying motion.
     b.   Neither color nor motion detection is critical to survival, if it can be erased through brain damage.
     c.   We have specialized areas for processing different kinds of visual information.
     d.   The brain is unable to simultaneously process information in multiple ways.

18. Shadowing can provide a cue for depth. For example, if a shadow appears on the bottom of a circle, the object appears convex. However, if the shadow appears on the top of the object, it appears concave. This happens because…
     a.   we have a part of the visual cortex that is dedicated to the interpretation of shadows that are at the bottom of an object.
     b.   in the real world, light comes from above more often than from below.
     c.   we were taught in school how to interpret shadows.
     d.   we are born with the ability to discriminate depth through use of shadows.

19. Imagine you are reading a puzzling email from a friend. You identify the words, but have a hard time reading between the lines. In this example, word identification involves _____ processing while reading between the lines involves _____ processing.
     a.   bottom-up; top-down
     b.   top-down; bottom-up
     c.   bottom-up; bottom-up
     d.   top-down; top-down

20. Facial recognition depends on recognition of…
     a.   the configuration of the parts.
     b.   the familiarity of the individual.

c. the lighting conditions.
d. the individual features of the face.

Attention

21. The difference between early selection models and late selection models of selective attention is that late selection models:
    a. emphasize distracting stimuli can still undergo some processing even though they were ignored.
    b. incorporate all information about the physical characteristics of attended and non-attended stimuli.
    c. focus on developing fine-grained attenuators that analyze incoming messages.
    d. have only been demonstrated in early dichotic listening experiments.
22. What is the difference between a feature search and conjunction search?
    a. A feature search is a search for one particular feature, while a conjunction search is a search for the combination of multiple features in a single object.
    b. There is no difference, they are the same thing, with a different name.
    c. A feature search is a search for only features, while a conjunction search is a search for a feature and something else on a single object.
    d. A feature search is harder than a conjunction search.
23. _____ is when a change occurs without the viewer realizing, often seen when comparing movie scenes where it can be referred to as continuity errors.
    a. Change blindness
    b. Inattentional blindness
    c. Balint's syndrome
    d. Preattentive search
    e. Feature binding
24. The ability to use selective attention to focus on a single object or thought comes at a price. _____ is the inability to describe stimuli that are not the focus of attention.
    a. inattentional blindness
    b. Balint's syndrome
    c. non-attentive search
    d. ineffective binding
25. Binding is the process by which different features are combined into:
    a. A unified perception of an object.
    b. A preattentive feature combination.
    c. A feature dictionary, ready to define the characteristics of an object.
    d. A restricted view of only the selected item.
26. A participant who has just participated in an experiment involving dichotic listening is LEAST likely to remember:
    a. whether input in the unattended channel was spoken by a male or a female.
    b. whether the unattended channel contained nonspeech noises or speech.
    c. how loud the signal of the attended channel was.
    d. the meaning of the words presented on the unattended channel.

27. A late selection view of attention suggests that…
    a. only the attended input is analyzed; the unattended input receives little analysis.
    b. all inputs are fully processed; however, only the attended input reaches consciousness.
    c. attention can switch back and forth between attended and unattended inputs.
    d. analysis of an unattended input is greater than that of the attended input.
28. Some researchers have compared visual attention to a searchlight beam sweeping across the visual field. Which of the following claims about this beam is NOT currently supported by evidence?
    a. It is possible to split the beam of visual attention, so that two nonadjacent positions are both within the beam.
    b. Movements of attention can be separate from movements of the eye.
    c. The beam of visual attention can be adjusted by the participant, so that it is sometimes wide and sometimes narrow.
    d. Stimuli inside the beam of visual attention are primed, promoting their perception.
29. The available data from patients with brain damage to circuits controlling attention indicate that:
    a. the brain mechanisms controlling attention are inseparable from the brain mechanisms directly involved in perception.
    b. multiple brain mechanisms are responsible for the control of attention.
    c. a single mechanism governs the ability to disengage attention from its current focus and the ability to lock into a new attention focus.
    d. the mechanisms controlling attention differ from one individual to the next.
30. Marcus is searching for a red square among an array of red and blue squares. Marcus is easily (and quickly) able to identify the red square because he is engaged in a _____ search.
    a. feature
    b. combination
    c. primed
    d. location-based

Memory

31. The phonological-similarity effect shows us that the phonological loop depends on sounds (and not a visual or symbolic representation) because when people make errors attempting to remember a list of letters the mistakes they make are largely:
    a. substituting letters that sound similar to the letter they wanted to remember
    b. letters whose sounds are complementary to the sound of the letter they wanted to remember.
    c. omissions that skip over sounds that are similar.
    d. added letters that sound similar to the letter they wanted to remember.
32. Check all of the brain regions that are associated with increased activation for viewing autobiographical images compared to a control set of images.
    a. Prefrontal cortex.

     b. Hippocampus.
     c. Amygdala.
     d. Parietal cortex.
     e. Medial temporal lobe.

33. Check all of the times during which memory distortions can occur.
     a. Perceptually, during the initial experience.
     b. In the initial period following the experience before consolidation.
     c. During recall of the memory by biasing which information is accessed.
     d. After the memory is consolidated as semantic associations.
     e. By dreaming about related events.

34. When asked to recall a list of 25 words, participants are likely to remember only some of them. The words they can recall are likely to include…
     a. approximately the last 12 words on the list.
     b. the first few words on the list and also approximately the last 6 words on the list.
     c. approximately the first 12 words on the list.
     d. words drawn from positions scattered throughout the list.

35. Which of the following groups is most likely to remember the material it is studying?
     a. Group 1 intends to memorize a series of words and, while studying, repeats the words mechanically over and over again.
     b. Group 2 intends to memorize a series of words and, while studying, pays attention to the exact appearance of the words.
     c. Group 3 has no intention of memorizing the words and searches the list for spelling errors.
     d. Group 4 has no intention of memorizing the words and attempts to determine how the words are related to one another.

36. In an experiment, participants learned materials in Room A and were tested in Room B. If they were asked to think about Room A just before taking the test, participants…
     a. performed as well as they would have done had there been no room change.
     b. performed worse on the test due to dual-task memory disruption.
     c. performed the same as those participants who were not asked to think about Room A.
     d. performed better than participants who were tested in Room B and were not asked to think about Room A, but worse than participants tested in Room A.

37. Which of the following statements is an example of a recognition test?
     a. "Which one of these individuals is the person you saw at the party?"
     b. "Describe how you spent New Year's Eve in 1994?"
     c. "What is the formula needed for computing the area of a circle?"
     d. "What political event does this song remind you of ?"

38. In many circumstances, participants correctly recognize that a stimulus is familiar but they are mistaken in their beliefs about where and when they encountered the stimulus. This error is referred to a:
     a. source confusion.
     b. origin error.

      c.   amnesia.
      d.   false identification.

39. The famous patient H.M. was unable to remember events he experienced after his brain surgery. The surgery apparently produced:
      a.   repression.
      b.   anterograde amnesia.
      c.   retrograde amnesia.
      d.   infantile amnesia.

40. Evidence suggests that decay:
      a.   accounts for the vast majority of forgetting.
      b.   probably explains far less forgetting than interference or retrieval failure.
      c.   in combination with repression explains virtually all of forgetting.
      d.   occurs for all memories.

Language

41. A unit of sound that can be put together with other units of sound to form words is referred to as a:
      a.   phoneme.
      b.   morpheme.
      c.   aural stimulus.
      d.   vocal feature.

42. Richard Warren described the phonemic restoration effect. Which showed that the perception of missing phonemes:
      a.   could be restored automatically with an appropriate contextual expectation.
      b.   could never be restored without repeating the missing entire word.
      c.   could be restored when presented in the other ear.
      d.   could only be restored when the preceding and following sounds were statistical predictive.

43. The finding that letters are more easily identified as part of a word than when isolated is called the:
      a.   word superiority effect.
      b.   letter union effect.
      c.   speech segmentation.
      d.   isolate agnosia effect.

44. According to syntax-first approaches to parsing, people who are reading sentences:
      a.   use late closure and group words according to syntax rules.
      b.   use semantic meaning to interpret syntax.
      c.   group words into phrases based on syntax rules.
      d.   assume each new word is part of the current phrase (known as late closure).

45. According to the situation model of inference, reading a story about someone tapping their foot while listening to a band performing should produce activation in which of the following regions of the brain?
      a.   Auditory cortex.

b. Motor cortex.
c. Wernicke's area.
d. Parietal cortex.
e. Frontal cortex.

46. The smallest units of language that carry meaning are called:
    a. morphemes.
    b. phonemes.
    c. phonetic elements.
    d. words.

47. Sentences such as Colorless green ideas sleep furiously indicate that:
    a. not all sentences need to have a verb phrase.
    b. it is possible for a sentence to have an irregular phrase structure.
    c. the semantic content of a sentence governs its syntactic form.
    d. a sentence can be grammatical even if it is meaningless.

48. Stephen and Stephanie both have problems with speech. Stephen's disorder is characterized with speech such as, Um . . . the . . . ahhh . . . I want . . . green . . . it's green. . .. Stephanie's disorder is characterized with speech such as, It is easy because . . . boys are looking but they look . . . see the cat is with the boys and machines and purple. Stephen is most likely suffering from _____ while Stephanie is suffering from _____.
    a. Wernicke's aphasia; Broca's aphasia
    b. Wernicke's aphasia; specific language impairment
    c. Broca's aphasia; Wernicke's aphasia
    d. specific language impairment; Broca's aphasia

49. Unlike other forms of animal communication, human communication includes:
    a. sounds that are linked to ideas.
    b. syntax.
    c. someone to listen.
    d. gestures.

50. Participant M speaks a language with a variety of color words, while Participant Q speaks a language that only differentiates between light and dark. Who is more likely to have more specific color discrimination?
    a. Participant M.
    b. Participant Q.
    c. They will have equal color perception.
    d. We cannot tell based on this evidence.

Knowledge

51. A prototype is a typical member of a category, what does atypical mean?
    a. An average of members of that category, but may not actually be a member.
    b. The first member that comes to mind that belongs to the category.
    c. An average of members that is also a specific member of the category.
    d. A member that is completely unlike other members of the category.

52. There have been numerous research studies carried out that support the claim that the exemplar and prototype approaches to mental categorization are not mutually exclusive but are actually very much connected. Which of the following is NOT a conclusion from the textbook about the relationship between the two categories:
    a. The prototype approach tends to work better for more abstract concepts (like social issues) and the exemplar approach works for more concrete concepts (like food).
    b. The exemplar approach works Â better for smaller categories (like U.S. presidents) and the prototype approach works better for larger categories (like birds).
    c. When we learn about a category we tend to initially average exemplars into one common representation, then as we expand our knowledge of this category some specific exemplars are reinforced over others and become stronger.
    d. Early in learning we are poor at taking into account "exceptions" to our prototypical categories (like adding ostrich to the category "bird"), but later exemplars are added for these more unique cases from experience with them.
53. Sentence verification technique is a procedure used to determine how quickly someone can answer questions about an object's category. This ability to judge highly _____ objects faster is called _____.
    a. prototypical; typicality effect
    b. prototypical; family resemblance
    c. primed; typicality effect
    d. primed; family resemblance
54. Which of the following findings would provide evidence *against* Collins and Quillian's hierarchical semantic network model?
    a. when asked to make yes/no judgments, participants respond more quickly to "schnauzers are a form of life" than "schnauzers are vertebrates".
    b. Participants exposed to the prime "schnauzers" are more likely to write in "dog" during a later stem completion task (i.e., the prompt "d___").
    c. Participants respond more quickly to "schnauzer; boxer" than "schnauzer; waiter" in a lexical decision task.
    d. When asked to make yes/no judgments, participants respond more quickly to "schnauzers are dogs" than "schnauzers are vertebrates".
55. In a connectionist network, representations are:
    a. a pattern of activity that is distributed across units.
    b. hierarchically distributed across nodes.
    c. accessed during back-propagation across complex nodes.
    d. organized as parent and child nodes.
56. It is spring and you are day dreaming in class. You imagine yourself approaching a buffalo shaped swimming pool. According to Kosslyn's 1978 experiment, as you get closer to the pool you should be able to recall _____ details of the pool. This _____ the idea that imagery and perception share resources.
    a. more; supports

b. more; contradicts
c. fewer; supports
d. fewer; contradicts

57. According to a shared resource view of imagery and perception, when asked to imagine traveling from one place to another. Traveling between two points that are further apart takes you _____ to imagine traveling between them because:
   a. longer; you are mentally travelling a longer physical distance.
   b. longer; the two concepts require more semantic links to connect.
   c. less time; you relate them directly, skipping physical distance.
   d. less time; the both fall under the same â€˜citiesâ€™ branch of the semantic network.

58. A researcher asks a participant to memorize a city map. On the map, the library and the school are 2 inches apart; the school and the hospital are 4 inches apart. The researcher now instructs the participant to form an image of the map and to scan from the library to the school. The researcher then asks the participant to scan from the school to the hospital. It is most likely true that the scanning time from the school to the hospital is _____ the scanning time between the library and the school.
   a. half
   b. triple
   c. the same as
   d. double

59. Damage to brain areas needed for vision:
   a. usually has little impact on visualizing.
   b. generally has opposite effects on visualizing and on vision.
   c. is likely to destroy altogether the patientâ€™s ability to visualize.
   d. often has disruptive effects for visualizing similar to the disruption observed for visual perception.

60. Participants are asked to perform an imagery task while simultaneously keeping track of a visual target (a light that varies in brightness). The visual task will:
   a. disrupt the imagery task.
   b. have no effect on the imagery task.
   c. disrupt the imagery task if it requires visual imagery but not if the task can be done with spatial imagery.
   d. cause the images to be less vivid but will have no other effects.

Higher-Order Cognition

61. Analogical problem solving involves creating parallels between the example and target problems. Which features are helpful when included in the process of mapping from example to target problem?
   a. Structure features.
   b. Surface features.
   c. Simple features.
   d. Structure and surface features.

62. The conclusion "all gators are over 7ft" is not a valid conclusion from the observation "I caught a gator in Orlando and it was 7ft" because it violates which principle of evidence accumulation for inductive reasoning?
    a. Number of observations.
    b. Representativeness.
    c. Quality of data.
    d. Heuristics.
63. Select all of the options below that are results of the Law of Large numbers.
    a. Small sample size can produce larger deviations from the true mean.
    b. A large sample size produces a mean closer to true mean.
    c. Small sample size produces a population mean closer to the true mean.
    d. A large sample size can produce larger deviations from the true mean.
    e. Conclusions form a small sample are equally well supported as conclusions from a larger sample size.
64. Which of the following findings does not provide support for the idea that contexts influence decision making?
    a. People often show confirmation bias (they favor information that supports their current beliefs).
    b. People make better fiscal decisions under conditions of increased bladder pressure.
    c. Judges are more favorable towards parole applications they review immediately after a break, relative to applications they review later in a sequence of cases.
    d. In games of chance, people become more cautious after a long winning streak.
65. All platypuses are mammals. All mammals lay eggs. Therefore, all platypuses lay eggs. The above syllogism is:
    a. valid and false.
    b. invalid and true.
    c. valid and true.
    d. invalid and false.
66. Heuristics are strategies that:
    a. sometimes risk error in order to gain efficiency.
    b. are underused, despite their advantages.
    c. protect us from overestimating the frequency of real-life events.
    d. ensure step-by-step procedures for finding correct conclusions.
67. Dual-process models state that people:
    a. have two ways of thinking: one is a fast and automatic process, whereas the other is slower but more accurate.
    b. have two ways of thinking, one involved in heuristics and the other involved in anchoring.
    c. have two ways of thinking, one involved in availability heuristics and the other involved in representative heuristics.
    d. always take both the base rate and the diagnostic information into consideration when thinking about a situation.

68. Several authors have proposed that we are generally aware of the _____ of our own thoughts even though we are usually unaware of the _____ of thought.
    a. product; processes
    b. decision-making processes; products
    c. implicit mechanisms; explicit mechanisms
    d. inferences; strategies
69. Much of our current understanding of consciousness derives from:
    a. subjective reports, although these had been deemed unscientific in the past.
    b. studies of what can be done in the absence of consciousness.
    c. chronometric studies.
    d. an increased sophistication in our ability to analyze introspective reports.
70. A patient with blind sight is likely to show all of the following traits EXCEPT if asked to:
    a. walk across the room, he or she does so easily.
    b. reach toward an object, he or she tends to reach in the appropriate direction.
    c. reach toward an object, he or she tends to reach with the appropriate hand position (e.g., with the hand open wide if the target is large).
    d. guess the identity of a visual stimulus, his or her guesses are consistently correct.

Appendix B

Complete 54-question subset of the Motivated Strategies for Learning Questionnaire (MSLQ)
Questions belonging to the self-efficacy measure are bolded.

Students rate themselves on a seven-point Likert scale:
1 = "not at all true of me"
7 = "very true of me"

1. When studying for a course I try to determine which concepts I don't understand well.
2. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for a course.
3. If I don't understand the course material, it is because I didn't try hard enough.
4. The most important thing for me right now is improving my overall grade point average, so my main concentration in a class is getting a good grade.
5. I try to relate ideas in a subject to those in other courses whenever possible.
6. Getting a good grade in a class is the most satisfying thing for me right now.
7. When I study for a class, I pull together information from different sources, such as lectures, readings, and discussions.
8. I quiz myself on class material because it helps me to remember.
9. If course readings are difficult, I change the way I read the material.
10. In a class, I prefer course material that arouses my curiosity, even if it is difficult to learn.
11. In a class, I prefer course material that really challenges me, so I can learn new things.
12. It is my own fault if I don't learn the material in a course.
13. I want to do well in my classes because it is important to show my ability to my family, friends, employer, or others.
14. I work hard to do well in a class even if I don't like what we are doing.
15. When I take tests, I think of the consequences of failing.
16. Before I study new course material thoroughly, I often skim it to see how it is organized.
17. **I am confident I can understand the most complex material presented by the instructor in my courses.**
18. During class time I often miss important points because I'm thinking of other things.
19. When I have the opportunity in a class, I choose course assignments that I can learn from even if they don't guarantee a good grade.
20. When I take a test, I think about how poorly I am doing compared with other students.
21. **I am confident I can learn the basic concepts taught in my courses.**
22. When I study for a course, I go over my class notes and make an outline of important concepts.
23. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
24. If I study in appropriate ways, then I will be able to learn the material in a course.
25. I often find that I have been reading for a class but don't know what it was all about.

26. When I study for a class, I set goals for myself in order to direct my activities in each study period.
27. I try to understand the material in a class by making connections between the readings and the concepts from the lectures.
28. If I try hard enough, then I will understand the course material.
29. I don't spend time on practice quizzes, because time spent studying is more valuable for performing well on a test.
30. **I am certain I can master the skills being taught in my classes.**
31. **I am certain I can understand the most difficult material presented in the readings for my courses.**
32. Even if I've already studied the material for a course, studying it again is still the best way to prepare for a test.
33. When studying for a course, I read my notes and the course readings over and over.
34. **I believe I will receive excellent grades in my classes.**
35. **Considering the difficulty of my courses, the teachers, and my skills, I think I will do well in my classes.**
36. If I can, I want to get better grades in my classes than most of the other students.
37. **I am confident I can do an excellent job on the assignments and tests in my courses.**
38. When I become confused about something I'm reading, I go back and try to figure it out.
39. When I study for a class, I practice saying the material to myself over and over.
40. When reading for a class, I try to relate the material to what I already know.
41. I feel my heart beating fast when I take an exam.
42. I have an uneasy, upset feeling when I take an exam.
43. If I get confused taking notes in class, I make sure I sort it out afterwards.
44. I ask myself questions to make sure I understand the material I have been studying in a class.
45. Even when course materials are dull and uninteresting, I manage to keep working until I finish.
46. When I take a test, I think about items on other parts of the test I can't answer.
47. When reading for a course, I make up questions to help focus my reading.
48. Giving myself practice quizzes is a good way to prepare for a test.
49. I make lists of important items for a course and memorize the lists.
50. When course work is difficult, I either give up or only study the easy parts.
51. I often feel so lazy or bored when I study for a class that I quit before I finish what I planned to do.
52. The most satisfying thing for me in a course is trying to understand the content as thoroughly as possible.
53. **I expect to do well in my classes.**
54. I memorize key words to remind me of important concepts in this class.

References

Ali, A., Eslami, A., & Tavakoli, M. (2011). A Confirmatory Factor Analysis of the Motivated Self-regulated Learning Questionnaire in an EFL Context. *International Education Studies*, *4*(4), 230-239.

Artino, A. R. (2012). Academic self-efficacy: From educational theory to instructional practice. *Perspectives on medical education*, *1*(2), 76-85.

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior 4*, 71-81. New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*. San Diego: *Academic Press*, (1998).

Bandura, A. (2008). An agentic perspective on positive psychology. *Positive psychology, 1*, 167-196.

Banfield, J., & Wilkerson, B. (2014). Increasing student intrinsic motivation and self-efficacy through gamification pedagogy. *Contemporary Issues in Education Research*, *7*(4), 291-298.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23*, 329-345.

Bruso, J. L., & Stefaniak, J. E. (2016). The use of self-regulated learning measure questionnaires as a predictor of academic success. *TechTrends*, *60*(6), 577-584.

Cahill Clark, J. L. (2008). String student self -efficacy and deliberate music practice: Examining string students' musical background characteristics, self -efficacy beliefs, and practice behaviors Retrieved from https://colorado.idm.oclc.org/login?url=https://search-proquest-com.colorado.idm.oclc.org/docview/304540442?accountid=14503

Casey, B. J., Somerville, L. H., Gotlib, I. H., Ayduk, O., Franklin, N. T., Askren, M. K., ... & Glover, G. (2011). Behavioral and neural correlates of delay of gratification 40 years later. *Proceedings of the National Academy of Sciences, 108*(36), 14998-15003.

Chemers, M. M., Hu, L. T., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational psychology*, *93*(1), 55.

Cleary, T. J. (2006). The development and validation of the self-regulation strategy inventory—self-report. *Journal of school psychology*, *44*(4), 307-322.

Cohen, P. A., Kulik, J. A., & Kulik, C. L. C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American educational research journal*, *19*(2), 237-248.

Credé, M., & Phillips, L. A. (2011). A meta-analytic review of the Motivated Strategies for Learning Questionnaire. *Learning and individual differences*, *21*(4), 337-346.

DeFreitas, S. C., & Bravo Jr, A. (2012). The Influence of Involvement with Faculty and Mentoring on the Self-Efficacy and Academic Achievement of African American and Latino College Students. *Journal of the Scholarship of Teaching and Learning, 12*(4), 1-11.

Doménech-Betoret, F., Abellán-Roselló, L., & Gómez-Artiga, A. (2017). Self-Efficacy, Satisfaction, and Academic Achievement: The Mediator Role of Students' Expectancy-Value Beliefs. *Frontiers in psychology*, *8*, 1193.

Dunn, K. E., Lo, W. J., Mulvenon, S. W., & Sutcliffe, R. (2012). Revisiting the motivated strategies for learning questionnaire: A theoretical and statistical reevaluation of the metacognitive self-regulation and effort regulation subscales. *Educational and Psychological Measurement*, *72*(2), 312-331.

Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. *The Cambridge handbook of expertise and expert performance*, *38*, 685-705.

Fiorella, L., & Mayer, R. E. (2013). The relative benefits of learning by teaching and teaching expectancy. *Contemporary Educational Psychology*, *38*(4), 281-288.

Fujita, K. (2011). On conceptualizing self-control as more than the effortful inhibition of impulses. *Personality and Social Psychology Review*, *15*(4), 352-366.

Gillebaart, M., & de Ridder, D. T. (2015). Effortless self-control: A novel perspective on response conflict strategies in trait self-control. *Social and Personality Psychology Compass*, *9*(2), 88-99.

Gonzalez, L., & Kardong-Edgren, S. (2017). Deliberate practice for mastery learning in nursing. *Clinical Simulation in Nursing*, *13*(1), 10-14.

Hacker, D. J., Bol, L., Horgan, D. D., & Rakow, E. A. (2000). Test prediction and performance in a classroom context. *Journal of Educational Psychology, 92*, 160-170.

Hambrick, D. Z., Oswald, F. L., Altmann, E. M., Meinz, E. J., Gobet, F., & Campitelli, G. (2014). Deliberate practice: Is that all it takes to become an expert?. *Intelligence*, *45*, 34-45.

Hepler, T. J., & Chase, M. A. (2008). Relationship between decision-making self-efficacy, task self-efficacy, and the performance of a sport skill. *Journal of Sports Sciences, 26*(6), 603-610.

Hilpert, J. C., Stempien, J., van der Hoeven Kraft, K. J., & Husman, J. (2013). Evidence for the latent factor structure of the MSLQ: A new conceptualization of an established questionnaire. *SAGE open*, *3*(4), 2158244013510305.

Huang, C. (2013). Gender differences in academic self-efficacy: a meta-analysis. *European journal of psychology of education*, *28*(1), 1-35.

Kim, W. (2016). Endogenous and Exogenous Instrumentality on Student Motivation and Achievement (Doctoral dissertation, Arizona State University).

Koh, A. W. L., Lee, S. C., & Lim, S. W. H. (2018). The learning benefits of teaching: A retrieval practice hypothesis. *Applied Cognitive Psychology*, *32*(3), 401-410.

Lens, W. (2001). How to combine intrinsic task-motivation with the motivational effects of the instrumentality of present tasks for future goals. In *Trends and prospects in motivation research* (pp. 23-36). Springer, Dordrecht.

Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading &Writing Quarterly*, *19*(2), 119-137.

Litt, M. D., Nye, C., & Shafer, D. (1993). Coping with Oral Surgery by Self-efficacy Enhancement and Perceptions of Control. *Journal of Dental Research*, *72*(8), 1237–1243. https://doi.org/10.1177/00220345930720081301

Macnamara, B. N., Hambrick, D. Z., & Oswald, F. L. (2014). Deliberate practice and performance in music, games, sports, education, and professions: A meta-analysis. *Psychological science*, *25*(8), 1608-1618.

Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2009) Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of Engineering Education*, *98*(1), 27-38.

Mevarech, Z. R., & Amrany, C. (2008). Immediate and delayed effects of meta-cognitive instruction on regulation of cognition and mathematics achievement. *Metacognition and Learning*, *3*(2), 147-157.

Milyavskaya, M., & Inzlicht, M. (2017). What's so great about self-control? Examining the importance of effortful self-control and temptation in predicting real-life depletion and goal attainment. *Social Psychological and Personality Science*, *8*(6), 603-611.

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., ... & Sears, M. R. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, 108*(7), 2693-2698.

Musculus, L., Raab, M., Belling, P., & Lobinger, B. (2018). Linking self-efficacy and decision-making processes in developing soccer players. *Psychology of Sport and Exercise, 39*, 72-80.

Otero, V., Pollock, S., & Finkelstein, N. (2010). A physics department's role in preparing physics teachers: The Colorado learning assistant model. *American Journal of Physics*, *78*(11), 1218-1224.

Pajares, F., & Schunk D. H. (2001). Self-beliefs and school success: Self-efficacy, selfconcept, and school achievement. In R. Riding, & S. Rayner (Eds.). Perception (pp.239–266). London: Ablex Publishing.

Pajares, F., & Usher, E. L. (2008). Self-efficacy, motivation, and achievement in school from the perspective of reciprocal determinism. Advances in Motivation and Achievement, 15, 391–423.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of educational psychology*, *82*(1), 33.

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and psychological measurement*, *53*(3), 801-813.

Pollock, S. J. (2009). Longitudinal study of student conceptual understanding in electricity and magnetism. *Physical Review Special Topics-Physics Education Research*, *5*(2), 020110.

Porter, S. R., & Umbach, P. D. (2006). College major choice: An analysis of person–environment fit. *Research in higher education, 47*(4), 429-449.

Reed, A. E., Mikels, J. A., & Löckenhoff, C. E. (2012). Choosing with confidence: Self-efficacy and preferences for choice. *Judgment & Decision Making, 7*(2).

Schuitema, J., Peetsma, T., & van der Veen, I. (2014). Enhancing student motivation: A longitudinal intervention study based on future time perspective theory. *The Journal of Educational Research*, *107*(6), 467-481.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational psychologist*, *26*(3-4), 207-231.

Schunk, D. H., & Pajares, F. (2002). The development of academic self-efficacy. In *Development of achievement motivation* (pp. 15-31). Academic Press.

Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2008). Motivation in education: Theory, research, and applications.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. *Reading & writing quarterly*, *23*(1), 7-25.

Sellami, N., Shaked, S., Laski, F. A., Eagan, K. M., & Sanders, E. R. (2017). Implementation of a Learning Assistant Program Improves Student Performance on Higher-Order Assessments. *CBE—Life Sciences Education*, *16*(4), ar62.

Siegle, D., & McCoach, D. B. (2007). Increasing student mathematics self-efficacy through teacher training. *Journal of Advanced Academics*, *18*(2), 278-312.

Sinkavich, F. J. (1995). Performance and metamemory: Do students know what they don't know? *Journal of Instructional Psychology, 22*(1), 77-87.

Talbot, R. M., Hartley, L. M., Marzetta, K., & Wee, B. S. (2015). Transforming undergraduate science education with learning assistants: student satisfaction in large-enrollment courses. *Journal of College Science Teaching, 44*(5), 24-30.

Talsma, K., Schüz, B., Schwarzer, R., & Norris, K. (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences, 61*, 136-150.

Titcombe-Parekh, R. F., Chen, J., Rahman, N. N., Kouri, N., Qian, M., Li, M., ... & Brown, A. D. (2018). Neural circuitry changes associated with increasing self-efficacy in Posttraumatic Stress Disorder. *Journal of Psychiatric Research*.

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of educational research*, *78*(4), 751-796.

Whitley, V. (2017). Relationship between student teacher self-efficacy and edTPA performance (Master's Thesis under the direction Dr. Travis Park) *NCState*.

Wigfield, A., & Eccles, J. S. (2002). Development of achievement motivation. Burlington: Elsevier.

Woolfolk, Anita. (2004). *Educational Psychology*. (9th ed). Boston: Allyn and Bacon.

Wright, B. J., O'Halloran, P. D., & Stukas, A. A. (2016). Enhancing self-efficacy and performance: an experimental comparison of psychological techniques. *Research quarterly for exercise and sport*, *87*(1), 36-46.

Zusho, A., & Edwards, K. (2011). Self-regulation and achievement goals in the college classroom. *New Directions for Teaching and Learning*, *2011*(126), 21-31.