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The Combined Effects of Mindset and Feedback on College Students' Motivation After Experiencing Failure

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To the Graduate Council:

I am submitting herewith a dissertation written by Janet Elaine Schwartz-Micheaux entitled "The Combined Effects of Mindset and Feedback on College Students' Motivation After Experiencing Failure." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in School Psychology.

Robert Williams, Major Professor

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The Combined Effects of Mindset and Feedback on College Students' Motivation After Experiencing Failure

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Abstract

The purpose of this study was to determine the effects of mindset and performance feedback on college students' motivation after experiencing failure in a web-browser experimental study. This study was conducted with students taking a general education course in Fall 2019 (N = 74). Students completed a 3-item Growth Mindset Scale (GMS) designed to measure individuals' beliefs about their own influence on personal ability levels. GMS can be conceptualized as a continuum ranging from a growth to a fixed mindset.

After completing the GMS, participants completed a Memory for Pictures task designed to induce success. Participants received one of three manipulated feedback conditions praising ability, effort, or no praise (control). They were then given a challenging Numerical Series task designed to induce failure. Participants were asked to rate attributions for failure, make a goal orientation selection, and make a risk-aversion selection after experiencing failure.

Primary analyses indicated a non-significant relationship between mindset and task persistence, as measured by total number of attempts on the Numerical Series task (r = 0.13, p = 0.26). Performance feedback conditions did not differ significantly in the number of attempts on the Numerical Series task (F = 0.40, p = 0.67). Mindset was not significantly correlated with attributions for failure, nor did the feedback conditions differ significantly on attributions for failure. A one-way ANOVA revealed that mindset made a significant difference on goal orientation (F = 8.71, p = 0.004). Specifically, growth mindset was significantly related to participants' selecting to view information related to problem solving strategies, whereas fixed mindset was significantly related to participants' selecting to view relative-performance feedback. Performance feedback was not significantly related to goal orientation (X^2 = 0.65, p =

0.72).

Results of a one-way ANOVA indicated no significant differences in risk-aversion based on mindset ($F = 2.28$, $p = 0.14$). A Pearson chi-square test of independence revealed no significant relationship between performance feedback and risk-aversion ($X^2 = 0.61$, $p = 0.74$). Exploratory analyses revealed marginally significant findings related to mindset, feedback and time spent on the study, as well as a significant relationship between goal orientation selection and risk aversion.

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Chapter I

Introduction and Literature Review

Young adults at college institutions often pursue higher education with excitement, hope, and vigor, fully aware that a college degree often brings about positive benefits to the recipient, such as increased earning potential (Carnevale, Cheah, & Hanson, 2015; PEW Research Center, 2011), more job opportunities (Carnevale, Smith, & Strohl, 2010), improved quality of life (Porter, 2002), and a chance to explore topics of interest. However, many incoming college students may not be adequately informed about or prepared for the rigor of college academics (Moore et al., 2010). In the face of exceptional challenge, some individuals may fail and end up on academic probation or be formally dismissed from the institution (Ishitani & Desjardins, 2002). However, many others rise to the occasion and persevere through the difficulties of college coursework, remain satisfied with their college experience, and commit to pursuing their degree (Chemers, Hu, & Garcia, 2001).

Motivation and Behavioral Responses After Failure

Theoretical Foundation

It is important to know why some students can remain persistent in the face of challenging tasks and will put forth great effort to ensure their best results, while still other students are more prone to quit or altogether avoid tasks that require additional effort. Several decades of research in the theoretical orientation of goal theory have shed light on student beliefs and behaviors surrounding challenging academics (Dweck, 1986; Roebken, 2007; Wolters, 2004). In achievement goal theory, it is believed that individuals hold different motivations for gaining knowledge and skills (Elliot & Dweck, 1988). Individuals with a mastery orientation tend to believe that one learns through putting forth effort and practicing. Mistakes are par for

the course, and individuals with a mastery orientation are willing to reflect on their errors and take on challenging tasks with the end-goal of developing one's competence or skills in an area. In contrast to those with a mastery orientation, individuals with a performance orientation tend to see achievement as a means to compare oneself to others. Individuals with a performance orientation may avoid challenging tasks in order to appear highly capable and largely devoid of mistakes, which they take as a sign of incompetence. Performance oriented individuals' primary goal is to appear capable and intelligent to others. Performance orientation may be further divided into performance-approach and performance-avoidance goals. Those who internalize the former goal orientation seek to achieve highly, while those who internalize the latter only hope to avoid failure (Elliot & Harackiewicz, 1996).

Classic achievement goal theory purported that an emphasis on performance orientation is negatively related to academic motivation and achievement, while mastery orientation is positively related to these desired outcomes (Ames, 1992). However, a more recent study suggests that combining mastery-orientation and performance-approach orientation goals may maximize learning potential and motivation (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002), while performance-avoidance goals alone are related to academic failure (Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009). Based on this research, knowledge of students' goal orientations can help predict student academic performance and motivation.

Research on goal orientation and college academic achievement suggests that students making adequate academic progress are significantly more likely to have a mastery orientation compared to students on academic probation. In contrast, the latter students are significantly more likely to adopt performance-avoidance goals (Hsieh, Sullivan, & Guerra, 2007). Collegiate-level research also suggests that mastery-orientation without a performance approach goal is

related only to deep learning strategies in high-interest course content, rather than high academic achievement (Senko & Miles, 2008). It appears as though striving to achieve both competence and high levels of measurable success results in the best achievement and motivation outcomes for college students.

Related to goal theory are implicit theories of intelligence, which suggest that individuals may believe that their abilities are innate and cannot be altered (i.e., an entity theory or fixed mindset) or their abilities can indeed be improved with high effort and repeated practice (i.e., an incremental theory or growth mindset; Dweck & Legget, 1988). Implicit theories of intelligence are also referred to as mindset. According to Dweck and Legget, mindsets are related to individuals' adopting either performance or mastery goals. Individuals with a fixed mindset often endorse performance goals and are more prone to select easy tasks that will allow them to appear capable. Those with a growth mindset often endorse mastery goals and are more likely to endure challenges with the desire to enhance their knowledge and abilities. This relationship is reflected in research on college students, where individuals with a growth mindset have higher academic achievement, are more likely to improve their grades after a failure (Grant & Dweck, 2003), and are more likely to intentionally choose professors that emphasize a learning-orientation, even when this decision results in more difficult coursework (Livengood, 1992).

Previous Research

In several replicated studies, researchers have explored the relationship between goal theory, mindsets, and feedback that emphasizes ability versus effort in children. Dweck and her colleagues (Mueller & Dweck, 1998) repeatedly found that children praised for their ability (i.e., their intelligence) on an easy task were more likely to endorse a performance-avoidance orientation when given a follow-up task that was much more difficult than the initial easy task

they were successful on, while children praised for their effort were more likely to endorse a mastery orientation in response to a challenge. Children praised for their intelligence were more likely to attribute their failure to a lack of ability, rather than a lack of time or persistence, and were less likely to report wanting to continue working on the challenging task than children praised for their effort. Research suggests that ability attributions to failure are related to academic underachievement (Bell et al., 1994). There is a need to understand how goal theory, mindset, and feedback contribute to attributions and subsequent behaviors following successes and failures. Additional lines of research on these factors have emerged since these major research findings were published, including experimental studies involving college students.

In a subsequent study done by Dweck and her colleagues, goal theory and imagined persistence in the face of failure were examined in an undergraduate student sample (Grant & Dweck, 2003). Undergraduate participants completed a survey that reflected their goal orientation, then read detailed scenarios of academic failure, and finally reported on how they would think, feel, and behave if such a situation happened to them. Performance-orientation was significantly and positively associated with decreased intrinsic motivation, decreased time and effort in similar future tasks, loss of self-worth, and musing on their failure. In contrast, mastery orientation was significantly and negatively related to decreased intrinsic motivation and decrease of time and effort. These findings suggest that students with a mastery orientation still held interest in the topic and were willing to invest in the course despite the instance of failure.

Additionally, those with a mastery orientation were significantly more likely to report planning ways to improve their performance in the future compared to performance-oriented students. When comparing attributions for the failure scenario, those with a performance-orientation were more likely to claim their failure was due to limited ability, while students with

a mastery-orientation were more likely to claim their failure was due to low effort or preparation (Grant & Dweck, 2003). When considering academic failure scenarios, it appears that undergraduates with a mastery orientation are more likely to think and act in ways that proactively protect against future failures and encourage future success compared to performance-oriented peers.

Goal orientation of college students also appears to significantly influence the extent of persistence in the face of repeated failure on seemingly impossible tasks and then during a follow-up, relatively easy task. Sideridis and Kaplan (2011) had undergraduates complete measures of goal orientation and affect, then attempt five wooden puzzles – the first three being impossible to solve, the fourth puzzle being relatively easy (acting as "the hope probe"), and the final puzzle being impossible to solve. Research covertly measured persistence (defined as time spent on each puzzle), as well as qualitative data on participant behavior and verbalizations as they attempted to complete what they were told to be solvable puzzles.

Performance-avoidance individuals persisted the least, beginning with the very first task, and across all subsequent tasks, and they were significantly more likely to have negative verbalizations when engaging in the tasks. Performance-approach individuals started with greater persistence on the initial task, but persistence did drop after experiencing failure. Interestingly, performance-approach individuals had the greatest persistence on the fifth rebound task after experiencing success. Mastery-oriented individuals had the highest level of initial task persistence and were more likely to increase their effort immediately after the initial failure, while making positive and effort-affirming statements during the tasks (Sideridis & Kaplan, 2011). During challenging tasks, it appears that performance-approach and mastery-orientated college students persist longer and verbalize less frustration compared to performance-avoidant

college students. Influencing students to adopt performance-approach and mastery orientations may result in behavior and motivation changes that lead to greater academic success, even after failure experiences.

College students' goal orientations may be induced, or shaped, by the feedback they receive (Dweck, 1986; Jagacinski & Nicholls, 1984). Hoyert and O'Dell developed goal orientation interventions for performance-oriented college students who failed the initial introductory psychology course exam (2006). The interventions included individual peer mentor sessions, guest lectures, and an interactive computer program, all of which focused on shifting students to a mastery orientation, addressing motivational issues, and discussing effective study strategies. All interventions were significantly related to an increase in mastery orientation and subsequent exam scores, compared to students who failed to complete the interventions (Hoyert & O'Dell, 2006). Muis, Ranellucci, Franco, and Crippen conducted a study in which college students received a raw score on weekly quizzes and additional feedback either highlighting individuals' personal improvement and rate of learning or individuals' performance relative to their peers. The results of this study suggest that students who are given mastery-orientation related feedback that emphasized learning and personal growth on college quizzes had significantly lower levels of personal performance-goals compared to students who received feedback about how they performed compared to their peers in the course (2013). These studies lend support for the notion that written and verbal feedback make a significant difference in the goals that college students adopt, and that instructors can significantly influence the achievement of their students depending on the type of feedback they provide to students.

Research on Goal Orientation, Feedback, Failure, and Outcomes of College Students

At the time of this study, there exists no published work that simultaneously examines mindset, feedback, goal orientation, and persistence of college students after experiencing failure in a single experimental study. Additionally, decision-making related risk aversion post-failure does not appear to be well explored either. Finally, it is unknown how different types of initial praise feedback will affect performance outcomes on challenging tasks at the collegiate level. Because of the considerable difficulty of college academics and the need to provide effective support for students truly at-risk of failure, it is worthwhile to pursue research on how student mindset and instructor feedback influence college students' persistence on and willingness to attempt challenging tasks.

Purpose of the Study

The purpose of this study was primarily to examine the effects of participants' theories of intelligence (i.e., fixed or growth mindset) and performance feedback that emphasizes either ability or effort on persistence during challenging tasks, as well as failure attributions, goal orientation, and risk aversion after experiencing failure. Namely, how do mindset and feedback affect college students' persistence when attempting to complete seemingly impossible test items? How do mindset and feedback change students' attributions for failure and future goals post-failure? Do mindset and feedback affect student decisions to take on additional risky challenges? College students' theoretical orientation of intelligence is measured using the Growth Mindset Scale (GMS; Dweck, 2006). Ultimately, the goal of this study was to determine the individual and interactive effects of student mindset and manipulated feedback on persistence during challenging tasks, attributions for failure, goal orientation after failure, and risk aversion after failure. In the present study, persistence was measured by the number of attempts

participants were willing to make before giving up and moving on to the next item. Attributions for failure were measured using Likert-scale items related to effort, ability, time, and luck after participants experienced failure. Goal orientation was determined based on the selection to view either problem solving strategies (suggesting a mastery orientation) or information related to relative performance on the failure task compared to peers (suggesting a performance orientation) after failure. Risk aversion was determined based on participant selection to either attempt bonus items similar to the induced failure task to potentially earn more bonus items or skip the bonus items entirely.

Following the work of Carol Dweck and her colleagues, there is strong empirical support indicating that the type of praise given to children after task completion has a significant effect on participant outcomes. Multiple studies have found that praising children for their effort leads to higher ratings of task enjoyment, greater task persistence, and greater interest in improving skills in the face of failure than praising them for their ability (i.e., their intelligence; Mueller & Dweck, 1998). Although Dweck's work has important implications for child educators, few published articles exist that experimentally examine the effects of manipulated praise (i.e., positive feedback that emphasizes either effort or ability) on persistence and beliefs about failure for college students. College students not only receive feedback on their performance through grades, but also through more detailed, qualitative critiques from instructors on assignments (Dorow & Boyle, 1998; Muis, Ranellucci, Franco, & Crippen, 2013). However, little is known about how comments that suggest growth or fixed theories of intelligence potentially shape college students' performance.

Questions on how student mindset and praise may affect beliefs and decision-making for college students in the face of failure were explored in this study. Would students' long-standing

mindset be more predictive of experimental task outcomes than the immediately preceding praise? Ultimately, which is more influential to college students' success, the potentially solidified theories of intelligence with which they enter college classrooms, or the type of feedback they get from their instructors? Depending on preliminary outcomes of mindset and feedback manipulation as separate variables, secondary analyses may include examining a potential interaction between mindset and feedback.

The author hypothesized that participants with a growth mindset who are provided effort-related feedback will exhibit the greatest degree of persistence on challenging tasks, be more likely to attribute their failure to lack of time or effort, be more likely to select to view strategy-related information, and have the greatest inclination to take on optional challenges post-failure. Those with a growth mindset believe that skills can be improved with effective effort and practice, and feedback emphasizing a relationship between effort and success confirming their mindset. Amid challenging tasks and setbacks, having both internal personal beliefs and external feedback linking effort to outcomes will likely result in increased motivation and desire to master the challenging tasks for these students.

Compared to participants with a growth mindset who are provided effort-related feedback, the author hypothesized that participants with a fixed mindset who are provided ability-related feedback will exhibit a lower degree of task persistence on challenging tasks, be more likely to attribute failure to lack of ability, be more likely to select viewing performance-related information, and have lower inclination to take on challenging risks in the wake of failure. Those with a fixed mindset believe that one's skills cannot be improved past an innate ceiling. When individuals with a fixed mindset receive feedback about their skills, however positive during the initially successful task, it orients these individuals to focus less on

maintaining high effort and more on appearing as competent as possible to others. When then faced with a challenge, individuals with a fixed mindset who receive ability-related feedback will not risk appearing incompetent and are concerned about how they are performing relative to peers. In an attempt to preserve their beliefs about their competency, those with a fixed mindset who receive ability-related feedback are more likely to give up quickly, seek out information about relative performance, and avoid future challenges. These are possibilities that are currently under-researched in the literature, and results from this study were intended to provide evidence for more effective means of supporting students who encounter difficulties with college coursework.

Chapter II

Methodology

Participants

Consenting participants included 74 undergraduate students enrolled across six sections of a general education psychology course at a large, research-intensive university in the Southeastern United States during the Fall 2019 semester. The majority of students were sophomores (n = 49) and juniors (n = 19), but the sample also included freshmen (n = 4), and seniors (n = 2) as well. Most of the sample identified as female (n = 66) and Caucasian (n = 67). The age of participants ranged from 18 to 27 years old, with a median of 19 years old. Self-reported GPA of non-freshman participants ranged from 2.25 to 4.0, with a median of 2.83. Due to attrition, randomly assigned performance feedback conditions were not equal, with fewer participants in the ability feedback condition (n = 17) compared to the effort feedback condition (n = 29) and control (n = 28). Students who volunteered and consented to participate in this research were included in the study.

Procedures

Introducing the Study and Informed Consent

Students across all sections of the course were initially informed about the opportunity to participate in this study via an announcement on Canvas, the university's online course management system (Appendix A). The announcements were personalized to the instructors and course numbers and posted the day before the first class. This announcement described that students interested in participating could find more information about the study in the consent form (Appendix B) attached to the announcement and posted on Canvas. The announcement also

stated that a graduate student not affiliated with the course would be presenting in-person information about the study on the first day of class, in order to reduce undue influence on students. Students who were not interested in participating in the study could leave class early during the ten minutes dedicated to explaining the study, completing initial consent, and participating in Part I in order to reduce the bandwagon effect and possible undue influence on uninterested students within the classroom. If students had questions about the study, they could direct them to the principal investigator or the course's research assistant.

In the last ten minutes on the first course meeting of the Fall 2019 semester, the instructor introduced the graduate student not affiliated with the course to students and left the vicinity of the classroom prior to the introduction of the research study. Students who were not interested in participating in research were free to leave only after the instructor. The non-affiliated graduate student provided the online link to complete online consent and the Part I survey to interested participants. The graduate student read a script that followed the consent form closely. Participants had the option of consenting to participate and having their data included in research analysis, consenting to participate and having their data destroyed before research analysis, and discontinuing participation and exiting the online survey. Participants also had the opportunity to ask the graduate student questions, and after completing the consent form and Part I, the graduate student provided a paper copy of the consent form for participants' records.

Growth Mindset Scale, Demographic Questions, and Sign-Up for Part II

After participants completed consent procedures, they were asked to provide their student ID number in order to link their responses to Parts I and II of the study without using their names. Participants' student ID numbers were later replaced with a de-identified research ID number prior to beginning data analysis. Next, participants were asked to respond to Carol

Dweck's three-item, six-point Likert scale Growth Mindset Scale (GMS; Dweck, 2006; Appendix C) to assess the degree of their growth versus fixed mindset. Dweck's Growth Mindset Scale has been used in other experimental studies related to student outcomes with sufficient internal reliability (α = 0.71 - 0.85; Broda et al., 2018; Karwowski, 2014; Kern, & Waters, 2015; Ortiz Alvarado, Rodriguez Ontiveros, & Ayala Gaytan, 2019). Results from the GMS were averaged across the three items for each participant and results were interpreted on a continuous scale, similar to previous research using the GMS as a predictor variable (Broda et al., 2018). Participants then responded to demographic questions regarding age, year in school, ethnicity/race, and college GPA for non-freshman participants (Appendix D). Participants were asked for their email address in order for researchers to send reminder emails of Part II appointments. Participants were then directed to an online scheduling poll to select a 45-minute time slot in the first two weeks of class to complete Part II of the study in a nearby computer lab within a group setting. If a participant's schedule conflicted with possible time slots or a participant preferred to participate in a private setting, he or she had the option of in a private office with the course's research assistant. Participants only received bonus credit if they attended Part II of the study. In order to increase attendance for Part II of the study, the researcher provided participants with a reminder email the morning of their Part II appointment (Appendix E). The principal investigator sent emails to students outside of her two sections of the course, while the research assistant sent emails to students within the principal investigator's course sections to reduce undue coercion. All participants who signed up for Part II of the study were randomly assigned to one of three feedback conditions applied in Part II of the study: 1) praise for ability, 2) praise for effort, and 3) control (i.e., no feedback on performance) by the principal investigator in between Parts I and II of the study (see Table Q1).

Memory for Pictures and Randomized Feedback Conditions

Participants arrived to either the computer lab or private office and then were prompted to take a seat at a desktop computer that had Part II of the study open on a web browser. Seating was arranged so that participants could not see the screens of other participants. All participants logged in with their student ID in order to link Part I and Part II data. Participants follow along with on-screen directions for Part II of the study (Appendix F). In Task I, participants were asked to complete an adapted version of the Test of Memory Malingering (TOMM; Tombaugh, 1996) called "Memory for Pictures" (Appendix G). This task involved viewing 50 line-drawing stimuli on the web-browser during a timed learning trial and discriminating between target stimuli that were presented from ones that were not presented during a recognition trial. Cognitively typical adults tend to perform accurately on 45 or more of the recognition items, despite the measure appearing more challenging to examinees (Tombaugh, 1996). For the purposes of this study, researchers required a task that most participants could complete successfully but not so easily that subsequent feedback seemed non-genuine. The Memory for Pictures task was designed to require participants' focus and attention and be a task unfamiliar to participants. Immediately after completing the Memory for Pictures task, participants received a randomized manipulated feedback condition described above (Appendix H).

Numerical Series (Induced Failure Task)

After receiving randomized manipulated feedback, participants completed three ceiling items from the Universal Nonverbal Intelligence Test, Second Edition (UNIT-2; Bracken & McCallum, 2016) Numerical Series subtest adapted to be impossible to solve (Appendix I). These items acted as the induced failure task in this study. Numerical Series involved presenting a series of numbers in a complex pattern, with the last number missing. Participants were asked

to determine the missing number without selecting from an array of possible responses in order to make the items particularly challenging and to avoid participants repeatedly guessing from a selection of options. Participants were provided with scrap paper and pencil to use during this task. When participants submitted a response, written feedback on the web browser was contrived to tell them that their response was incorrect. Participants were then prompted to either attempt again or give up, with a maximum of five attempts before being automatically directed to the next item or task. Participants had the option of giving up and moving on to the next item on every page of the study during the Numerical Series task. Once participants attempted up to five times or gave up on all three Numerical Series items, participants received written feedback on the web browser that their performance on the Numerical Series task significantly declined compared to their previous performance on the Memory for Pictures task (Appendix J).

Post-Failure Ratings of Difficulty, Mindset, and Attributions for Failure

Next, participants were prompted in the web browser to rate the accuracy of the statements relating to difficulty of their experience, mindset, and attributions post-failure (Appendix K). Items in this part of the study included the following options: “The Numerical Series task was challenging for me,” and “I would enjoy attempting additional Numerical Series items if given the chance,” on a 5-point Likert scale, ranging from “Completely Disagree” to “Completely Agree.” These items were included as a validity measure for the Numerical Series task as an adequately challenging task and as a secondary measure of persistence, respectively. Participants were also asked to rate the accuracy of the statements, “I could be better at Numerical Series with more practice,” and “People are either good at Numerical Series or they are not,” on a the same 5-point Likert scale as previously described. These items were included

to measure participants' alignment to a growth or fixed mindset immediately after a failure experience.

Participants then rated reasons for their poor performance on Likert-scale items ranging from "Completely Disagree" to "Completely Agree." The attributions for failure included lack of effort ("I didn't work hard enough"), lack of ability ("I'm not a good problem solver"), task difficulty ("I found the task too challenging."), and luck ("I was unlucky in my attempts."), based on Weiner's model of achievement motivation (1972). Participants were given the option to provide qualitative reasons for their decline in performance. This option is included for participants to potentially indicate additional attributions for failure, and as a validity check if they suspected the Numerical Series items to be contrived.

Post-Failure Performance- or Mastery-Orientation Selection

After the failure task and follow-up survey items, participants completed Task III, in which they were asked to choose between two options: 1) a link to information about strategies for solving Numerical Series problems, or 2) a link to information about relative performance of other students in the general education course on the same task (Appendix L). This step was included to measure mastery versus performance orientation (i.e. goal orientation) of participants after experiencing failure. Once an option was chosen, the participant was able to view information pertaining to their choice before moving on to the next measure. This measure was included to examine whether participants praised for effort are more inclined to choose the strategy option, allowing them to reflect on their errors and potentially learn more effective problem-solving strategies. This selection reflected a mastery orientation. In turn, those praised for ability might focus more on their perceived performance compared to others and choose the

option in which they could view their scores relative to other students in their general education course. This selection reflected a performance orientation.

Post-Failure Risk-Aversion Task

Participants were then presented with Task IV, an opportunity to attempt risky bonus questions (Appendix M). The bonus questions were three Numerical Series items of lesser difficulty than the preceding items in Task II (the Numerical Series task that was designed to induce failure) and were presented as multiple-choice items. Participants were told if they answered any of the three bonus items correctly, they would be awarded five additional bonus points for a total of 15 bonus points for study participation. However, if participants failed to correctly respond to all three bonus items, they would lose two bonus points for a total of eight bonus points for study participation. Participants were told that they would have one attempt per item on the bonus task. Participants could choose to take this risk or skip this task to continue with the study. This measure was included to examine participants' approach to uncertain challenges after experiencing failure. It was hypothesized that those praised for ability would be more risk averse, viewing the bonus questions as a potential additional failure, and skip them. Those praised for effort were hypothesized to be more likely to attempt the bonus questions, viewing the bonus questions as an additional learning opportunity or means to continue their high effort in the study. For participants who elected to skip the bonus task, an opportunity to provide qualitative reasons for their decision to skip was presented. This option was included as another means to potentially assess reasons for risk-aversion post-failure.

Debriefing, Reconsent, and Additional Experience Measures

The participants completed the study by independently reading a debriefing statement on their web browser and reconsenting based on full disclosure (Appendix N), reviewing a referral

list (Appendix O), and then completing a five-item measure of distress, a four-item measure of overall study experience, and a one-item question about perceptions on the contrived nature of the study (Appendix P). All items were on a four-point scale ranging from "Not at All" to "Extremely." As participants left the computer lab or office, the researcher proctoring the session handed a physical copy of the debriefing statement and referral list for participants' records. No participants in this study verbally expressed distress as a result of being in a study that used deception or contacted the researchers post-study with concerns about deception. All participants were awarded the maximum bonus credit of 15 points. These points were entered by the course's research assistant to help preserve anonymity of participants.

Chapter III

Results of the Study

Analysis Plan

In this study, bivariate correlations, linear regression analyses, analyses of variance, and chi-square analyses were used to determine whether mindset and/or feedback were significantly related to (1) total number of attempts across the three trial challenging task, (2) attributions for failure, (3) choice of information to view after failure, and (4) choice of attempting the bonus task.

Additionally, bivariate correlations and nonparametric Spearman correlations were used to determine whether mindset and/or feedback are significantly related to total time spent engaging in tasks during Part II of the study. Bivariate correlations were also used to determine whether participant scores on the GMS scale are significantly related to self-reported mindset and enjoyment after failure. A chi-square test of independence was used to explore a potential relationship between selection of goal orientation information and risk-aversion after failure.

Preliminary Analysis

Each participant's responses to the 3-item Growth Mindset Scale were averaged to provide a mean GMS score, ranging from growth (mean of 1) to fixed (mean of 6). Across all participates, the mean GMS score was 2.86, with a standard deviation of 0.98, slightly negatively skewed toward growth mindset. Internal consistency for the GMS was strong ($\alpha = 0.91$). Average GMS scores ranged from 1.00 to 5.00 across all participants.

On the Memory for Pictures task, accuracy in identifying the stimuli presented in the series on each of the 50 test items ranged from 85.71% to 100% across participants. The average accuracy on the Memory for Pictures task was 95.97%, or approximately 48 correct out of the

50-item trial. This percentage exceeded the accuracy of cognitively typical individuals on the standardized Test of Memory Malingering. It was also approximately the same percentage as reported on the contrived feedback (i.e., "On the Memory for Pictures task, you answered 49 out of 50 trials correctly…"), and thus the contrived feedback was likely believable for participants. This high percentage for accuracy also likely reflects that participants were genuinely attempting the Memory for Pictures task and put forth effort on tasks within this study.

On the Numerical Series (induced failure) task, the mean, standard deviation, and range of number of attempts on each of the three trials and across all three trials are calculated (see Table Q2). The number of attempts is positively skewed across all trials, with the average number of attempts being 1.38, 0.53, and 1.46 on trials 1, 2, and 3, respectively. Primary analyses involving number of attempts during the Numerical Series task focuses on the total number of attempts across all three trials due to low numbers of attempts within trials.

Participants' ratings on perceived task challenge, enjoyment, induced growth mindset, and induced fixed mindset Likert scale items were calculated (see Table Q3). Responses ranged from "1" (Completely disagree) to "5" (Completely Agree). Nearly all participants (n = 73) responded "Completely Agree" to the item, "The Numerical Series task was challenging for me" (M = 4.99), suggesting that participants put forth effort on the task and did not suspect that the Numerical Series was a contrived failure task. Additionally, qualitative data responses for the item, "Are there other reasons that would explain your decline in performance? If so, please describe them below," contained no responses that alluded to suspected deception.

Pearson bivariate correlations were used to identify significant relationships between mindset measured during Part I using the GMS scale and perceived challenge ("The Numerical Series task was challenging for me"), enjoyment ("I would enjoy attempting additional

Numerical Series items if given the chance"), and mindset after failure (i.e. "I could be better at Numerical Series with more practice," to measure induced growth mindset and "People are either good at Numerical Series or they are not," to measure induced fixed mindset). Correlations between variables are summarized in Table Q4. Results indicated a statistically significant negative relationship between GMS scale and induced growth mindset (r = -0.25, p = 0.03; d = .06) and a statistically significant relationship between GMS scale and induced fixed mindset (r = 0.43, $p < 0.001$; d = .18). These results suggest that initial ratings of mindset may have remained stable from Part I through the failure experience in Part II, however, it should be noted that based on Cohen's (1988) convention of effect size, both of these significant findings likely have minimal practical significance. It is possible that participant mindset is indeed a stable trait, and methodological limitations in follow-up question design diminish the effect size seen.

Results of the Pearson bivariate correlations described above also indicate a statistically significant relationship between induced growth mindset and perceived task enjoyment (r = 0.37, $p < 0.001$; d = .14), as well as a statistically significant negative relationship between induced fixed mindset and perceived task enjoyment (r = -0.27, $p < 0.05$; d = .07). These results suggest that participants' mindset after experiencing failure is significantly related to how much they enjoyed the task, with individuals endorsing a growth mindset reporting to have enjoyed the Numerical Series task, even after failure. However, it should also be noted that effect size for both of the former relationships are small, suggesting that induced mindset and task enjoyment may not have practical significance. Participants' ratings of failure attribution were also determined using Likert scale items (see Table Q5). Responses again ranged from "1" (Completely disagree) to "5" (Completely Agree). Overall, participants rated the task difficulty

(*M* = 3.84) as the highest attribution, then effort (*M* = 2.82), luck (*M* = 2.70), and ability (*M* = 2.64).

Participant ratings of distress after completing the study, learning of the study's use of deception, and reviewing informed consent were determined using a five Likert-scale items (see Table Q6). Responses ranged from "1" (Not at All) to "4" (Extremely). The item reading, "I understand why participants are not told the true intent of the study until the end," was reverse coded. The five-item distress scale appeared to have low internal consistency ($\alpha = 0.42$). Participants rated higher levels of distress related to their inability to solve the difficult Numerical Series items (*M* = 2.32). However, participants reported minimal distress knowing the study used deception (*M* = 1.20), and they reported minimal distress after reviewing the informed consent and resource list (*M* = 1.14).

After completion of the study and reviewing informed consent, participants responded to the item, "Before being debriefed, I had a sense that deception was involved in this study." Responses ranged from "1" (Not at All) to "4" (Extremely). Overall, most participants indicated minimal sense of deception prior to being debriefed (*M* = 1.66, *SD* = 0.74).

Participant's ratings of their overall experience of participating in the study after informed consent was determined using five Likert-scale items (see Table Q7). Responses ranged from "1" (Not at All) to "4" (Extremely). The four-item participant experience scale appeared to have adequate internal consistency ($\alpha = 0.68$). Overall, participants reported high levels of enjoyment in participating in the study (*M* = 2.92), being challenged (*M* = 3.05), and reflecting on their personal response to failure (*M* = 3.32).

Primary Analyses

Mindset, Feedback, and Total Number of Attempts on Numerical Series Task

A bivariate Pearson correlation was used to determine if mindset and the total number of attempts made across the three Numerical Series (induced failure) trials were significantly related (see Table Q8). Results indicated a non-significant relationship between mindset and total number of attempts ($r = 0.13$, $p = 0.26$).

A one-way ANOVA was used to determine if there were significant differences among feedback conditions (i.e., ability, effort, and control) and the total number of attempts made during the Numerical Series (induced failure) task (see Table Q9). Results indicated no significant differences in mean number of attempts based to feedback condition (F (2, 71) = 0.40, $p = 0.67$).

A linear regression was used to determine if mindset and feedback together predict total attempts made during the Numerical Series (induced failure) task (see Table Q10). Results indicated that mindset ($\beta = .14$, $t(73) = 1.15$, $p = .26$) and feedback ($\beta = .04$, $t(73) = .36$, $p = .72$) were not significantly predictive of total number of attempts ($F = 0.70$, $p = 0.56$). Controlling for mindset, the semi partial correlation between performance feedback and total number of attempts was non-significant ($r = .04$, $p = .72$). Controlling for performance feedback, the semi partial correlation between mindset and total number of attempts was also non-significant ($r = .14$, $p = .26$).

Mindset, Feedback, and Attributions for Failure

Bivariate Pearson correlations were used to determine if mindset and attributions for failure (i.e., degree to which participants attributed failure on the Numerical Series task to lack of effort, lack of ability, task difficulty, and luck) were significantly related (see Table Q11).

Results indicated a non-significant relationship between mindset and lack of effort attribution (r = -0.14, p = 0.22), lack of ability attribution, (r = 0.14, p = 0.24), task difficulty attribution (r = -0.11, p = 0.93), and luck attribution (r = 0.13, p = 0.27). Correlation coefficients were also calculated to determine potential relationships among attribution ratings, and a small, significant negative relationship between the effort attribution and task difficulty attribution (r = -0.25, p = 0.03; d = .06) was obtained. Namely, there is a negative relationship between participant endorsements of lack of effort, such as "I didn't work hard enough," and endorsements of task difficulty such as, "I found the task too challenging," although the effect size of this finding is small.

A one-way MANOVA was used to determine if there are significant differences between feedback condition composite means on the attributions for failure (see Table Q12). There appeared to be a non-linear relationship between each pair of attribution ratings across each level of performance feedback; results should be interpreted with caution. There was a non-significant difference in composite means of the failure attribution based on feedback condition, $F(8, 136)$ = .77, p = .63. Post hoc follow up results indicate that feedback condition composite means did not differ significantly on the lack of effort attribution (F = 0.03, p = 0.97), lack of ability attribution (F = 0.43, p = 0.65), task difficulty attribution (F = 2.30, p = 0.11), and luck attribution (F = 0.16, p = 0.85).

Mindset, Feedback, and Goal Orientation After Failure

A one-way ANOVA was used to determine if there are significant mean differences in participants' decision to either view problem solving strategies or relative-performance information following failure based on participant mindset (see Table Q13). Results indicate that participants who select to view problem solving strategies (n = 40) have a significant lower mean

GMS scale score (i.e., endorse a growth mindset; $M = 2.6$) than participants who elected to view relative-performance information (i.e., endorse a fixed mindset; $n = 34$; $M = 3.2$). This difference was statistically significant ($F = 8.71$, $p = 0.004$; $\eta^2 = .11$). It appears that participants who endorse a growth mindset are significantly more likely to select to view information related to a mastery orientation, while participants who endorse a fixed mindset are significantly more likely to select to view information related to a performance orientation. This significant finding is also considered to have a large effect size (Miles & Shevlin, 2001), suggesting that mindset accounts for a notable proportion of the variance in goal-orientation selection after failure.

A Pearson chi-square test of independence was used to determine if there are significant differences in participants' goal orientation decision making based on randomized performance feedback (see Table Q14). Namely, are there significant differences between participants praised for effort or ability on their decision to either view problem solving strategies or information related to relative performance among peers following failure? Results indicate that performance feedback is not significantly related to goal orientation decision making ($X^2 = 0.65$, $p = 0.72$).

Mindset, Feedback, and Risk-Aversion After Failure

A one-way ANOVA was used to determine if there are significant differences in participants' decision to either attempt or not attempt the bonus Numerical Series task, based on participant mindset (see Table Q15). Results indicate no significant differences in decision making to attempt the bonus task based on participant mindset ($F = 2.28$; $p = 0.14$).

A Pearson chi-square test of independence was used to determine if there are significant differences in participants' decision to either attempt or not attempt the bonus Numerical Series task, based on performance feedback (see Table Q16). Results indicate that performance

feedback was not related to whether participants decide to attempt the bonus task ($X^2 = 0.61$, $p = 0.74$).

Exploratory Analysis

Mindset, Feedback, and Total Time on Part II of the Study

This study utilized Question Pro online survey software, which provides a timestamp for total time taken on a survey for each participant. The average time taken by participants on Part II of the study was 19.02 minutes, with a standard deviation of 6.53 minutes. Time spent on Part II of the study ranged from 9.16 minutes to 42.52 minutes, with data significantly negatively skewed. There is a significant moderate correlation between total number of attempts on the Numerical Series (induced failure) task and total time taken on the Part II survey ($r = 0.46$, $p < 0.001$; $d = .21$). This relationship suggests that participants who made more attempts across the Numerical Series task may have spent more time completing the entire study. However, time spent is another way to conceptualize persistence beyond number of attempts. Time spent also represents a predictive variable with greater variability than total number of attempts. Exploratory analyses of the relationships between mindset, feedback, and persistence as measured by time may provide direction in methodological and conceptual design for future research. Descriptive frequencies for time spent across feedback conditions were also calculated (see Table Q17). Median time spent on Part II of the study was 21.43 minutes, 16.71 minutes, and 15.40 minutes for ability, effort, and control feedback, respectively.

An exploratory bivariate Pearson correlation was used to determine if mindset and the total time spent on Part II of the study were significantly related (see Table Q18). Results indicated a non-significant relationship between mindset and total time ($r = -0.03$, $p = 0.81$). An exploratory nonparametric Spearman's rho bivariate correlation was used to further explore if

mindset and the total time spent on Part II of the study were significantly related, inasmuch as the data were not normally distributed (see Table Q19). Results indicated a non-significant relationship between mindset and total time using Spearman's rho (r_s = -0.17, p = 0.14).

An exploratory one-way ANOVA was also used to determine if there were significant differences between feedback conditions on the total time spent on Part II of the study (see Table Q20). Results indicated that feedback conditions did not differ significantly in total time spent (F = 2.26, p = 0.11).

Since total time spent on Part II is not normally distributed, participants' time was ranked and analyzed. An exploratory Kruskal-Wallis chi square test was used to rank participants' time spent on Part II of the study and determine if there are significant differences between feedback conditions on the total time spent based on relative ranking (see Table Q21). Results indicated that feedback conditions did not differ significantly in the mean ranking of total time spent, although significance is marginal (X^2= 5.14, p = 0.08).

An exploratory one-way ANOVA was used to determine if there were significant differences between feedback conditions on the mean ranking of total time spent (see Table Q22). Results indicated that feedback conditions did not differ significantly in relative ranking of total time spent, although significance was marginal (F = 2.69, p = 0.08).

An exploratory linear regression was used to determine if mindset and feedback together predict ranked total time on Part II of the study (see Table Q23). Results indicated that mindset and feedback were not significantly predictive of ranked total time, although significance was marginal (F = 2.713, p = 0.051).

Goal-Orientation and Risk-Aversion Task

An exploratory chi-square test of independence was used to determine if selection of goal-orientation information is significantly related to decision-making regarding the bonus task (see Table Q24). Specifically, are participants who view relative-performance feedback instead of problem-solving strategies less likely to choose to attempt a bonus task? Results indicated that selection of goal-orientation information was significantly related to the decision to attempt the bonus task (X^2= 12.371, $p < 0.001$). The results appeare to indicate that participants who view relative-performance information are significantly less likely to attempt a bonus task, while participants who view problem solving strategies are significantly more likely to attempt the bonus task.

Chapter IV

Discussion

The primary goal of the study was to determine whether college student mindset and/or performance feedback are related to outcome variables of persistence on a challenging task, attributions for failure, goal-orientation decision-making, and risk-aversion decision-making after experiencing failure in an experimental study. It was expected that participants with a growth mindset who receive feedback related to effort would make more attempts on a challenging follow-up task, attribute failure to lack of effort, decide to view problem-solving strategy (mastery orientation) information, and choose to attempt a challenging bonus task compared to participants with a fixed mindset who receive feedback related to ability. It was also expected that participants with a fixed mindset who receive feedback related to ability would make fewer attempts on a challenging follow-up task, attribute failure to lack of ability, decide to view relative-performance (performance orientation) information, and choose to skip a challenging bonus task compared to participants with a growth mindset who receive feedback related to effort.

Results indicate that mindset is significantly related to decision-making surrounding goal-orientation information, with participants who endorse a growth-mindset more likely to view problem solving strategies, while participants who endorse a fixed-mindset more likely to view relative-performance information, with a large effect size. This aligns with the original hypotheses of the current study its theoretical foundation. In implicit theories of intelligence, individuals who hold a growth mindset are thought to desire to improve their abilities and focus on their own progress rather than their relative standing. Individuals who hold a fixed mindset are thought to assume that abilities cannot be improved past a natural ceiling and would thus

focus on how they compare in their abilities to others. The results of this study further lend support for these diverging tendencies among growth versus fixed mindset individuals.

Exploratory analyses of the relationship between mindset, performance feedback, and total time spent on Part II of the study and outcome was conducted to determine if future research on persistence should more appropriately conceptualize persistence as time spent on a task rather than number of attempts made on a task. An exploratory linear regression revealed mindset and feedback as marginally significantly predictive ($p = 0.051$) of ranked total time on Part II of the study. This may suggest that mindset and/or feedback may significantly contribute to persistence after failure by college students, when persistence is conceptualized as time spent attempting difficult tasks rather than the number of attempts made.

Finally, in a further exploratory analysis, selection of goal-orientation information was significantly related to bonus task decision-making, with participant selection to view problem solving strategies significantly related to attempting the bonus task and selecting to view relative-performance information would be significantly related to skipping the bonus task. The utility of the feedback presented in the problem solving strategies may have increased participants' mastery orientation, where they learned strategies for solving Numerical Series, adopted the goal to test their competence in this skill, and were more willing to take on the bonus task. In contrast, the feedback presented in the relative performance information highlighted the degree of failure that participants experienced by stating, "You answered 0 of the 3 items correctly and scored in the bottom 6th percentile on this task, compared to other EDPY 210 students." This may have led participants to adopt a performance-avoidance approach, where they learned they currently have low-ability compared to peers, adopted the goal to avoid demonstrating further failure, and were less willing to take on the bonus task.

Implications of Findings

The findings presented in the Results section did not show that effort or ability performance feedback was related to the targeted attempts made on challenging follow-up tasks, attributions for failure, goal-orientation information selection, or risk-aversion decision-making. Similarly, mindset was only significantly related to goal-orientation information selection. The results of this study differed dramatically from a similar series of studies conducted by Mueller and Dweck with child participants (1998). Numerous factors may explain this difference in results. Firstly, it is possible that the feedback provided in-person to child participants by an adult examiner in former mindset studies was internalized more readily compared to the computer-delivered feedback given to adult college students in the present study. Participants in the present study performed tasks anonymously on a computer without the individual attention given to child participants in Mueller and Dweck's studies. It is also possible that important elements of motivation such as competence beliefs, control beliefs, interests, values, and goals (Pintrich, 2003) shifted with development from childhood to adulthood, and elements beside mindset were not captured in the present study.

Variability in the number of attempts made on each trial of the Numerical Series task was quite low. Most participants, regardless of their mindset or performance feedback condition, attempted only once or not at all before giving up and moving on to the next trial or task. Time spent on Part II of the study revealed a greater degree of variability than number of attempts on the Numerical Series task. Rank order time acted as an imprecise variable to potentially explore persistence as measured not by number of attempts, but rather by time spent on the challenging task. It is important to emphasis the large degree of uncertainty when interpreting the exploratory analysis surrounding the relationship between mindset, feedback, and persistence as measured by

time. Rank order time spent on the entirety of Part II of the current study is markedly different than a true measure of time spent in minutes specifically on the Numerical Series task. An abundance of caution should be taken when interpreting these results. Although research findings from this study may suggest that mindset and feedback may be significantly predictive of persistence (as measured by time spent in minutes) on challenging tasks; subsequent research is needed to confirm this possibility.

In the present study, mindset was significantly related to goal orientation selection, where participants with a growth mindset were more likely to select to view problem solving strategies (i.e., mastery-orientation information) while participants with a fixed mindset were more likely to select to view relative performance feedback compared to peers (i.e., performance-orientation information). In college courses, this finding may be reflected in a tendency for students with a growth mindset to actively seek additional resources and explanations for difficult subject matter that they have not mastered, while students with a fixed mindset may spend excessive time inquiring about the performance of their peers and their relative standing in a difficult course. The current study also required participants to choose to view only one option, when college students in courses may elect to find both mastery-orientation and performance-orientation information after failure. Additional research beyond the present experimental study is necessary to better understand the influence of college student mindset on goal orientation after experiencing true failure in coursework.

A follow-up analysis revealed a significant relationship between goal-orientation decision making and bonus task decision-making. Information related to relative-performance feedback read, “You answered 0 of the 3 items correctly and scored in the bottom 6th percentile on this task, compared to other EDPY 210 students.” It is possible that participants who selected

relative-performance feedback and learned they performed below average compared to peers adopted a performance-avoidance orientation. The desire to avoid another possible failure may have influenced their decision to skip the bonus task. In contrast, participants who selected the problem-solving strategies information and learned ways to identify patterns within Numerical Series may feel more competent after reviewing strategies. Thus, they might have adopted a performance-approach or mastery orientation, which influenced their decision to attempt the bonus task.

Additional research is needed to determine how goal orientation and viewing specific types of information influences risk-aversion after failure. Students who adopt performance-avoidance goals in college may prematurely drop courses or avoid majors that they anticipate will be too difficult for them, believing that remaining in difficult courses will mean risking failure or relatively poor performance compared to peers. However, these students may be capable of improving and succeeding in these courses if they adopt a mastery-orientation. Additionally, current literature suggests that coupling college students' grades with either mastery- or performance-oriented feedback significantly influences the types of goals students adopt (Muis et al., 2013). Drawing from the study conducted by Muis and her colleagues, future research on feedback and performance-orientation could also examine risk-aversion outcomes, such as administering academic risk-taking and failure tolerance measures after exams.

Findings from the present study suggest that when presenting information to students after experiencing failure, focusing on strategies for success rather than relative standing may support students' decisions to make future attempts at similar difficult tasks. In college courses, it is therefore possible that practices such as providing additional scaffolded resources for struggling students and emphasizing learning strategies support future academic risk-taking in

students. Additional research on modes of delivering mastery-oriented feedback (ex. asynchronously online with exam scores, face-to-face with instructors in a course performance meeting), academic outcomes, and academic risk-aversion are warranted.

Although adopting a growth mindset and demonstrating persistence are often conceptualized as adaptive tendencies for students in the face of failure, unexplored in the present study and in much of the motivation literature is the possibility of maladaptive overpersistence. It is possible that students who have an extremely growth-oriented mindset and maladaptive overpersistence may be unwilling to consider different avenues for success, such as switching majors or universities, despite substantial financial loss and time wasted without significant progress. This scenario may then lead to other negative outcomes for these students, such as long-term frustration and anxiety, lack of academic progress, and financial debt without an earned degree. In higher education, it is crucial to strike a balance between encouraging students to persist after experiencing failure and encouraging students to make reflective decisions about their education informed by the progress they are making toward personal academic goals.

Limitations

Several sampling limitations existed within this study. Sample size was smaller than the researcher initially planned. Observed power in post-hoc analyses of significant and marginally significant findings ranged from .93 to .96. In research conducted in former semesters with this student population, participants completed research tasks in class. New procedural safeguards dictated that interested students were required to use personal time to meet the principal investigator outside of class in a computer lab, which was arguably more inconvenient for them compared to previous semesters. Attrition between Part I and Part II of the study was high, with

Part I resulting in 134 consenting participants and Part II ending in only 74 participants, likely due to inconvenience of participation, as well as concerns related to the difficulty of the tasks discussed in the consent form. Future research should focus on increasing ease, convenience, incentives, and the sample pool of student participants in order to increase sample size. These issues could be mitigated by adapting the methodology to allow students to complete the study at home at their convenience, providing an incentive that would benefit students outside of the sampled course (ex. gift cards), and advertising the study as available to undergraduate students across campus.

Sampling limitations also impeded on the generalizability of the results. The majority of participants in this study were identified as Caucasian and female. Historically, many of the students enrolled in the course sampled from intend on pursuing a career in education. Future educators may be more likely to endorse a growth mindset compared to the general population, since one of the foundational tenants of teaching is the belief that students can improve their knowledge and skills with high-quality instruction and intentional practice. It is possible that diversity in personal background, majors, and career interests would increase variability of mindset beliefs, and study results would be a better representation of college students' motivation after failure.

Additional limitations stem from the survey platform used to complete the present research. QuestionPro does not permit randomization upon log-in to the survey; therefore, the principal investigator had to randomize participants in Part I into performance feedback conditions prior to their arrival to Part II of the study. Coupled with the effort to increase ease of participation, using a platform that better ensures equal grouping of randomized conditions would improve the power of the statistical findings.

Question Pro also does not provide a timestamp for total time taken on a single item, page, or block of questions; therefore, it is uncertain if there is a significant relationship between total number of attempts and time spent on the Numerical Series task, specifically. Therefore, persistence as measured by time spent attempting difficult items could not be directly measured. Other survey platforms such as Qualtrics do have this feature, and it would be highly valuable in determining if persistence as measured by time spent overall on the difficult task or time spent per attempt is related to mindset or performance feedback.

As stated previously, mindset is only one factor that potentially contributes to student motivation. Other elements such as competence beliefs, control beliefs, interests, values, and goals were not as deeply explored as mindset within this study. Future research should expand upon Part I to include standardized measures beyond the Growth Mindset Scale, such as performance orientation scales or frustration tolerance scales, to provide a more comprehensive exploration of student motivation after failure.

There are some limitations in interpreting findings of the distress scale presented to participants after debriefing and reconsent procedures. As noted previously, the internal consistency of the distress scale is low ($\alpha = 0.42$). Cronbach's alpha could be improved ($\alpha = 0.66$) if the reverse-coded item, "I understand why participants are not told the true intent of the study until the end," is removed. This is likely because understanding the need for deception in the study is related to - but not the same construct as – distress. Additionally, internal consistency is likely lower than desired because items in the distress scale asked about distress levels at different times throughout the study (i.e., completing the challenging Numerical Series items, reading that the study used deception, leaving the computer lab). The distress scale was

developed and intended as a social validity check, and it is advised that future research revise the distress scale in the current study to improve internal consistency.

Finally, although experimental studies are better able to control for potential extraneous variables, this experimental study had the major limitation of lacking ecological validity. Participants likely experienced frustration and reported being challenged when attempting to complete the Numerical Series task designed to induce failure. However, participants were also aware that their poor performance did not necessarily result in real-world consequences. In fact, they would be given bonus credit regardless of their performance. The structure of this study differed greatly from the realities of students who experience real failure in their coursework. It is possible that there would be true differences in college student motivation and decision-making based on mindset and performance feedback after experiencing a true failure in a course.

Concluding Comments

Despite limitations in the present study, there are several promising future directions to consider in this line of research that would make improvements on both methodology and the conceptual framework outlined in this study. Future research should focus on how student characteristics (mindset and additional elements of student beliefs and motivation) and performance feedback are related to student outcomes in college classes, particularly classes that have high rates of student failure (ex. pre-medical classes, general education science courses). Persistence may be measured as time spent on exams or problem sets, and changes may be tracked over the course of the semester. Persistence could also be measured as retention in a class after experiencing failure. It may be that mindset along with other measures of motivation (ex. measures of goal orientation, competency beliefs, intrinsic interest) play a significant role in persistence in real performance in college courses, more so than in experimental procedures.

Although randomized performance feedback was not significantly related to any of the outcome variables measured in the present study, the exploratory analyses revealed that viewing different types of information may significantly relate to students' willingness to make additional attempts on similar tasks. It is possible that viewing specific types of information immediately before potentially attempting another difficult task was more influential than the distally reviewed performance feedback at the beginning of Part II of the study. Perhaps timing of performance feedback made a significant difference. Perhaps the response professors provide to college students after failure is important for willingness to make future attempts, although emphasizing effort over ability is not. Rather, focusing on students' low-relative standing in a course would hinder students' willingness to try again. Sharing strategies for success and means of improving one's competency appears to relate to a greater willingness to make future attempts, despite former failures. Based on the present study and current published literature, there still exists a need to examine how student characteristics and performance feedback (both timing and type) relate to response after failure for college students.

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Appendices

Appendix A

Initial Canvas Announcement

Hello class,

I hope you're all doing well and that you had an enjoyable as well as a refreshing summer!

Welcome to your Fall 2019 semester and the EDPY 210 course. My name is [instructor name] and I will be your instructor for EDPY 210 section [section number] at [time] in [room location]. I am excited to teach you all starting this Thursday and guide you through the course materials. The Canvas site is now available to students, in which you will find important course documents. To familiarize yourself with EDPY 210, it is highly recommended that you read over the syllabus prior to coming to class. We will review the structure of the course and expectations for students and instructors during our first class meeting. If you have any questions about the course or expectations for your performance in the class, please, feel free to email me at [instructor email address].

This semester, EDPY 210 students have the option of participating in an online research study for a small amount of bonus credit. More information about the study is available in the consent form attached to this announcement and posted on Canvas near the top of the "Modules" page as well. During the last 10 minutes of class, I will leave the room and a graduate student who is not affiliated with EDPY 210 will provide additional information about the study and answer any student questions. If you are not interested in participating in this research study, you do not need to stay for the last 10 minutes of class. If you are interested in participating, you will need to bring a laptop or tablet to complete the consent form, complete Part I of the study, and sign up for Part II. You will also need to know your student ID number (you can find this on your student ID card, or on the home page of myutk.utk.edu once you log in). If you have any questions or concerns, please feel free to email [myself/Janet Schwartz-Micheaux], the principal investigator, at jschwa15@vols.utk.edu. If you would prefer to send questions about the study to a non-instructor, please email Charaya Upton, graduate research assistant for EDPY 210, at cupton4@vols.utk.edu.

I look forward to seeing everyone tomorrow [morning/afternoon],

[Instructor name]

Appendix B

Consent Form

CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT

Title: Problem Solving and Decision Making on Computer-Based Tasks Among College Students
Principal Investigator: Janet Schwartz-Micheaux, M.S.
Faculty Advisor: Robert Williams, Ph. D.

I. Introduction/Background/Purpose: You are invited to participate in a research study. This study is designed to gather information about how college students solve problems and make decisions when presented with challenging tasks. The purpose of this study is to examine what factors influence college students' problem-solving abilities and how problem-solving and decision making during challenging tasks are related. Part I of this study consists of a brief scale asking questions about your beliefs regarding intelligence and will take up to 5 minutes of your time. Part II of this study consists of problem-solving tasks to be completed online during one of the time slots presented after completing the scale in Part I. Part II will take approximately 45 minutes and will be completed outside of class time. Approximately 180 individuals will participate in this research study.

II. Procedures: In Part I of the study, you will answer three, six-point Likert items asking about your beliefs regarding intelligence and items about demographic information. Responding to these items will take 5 minutes or less. Then, you will be redirected to an online poll to select a single 45-minute time slot where you will complete the second part of the study. The principal investigator will provide an email reminder with the date, time, and location for you to complete Part II of the study in the computer lab located in BEC A401. If none of the time slots work for you, or if you would prefer to complete the second part of the study in a private office, email Janet Schwartz-Micheaux at jschwa15@vols.utk.edu and she will set up an appointment for you to complete Part II in BEC 534. If you would prefer to complete Part II with a non-instructor of EDPY 210, email Charaya Upton, graduate research assistant for EDPY 210, at cupton4@vols.utk.edu.

During Part II of the study, you will be asked to solve challenging problems involving memory and reasoning. You will also be asked questions regarding your performance. At the end of Part II of the study, you will have the opportunity to earn up to five additional bonus credit points by solving optional problems. You will complete all tasks on a secured, confidential computer, which will take approximately 45 minutes. Following problem-solving tasks, you will complete a brief set of questions regarding your experience solving challenging problems, which should take 5 minutes or less. After completing Part II of the study, your participation in this research study will be over.

III. Compensation: Your participation in this study will last approximately one hour. Completing the scale in Part I and participating in Part II of the study will result in 10 points worth of bonus credit in EDPY 210. If you only complete Part I of the study, you will not receive

bonus credit. If you choose to withdraw from the study during Part II, you will still receive 10 points worth of bonus credit. If you attempt the optional task at the end of Part II and answer one of them correctly, you will receive an additional 5 bonus points for a total of 15 bonus points acquired for participation. If you attempt the optional task in Part II and answer all of them incorrectly or give up, you will lose 2 bonus points, awarding you a total of 8 bonus points acquired for participation. You may choose to skip the optional task in Part II and receive 10 bonus points.

IV. Risks: There is the possibility that participation in this study could cause frustration while completing challenging tasks. The challenging tasks used in this study have been administered to undergraduate students for research and assessment purposes with no significant adverse effects. If you experience any significant distress while participating in this study, please tell the experimenter. You may skip questions by clicking "I give up" during the non-optional tasks in Part II at any point without penalty. Most research involves some risk to confidentiality, and it is possible that someone could find out you were in this study or see your study information. The investigators believe this risk is unlikely because of the procedures we will use to protect your information. In case of any distress from participating in this study, the following counseling centers are available to you: assistance from the UT Counseling Center (865-974-2196) or the UT Psychological Clinic (865-974-2161). The University of Tennessee, however, has not set aside funds to pay for this care or to compensate you if something should occur. Thus, any treatment sought will be provided at your expense.

V. Benefits: Participation in this study may not benefit you personally. You will get to see the process of research. The main benefit is to society. Overall, we hope to gain information about undergraduate students' beliefs about intelligence, problem-solving abilities, and decision making when presented with challenging computer-based tasks.

VI. Voluntary Participation and Withdrawal: Participation in research is voluntary. You do not have to be in this study. It is possible to make an A in EDPY 210 without participating in research or earning any extra credit. You have the right to refuse to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. Should you choose to drop out of the study, data you previously provided will be kept on a secure, password-protected computer. You may skip questions or stop participation at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VII. Alternative Assignment: For individuals who do not want to participate in the research study, an alternative assignment is available that is worth 10 bonus points. This assignment involves watching a course video already assigned in EDPY 210 and writing a 2-page, double-spaced paper. This paper should summarize concepts presented in the video and describe applications of the concepts to educational psychology. Students cannot participate in both the research study and the alternative assignment.

VIII. Confidentiality: Research data will be kept confidential. Janet Schwartz-Micheaux, Dr. Williams, and their research staff will have access to the information you provide. Data will be stored in password-protected electronic files and will be made available only to individuals conducting the study. Data saved in data analysis software will contain a research identification

number in place of your name. No reference will be made in oral or written reports regarding information that could link participants to the study.

IX. Future Research: We will keep your information to use for secondary analyses in the future. Your name and other information that can directly identify you will be deleted from your research data collected as part of the study. We will not share your research data with other researchers.

X. Contact Information: If you have questions at any time about this study or the procedures (or you experience problems as a result of participating in this study), you may contact the principal investigator, Janet Schwartz-Micheaux, at jschwa15@vols.utk.edu or the faculty advisor, Dr. Robert Williams, at bobwilliams@utk.edu. If you have questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

XI. Copy of Consent Form to Subject: We will give you a physical copy of this consent form to keep. Please sign and date below and indicate if you are willing to participate in this research study by select one of the two options.

If you have questions, you are free to ask them publicly at this time or email the principal investigator at jschwa15@vols.utk.edu or the graduate research assistant at cupton4@vols.utk.edu if that is preferred.

If you are not interested in participating in this study, please click "Exit Survey" in the top left corner of the screen now. Thank you.

CONSENT OPTION 1: I have read the above information. I have received a copy of this form. I consent to participate in this study, and I consent to having my data used in research.

Participant's Name (typed) _____ Date _____

OPTION 2: I have read the above information. I have received a copy of this form. I consent to participate in this study, but I do not consent to having my data used in research. I will participate in the research study and receive bonus credit, but my data will be immediately destroyed and will not be included in data analysis.

Participant's Name (typed) _____ Date _____

Appendix C

Growth Mindset Scale Items

Instructions: Read each sentence below and then select the one option that shows how much you agree with it. There are no right or wrong answers.

	Strongly Disagree	Disagree	Mostly Disagree	Mostly Agree	Agree	Strongly Agree
1. You have a certain amount of intelligence, and you can't really do much to change it.						
2. Your intelligence is something about you that can't change very much.						
3. You can learn new things, but you can't really change your basic intelligence.						

Appendix D

Demographic Items and Directions for Part II Scheduling

Instructions: Please answer the following demographic questions based on the responses that best describes you.

Please indicate your age in years: _____

Please select your year in school:
____ Freshman
____ Sophomore
____ Junior
____ Senior
____ Graduate Student
____ Non-degree Seeking Student
____ Other (Please Describe Below):
_____
Please select your gender:
____ Female
____ Male
____ Transgender
____ Non-Binary/Third Gender
____ Prefer Not to Say
____ Prefer to Self-Describe:
_____

Please specify your ethnic origin or race (check **all** that apply):
____ White
____ Hispanic/Latino
____ Black or African American
____ Native American or American Indian
____ Pacific Islander
____ Prefer not to answer
____ Other (Please Describe):
_____

Please provide an estimate of your current college GPA from 0.0 to 4.0. If you are unsure of your current GPA, type "I don't know" in the text box below.
_____

Please provide a good email address for us to send the Part II reminder email to you:
_____

When you click **Done**, you will be redirected to an online poll to **select a single 45-minute time slot** where you will complete Part II of the study in the computer lab in **BEC A401**. The dates

offered are Monday, Tuesday, and Wednesday of next week (August 26th, 27th, and 28th). Either Janet Schwartz-Micheaux or Charaya Upton will send an email reminder with the date and time you selected, as well as a reminder of the location. You must attend Part II in order to receive bonus credit for participating in this research study.

As time slots fill up on the poll, fewer options will be displayed. You may need to refresh the online poll to see updated availability, as your peers in EDPY 210 are completing the poll at the same time. **After reviewing the poll**, if none of the time slots work for you are if you would prefer to complete Part II of the study in a private office, email Janet Schwartz-Micheaux at jschwa15@vols.utk.edu and she will set up an appointment for you to complete Part II in BEC 534. Click **Done** now to view the online poll.

Appendix E

Email Reminder for Part II of the Study

Hello [name of participant],

This is a reminder that you have signed up to participate in the EDPY 210 Study Part II **TODAY [date]** at **[time]** in the **BEC A401 computer lab**.

If you have any questions, please email me back or Charaya Upton at cupton4@vols.utk.edu. If you would like to change your time slot for Part II, please check the Doodle Poll for availability (linked below) and sign up for a different time. If none of those times work, please reach out and we can make an appointment.

[link to online scheduling poll]

Thank you,

Janet Schwartz-Micheaux (she/her/hers)
EPC Graduate Teaching Associate
College of Education, Health, and Human Sciences
The University of Tennessee - Knoxville

Appendix F

Introduction to Part II of the Study

Hello! Thank you for attending Part II of the College Student Problem Solving and Decision Making Study. During this part of the study, you will engage in tasks designed to assess your memory and reasoning abilities. You will also answer questions about your performance, choose to view different types of information, and potentially earn additional bonus points in an optional task. Part II of the study is expected to take no more than 45 minutes. Please read all directions and feedback carefully. Click **Next** to continue.

Appendix G

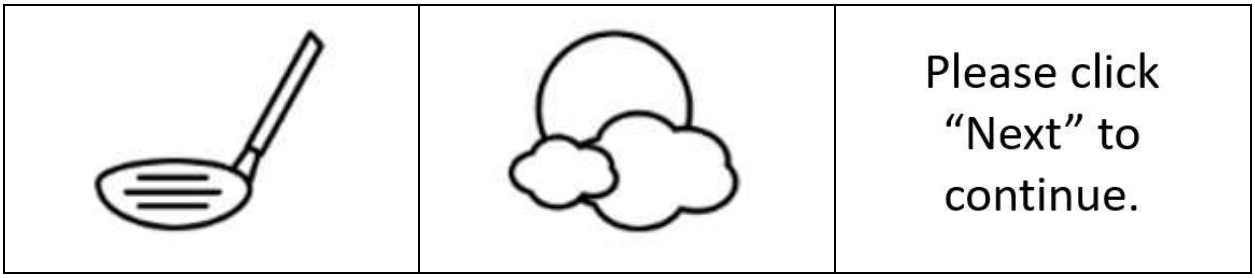
Memory for Pictures Task

Task I: Memory for Pictures

This is a test of your ability to learn and to remember pictures of common objects. You will see 50 pictures, one at a time. Then, you will select which pictures you remember seeing. If you are unsure, take your best guess. Before you start, you will try a sample trial that contains only two pictures. Look carefully at each picture and try to remember it. Click Next when you are ready.

---page break---

The pictures will change automatically. Please only click Next when you are prompted.



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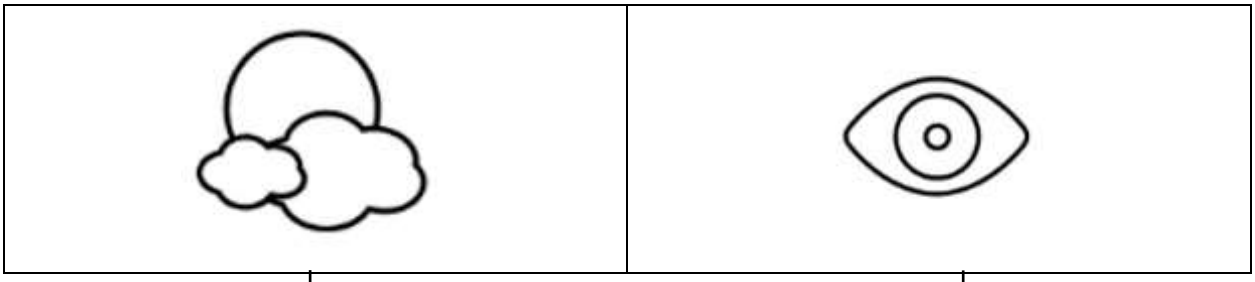


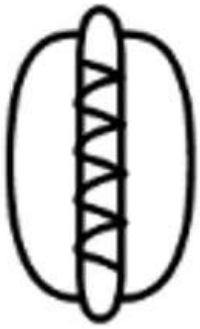
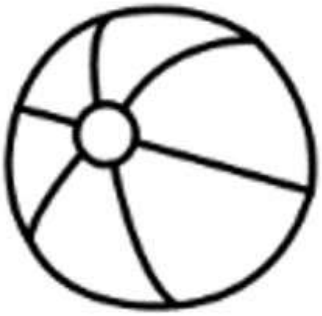
You are correct! The picture shown previously was of the clouds and sun. Please click **Next** to continue.	You are incorrect. The picture shown previously was of the clouds and sun, *not* the eye. Remember, look carefully at each picture and try to remember it. Please click **Next** to continue.

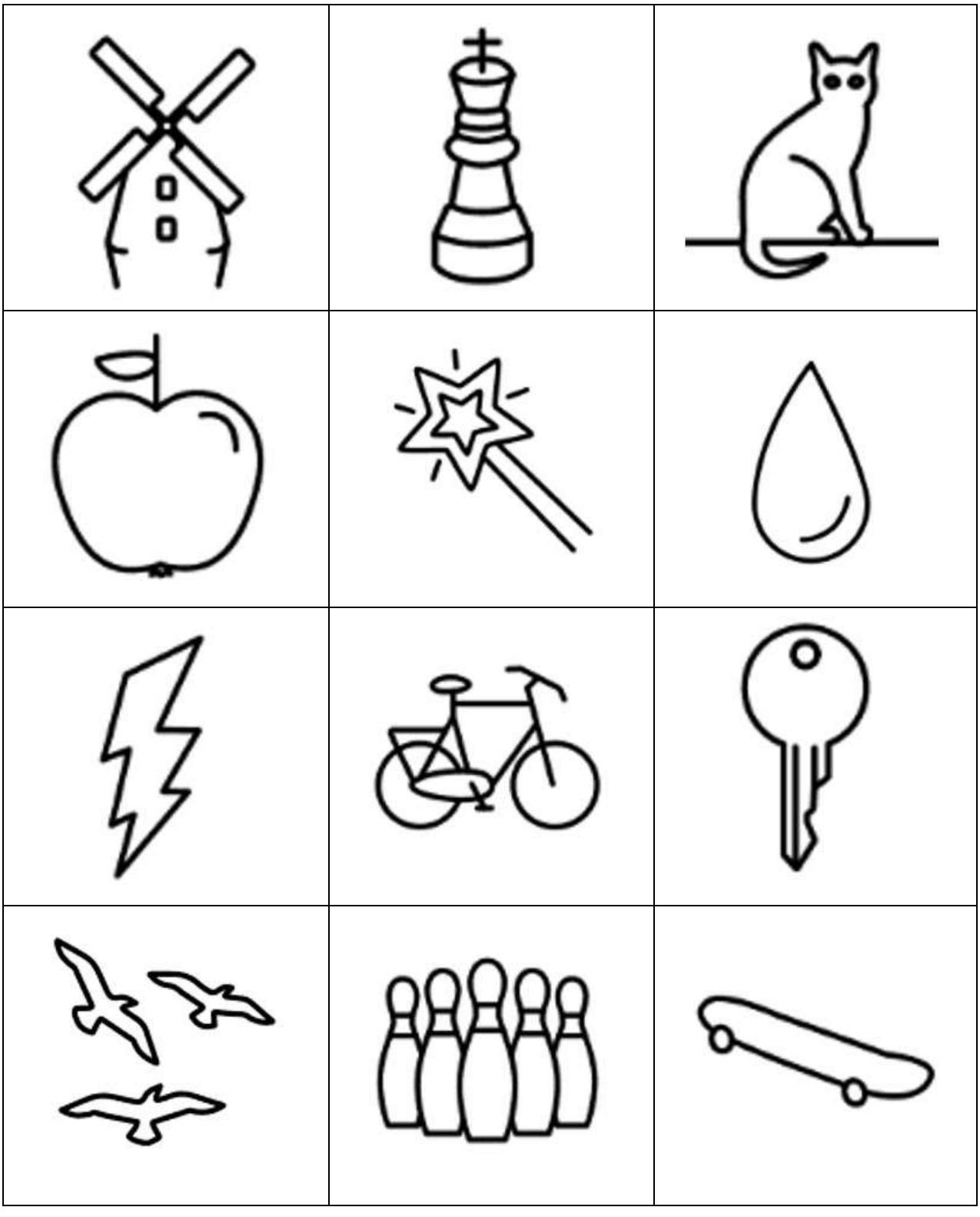
---page break---

You are about to start the full Memory for Pictures task. You will see 50 pictures, automatically presented one at a time. Then, you will select which pictures you remember seeing. Try to remember all of the pictures. Click **Next** when you are ready to begin.

---page break---

The pictures will change automatically. Please only click Next when you are prompted.

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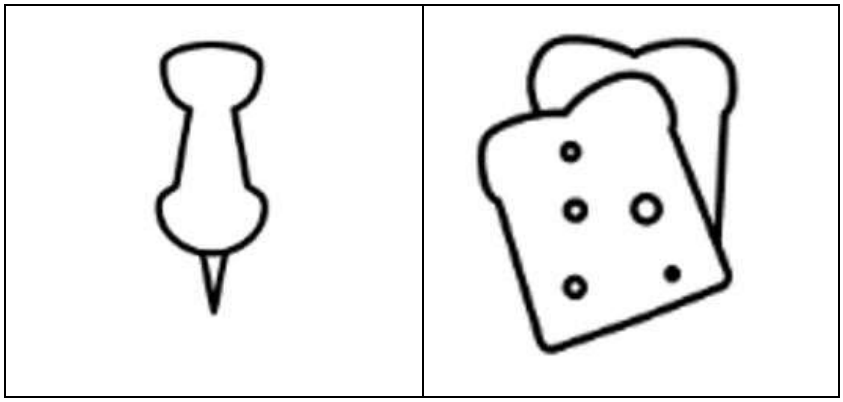

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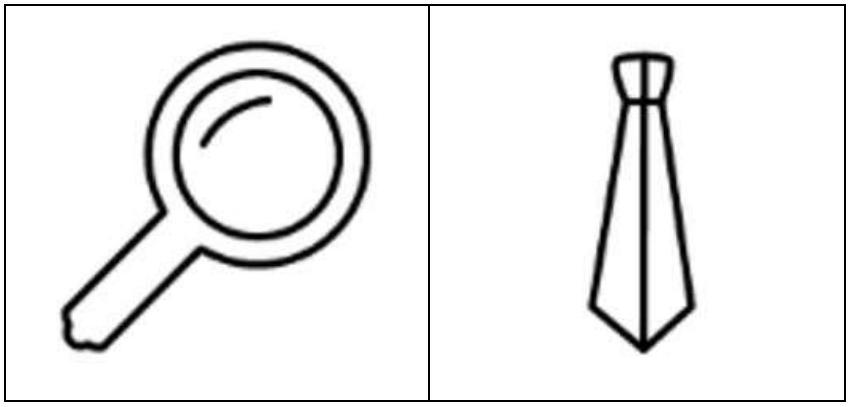

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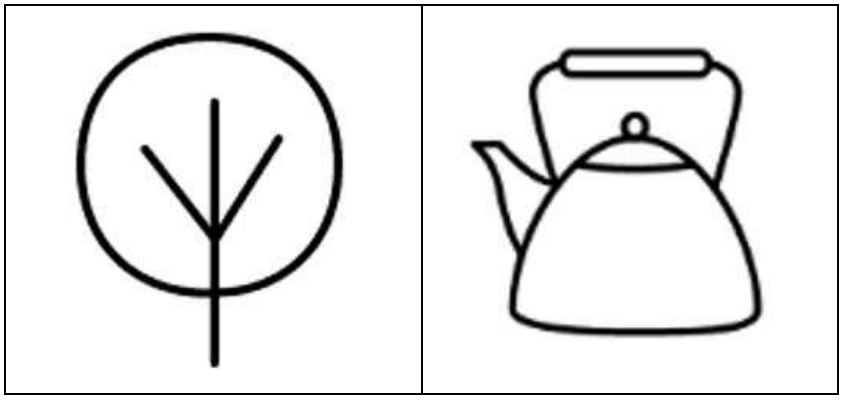

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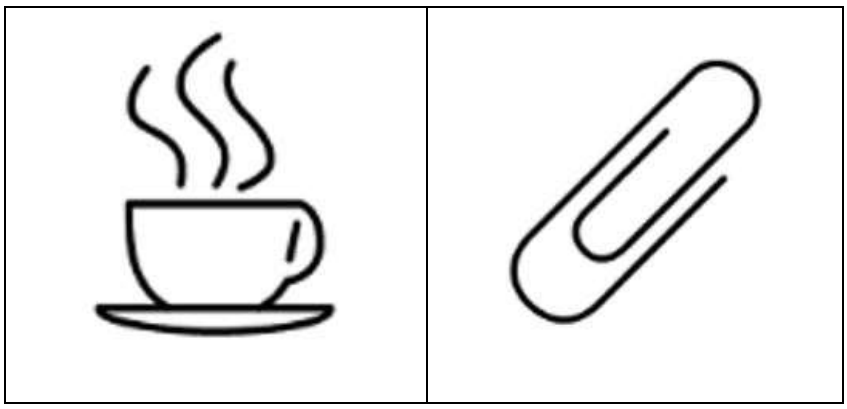

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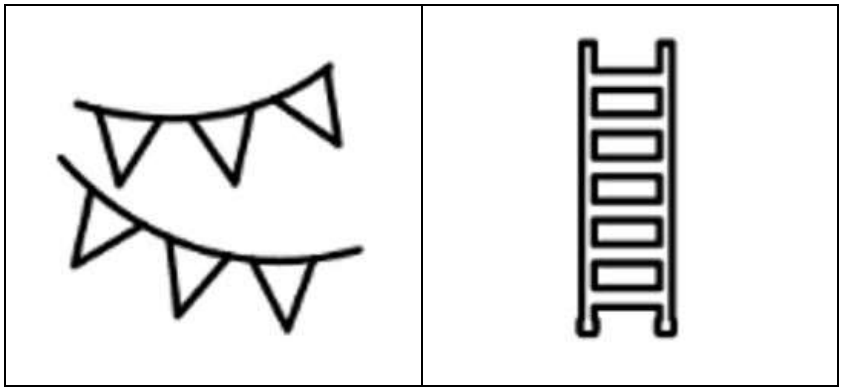

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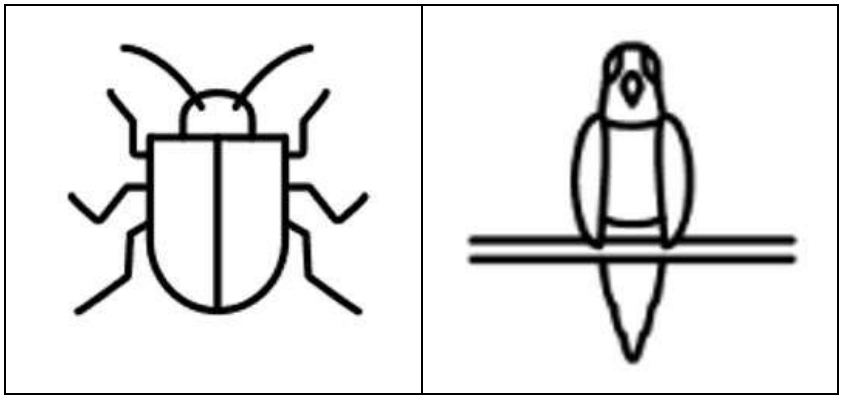

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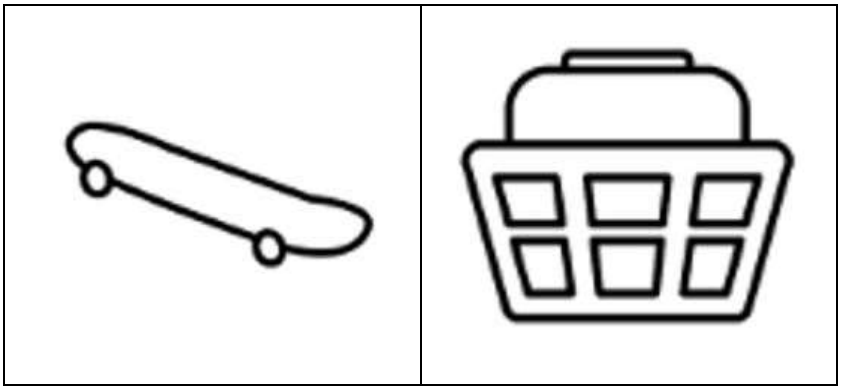

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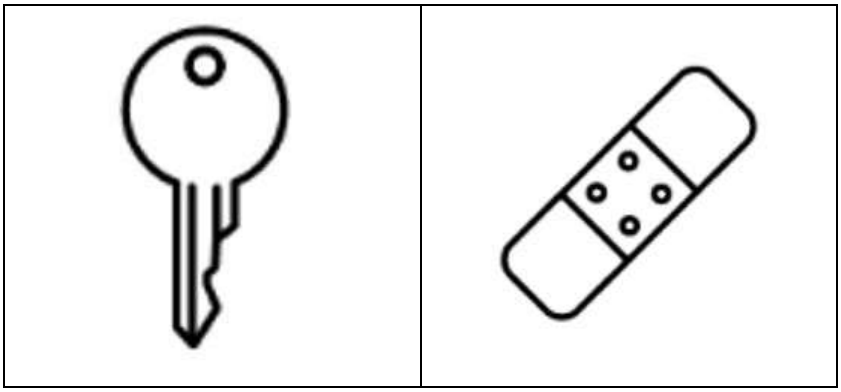

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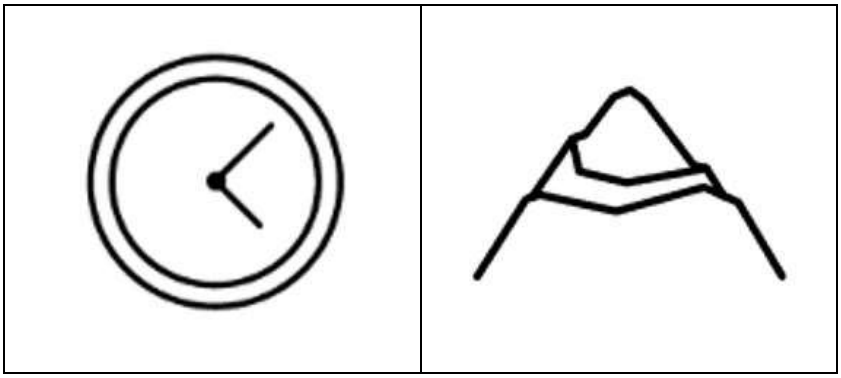

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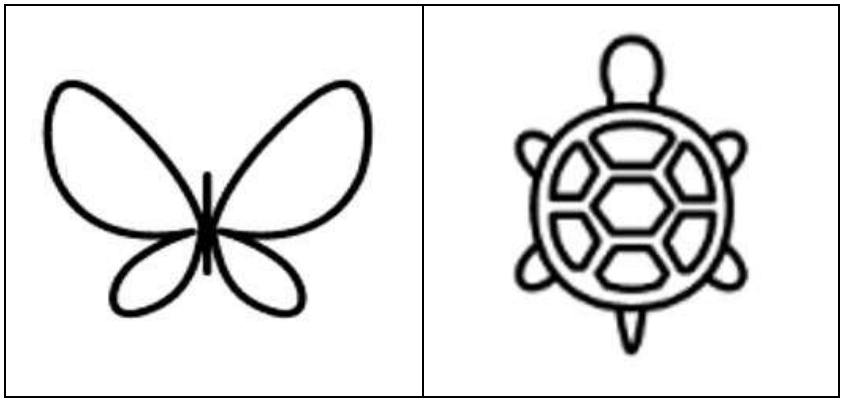

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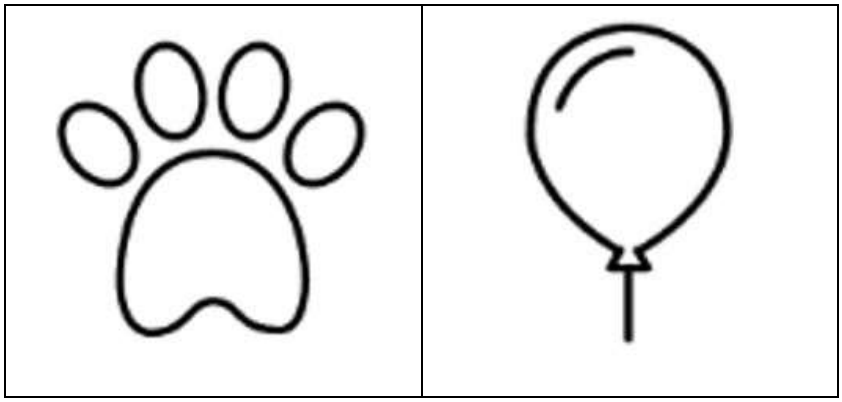

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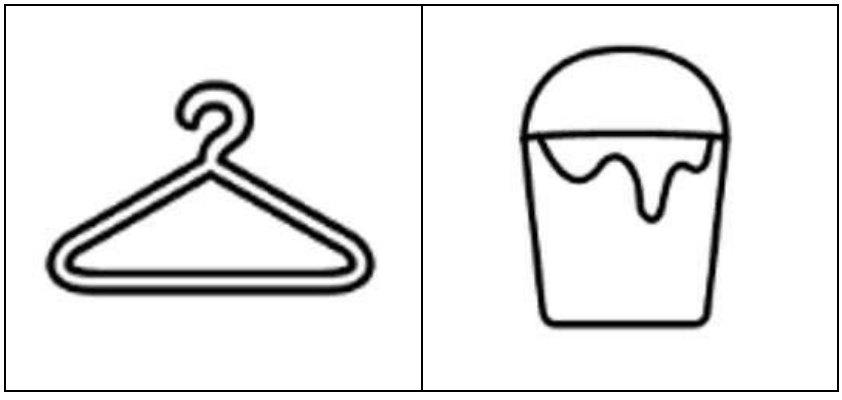

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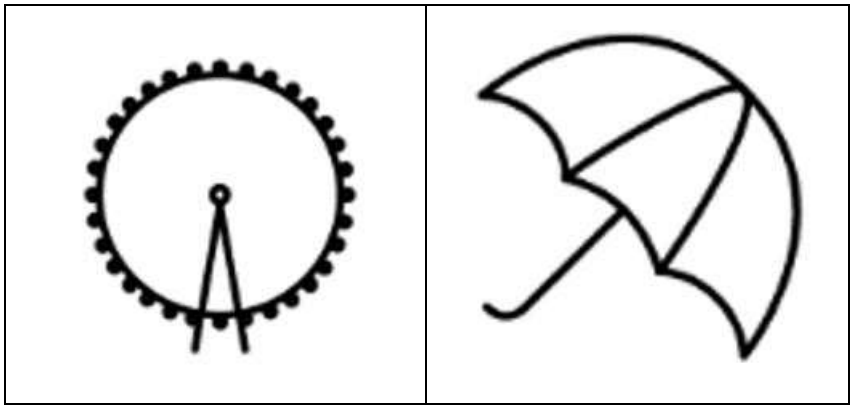

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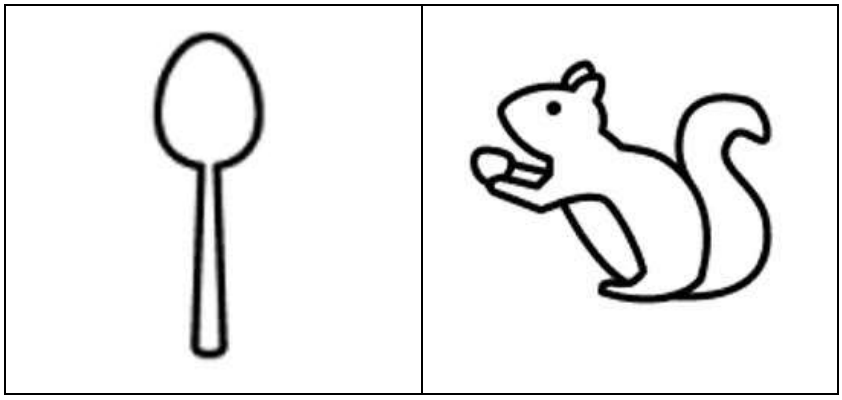

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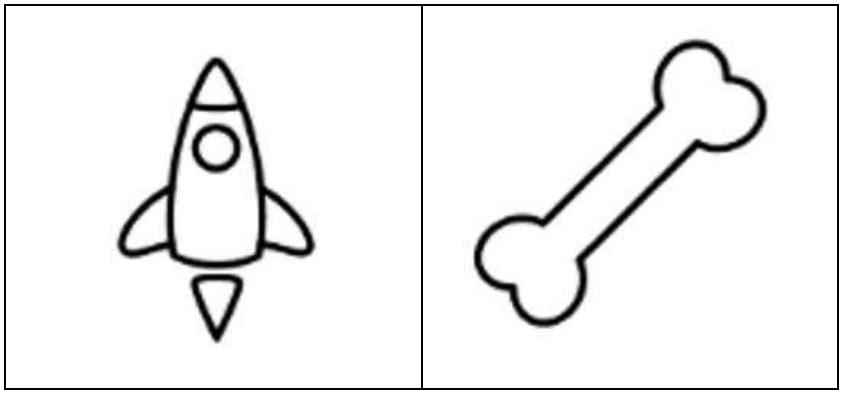

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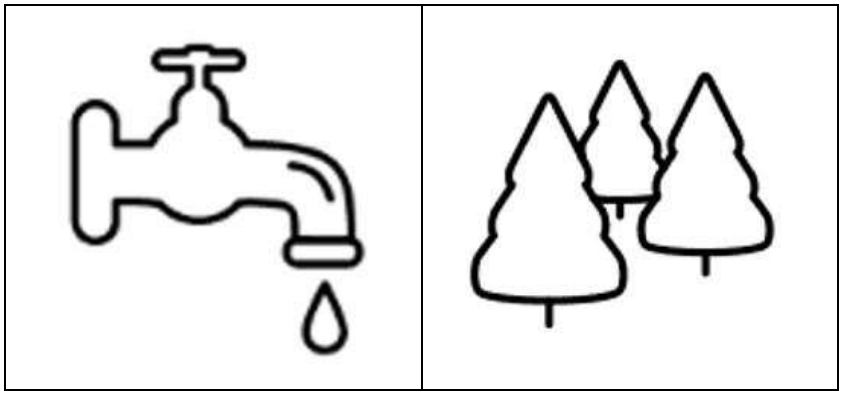

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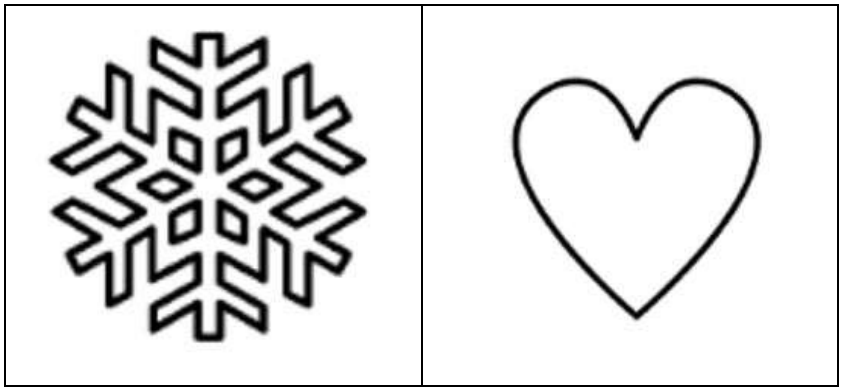

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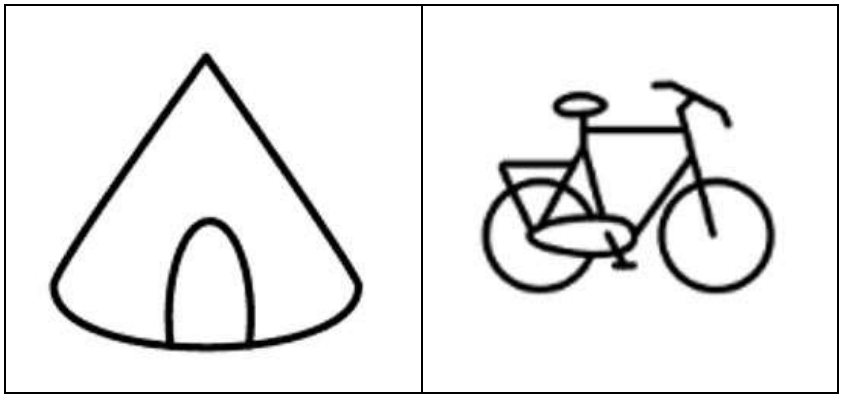

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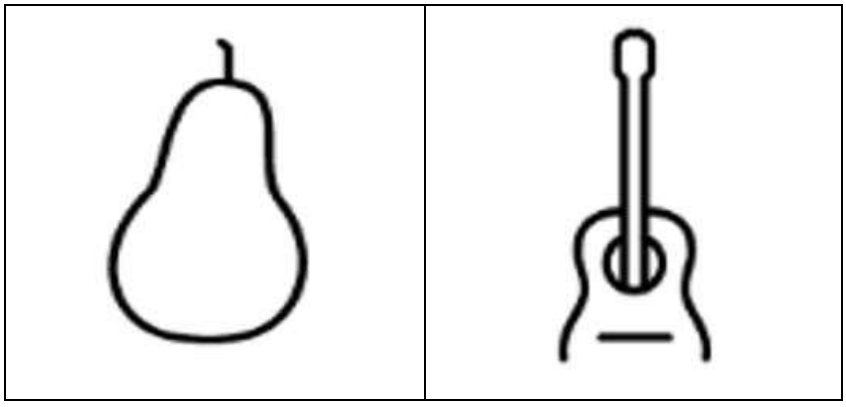

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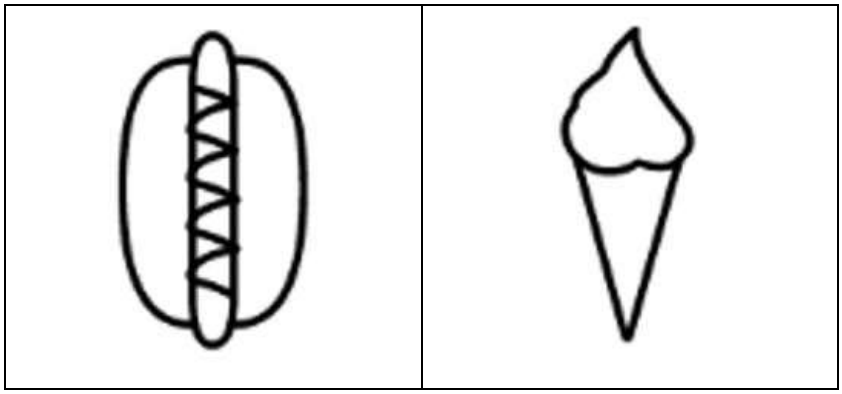

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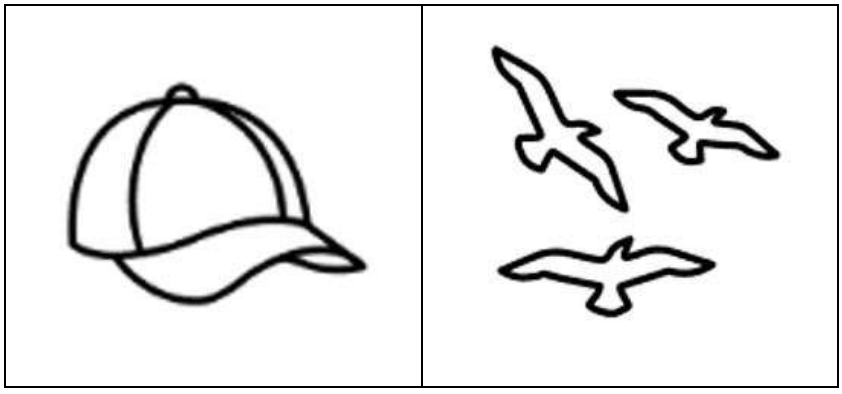

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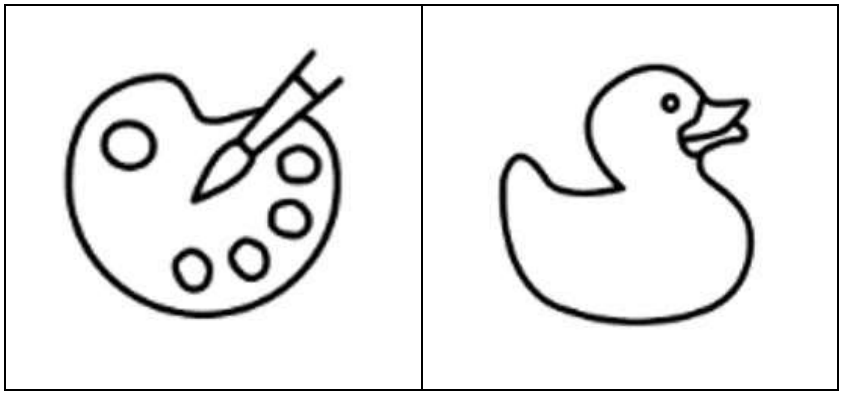

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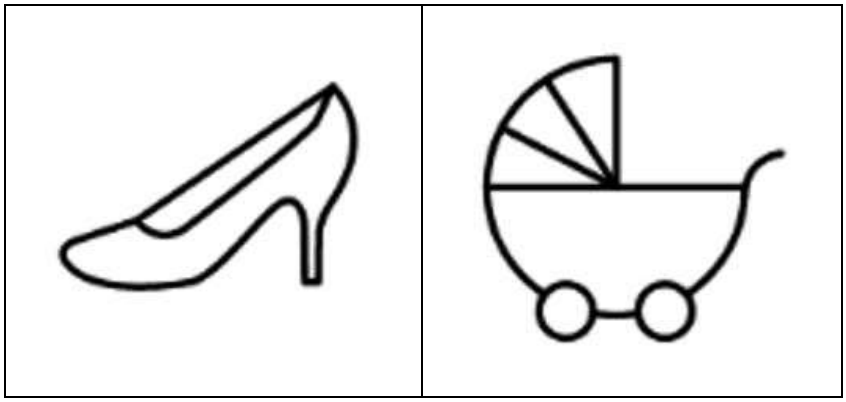

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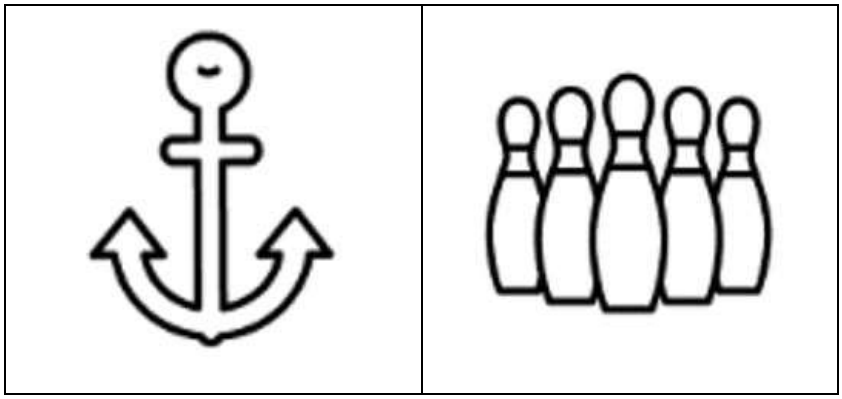

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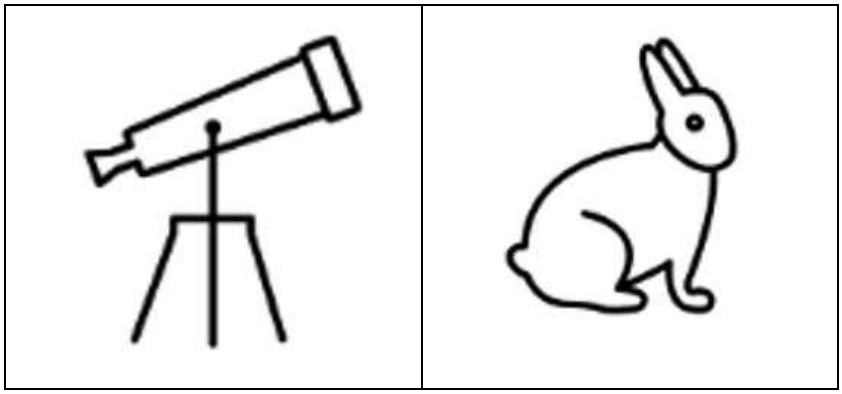

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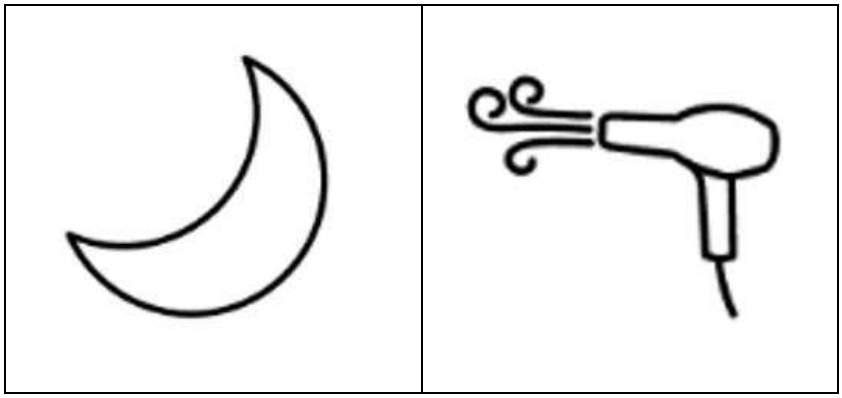

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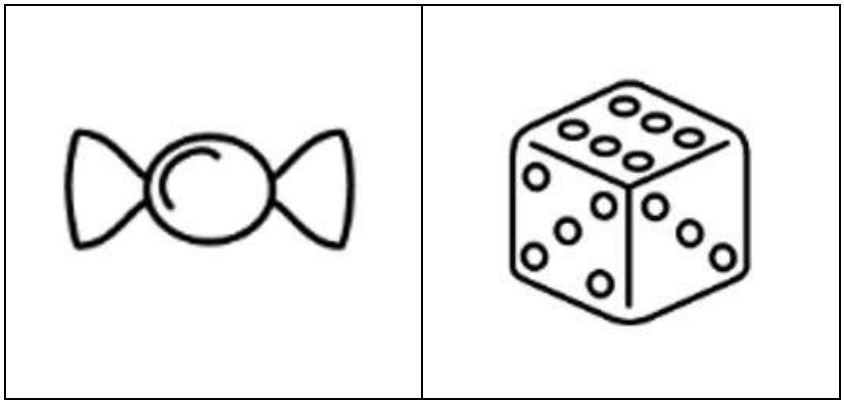

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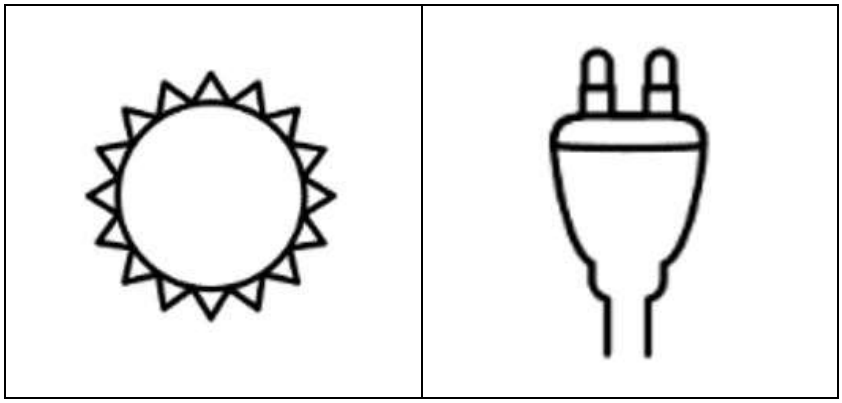

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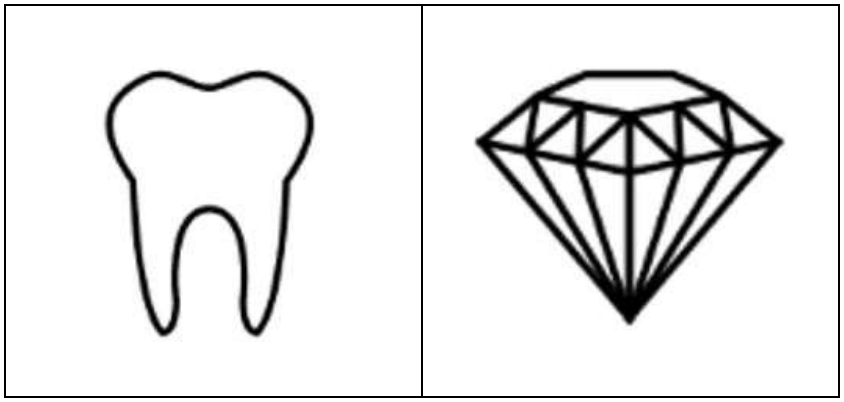

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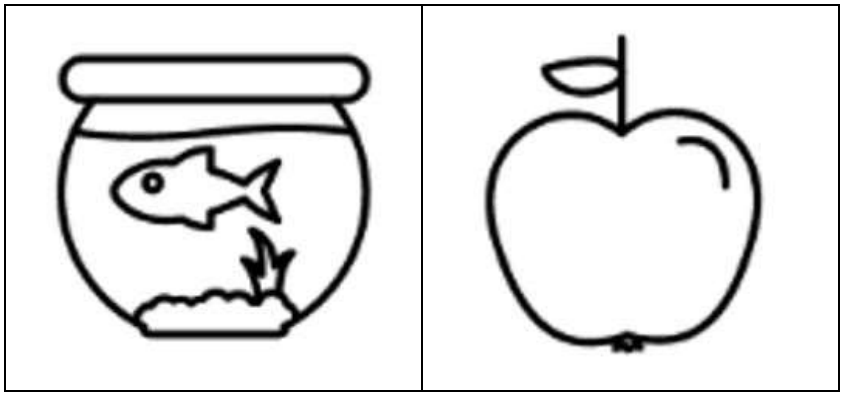

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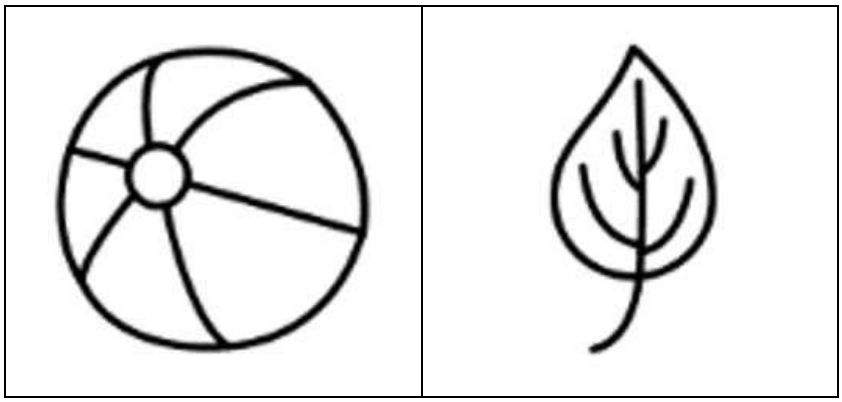

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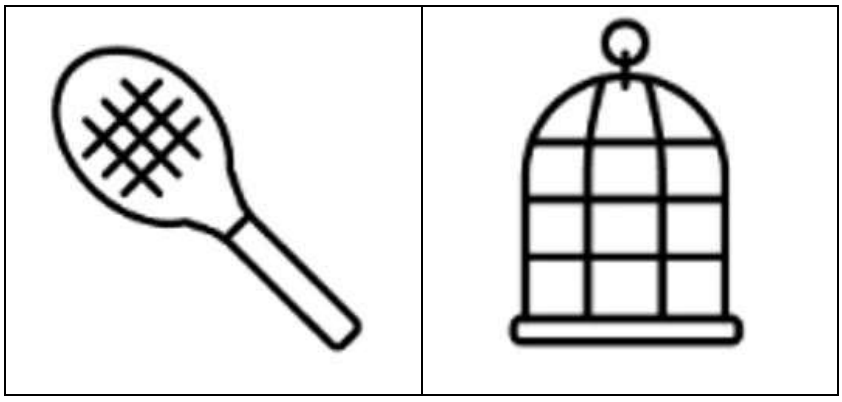

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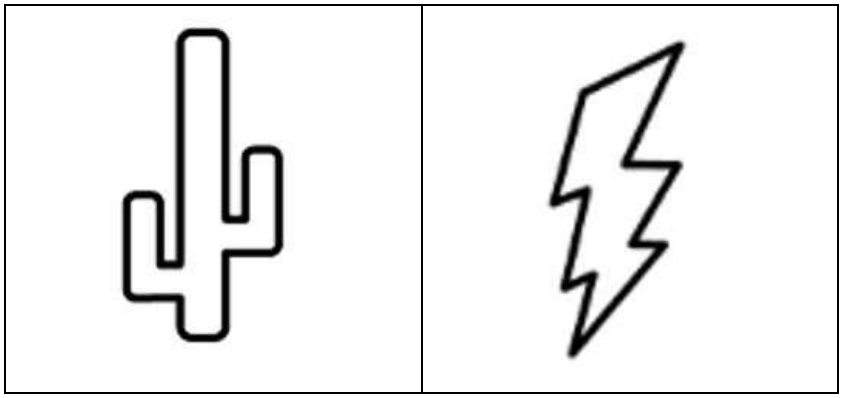

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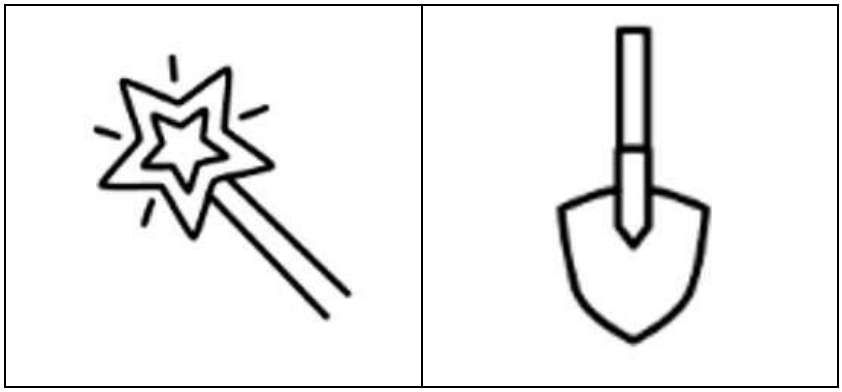

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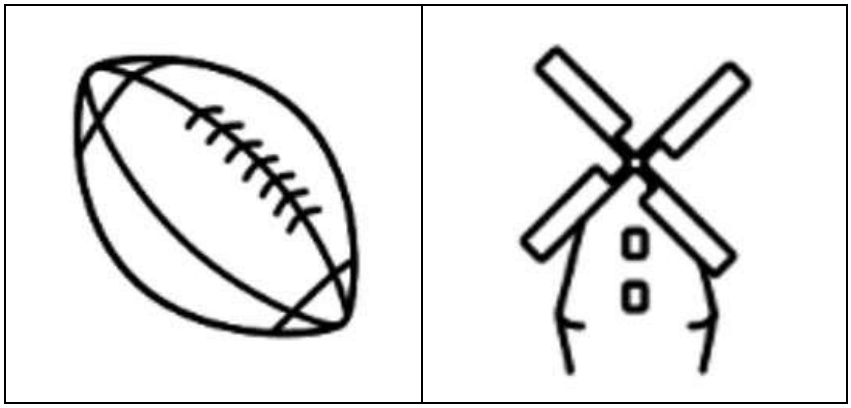

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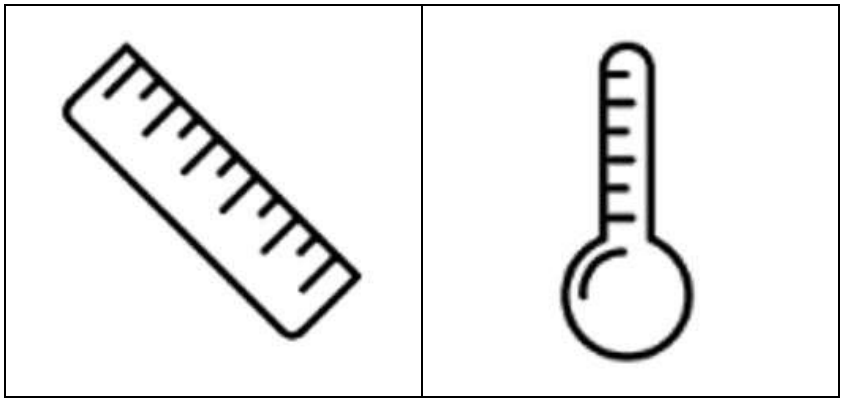

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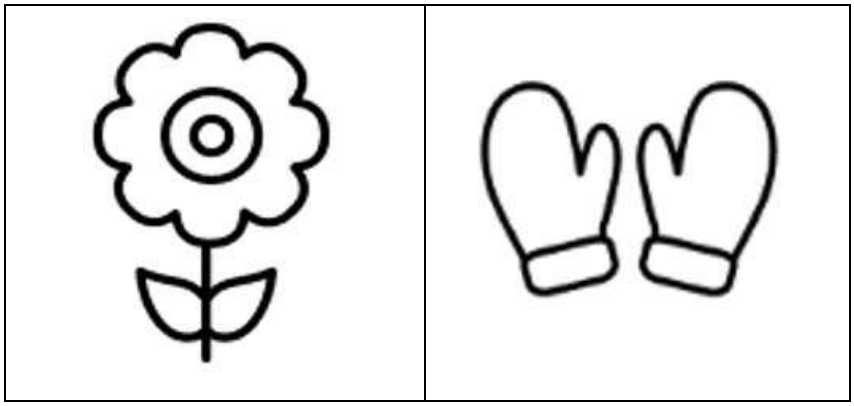

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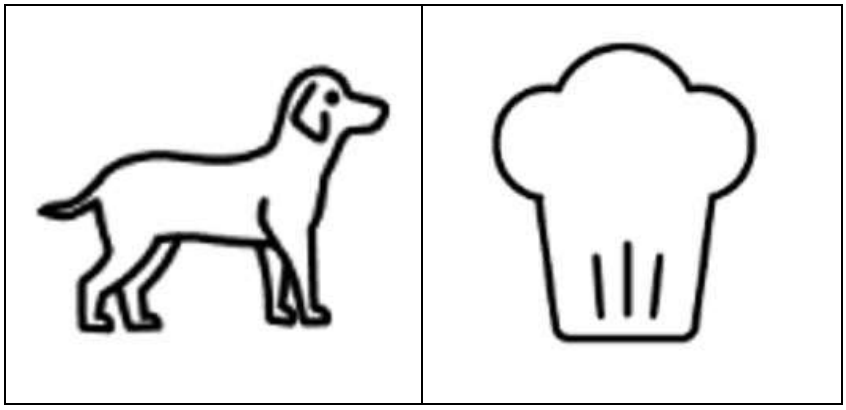

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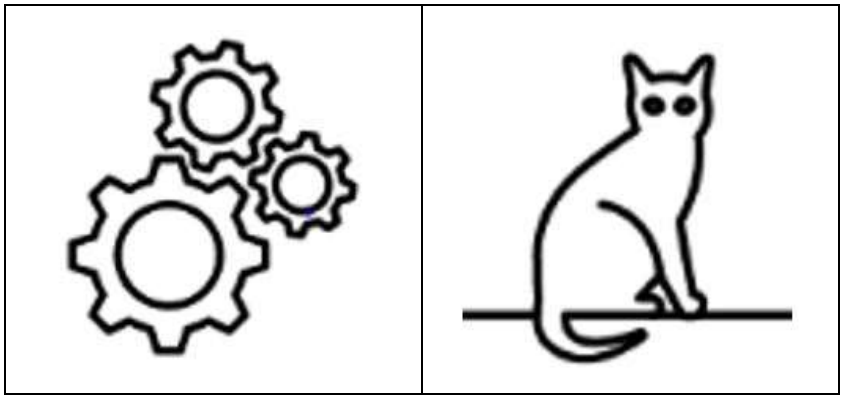

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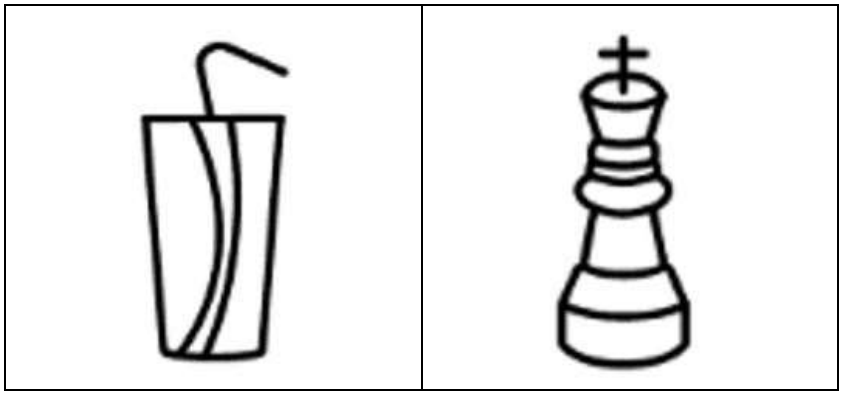

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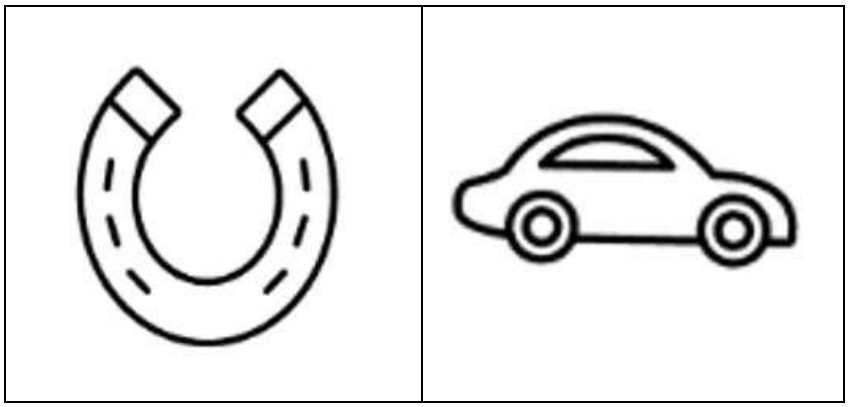

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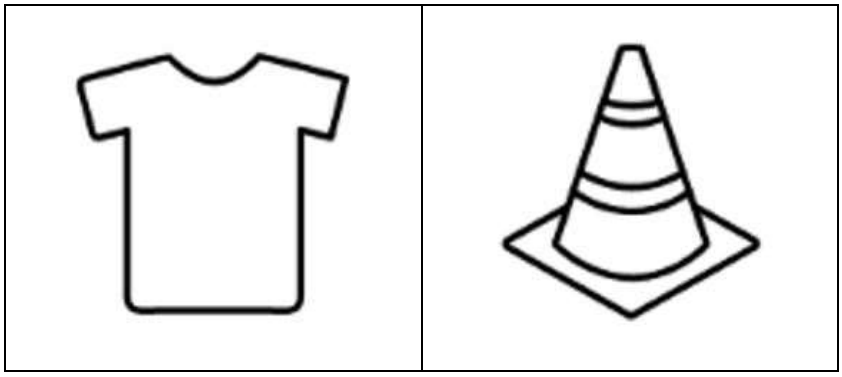

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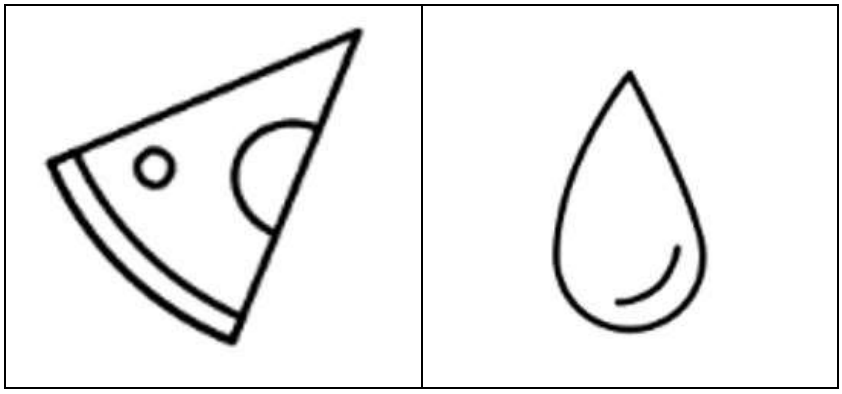

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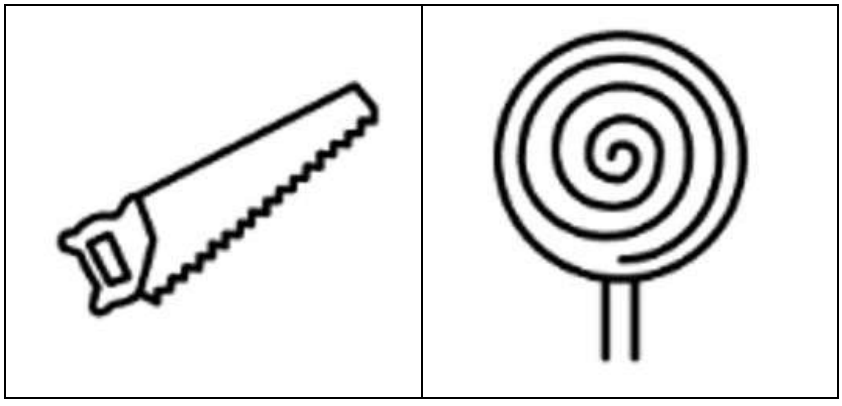

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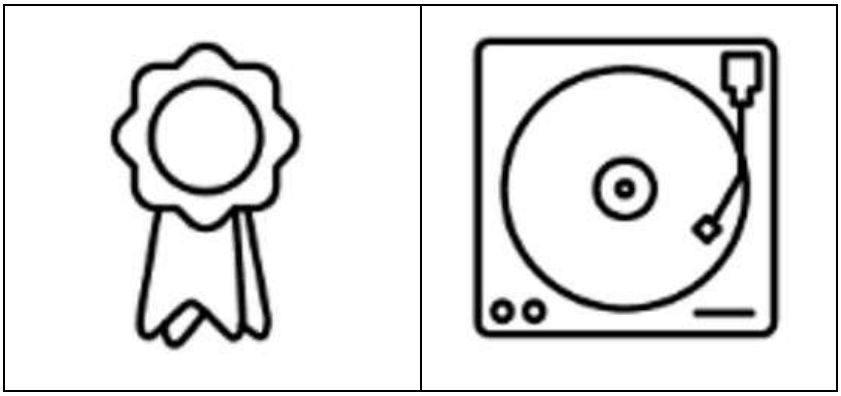

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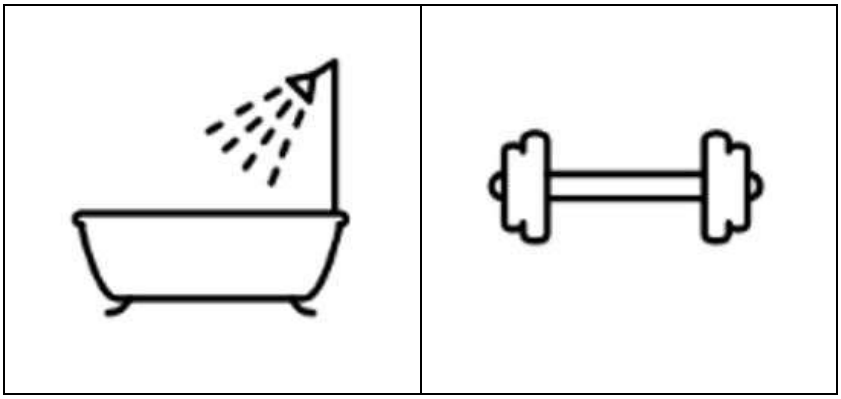

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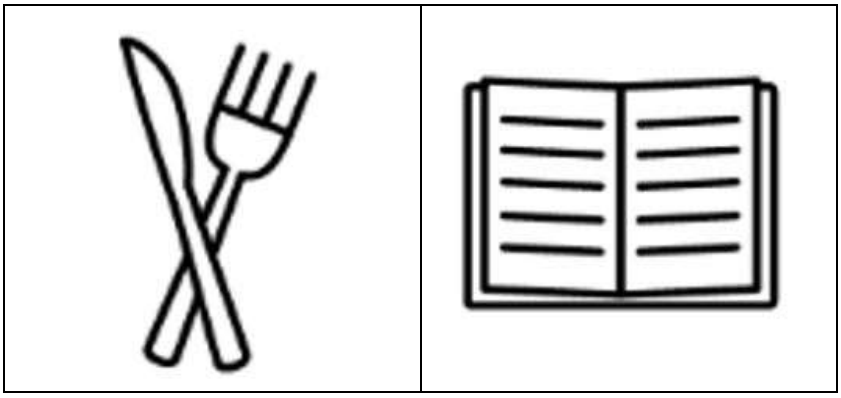

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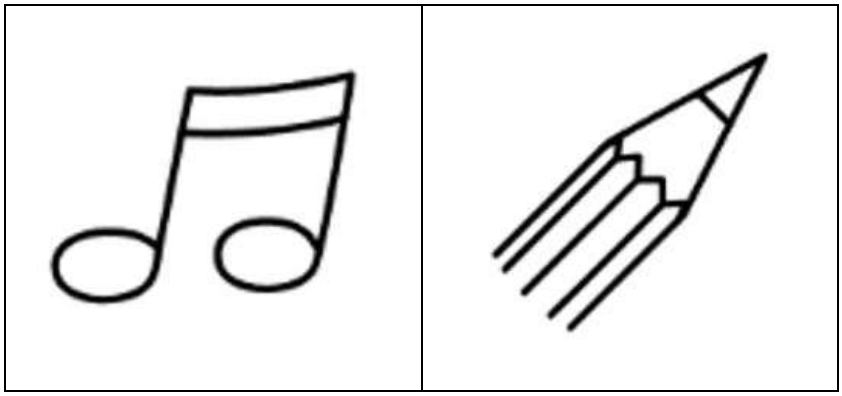

Appendix H

Randomized Feedback Conditions

Ability Feedback	On the Memory for Pictures task, you answered 49 out of 50 trials correctly. You performed in the top 98th percentile compared to other students enrolled in a 4-year university. Previous research indicates that individuals who perform significantly above average on this task also tend to perform significantly above average on measures of memory and general intellect. Please press **Next** to continue.
Effort Feedback	On the Memory for Pictures task, you answered 49 out of 50 trials correctly. You performed in the top 98th percentile compared to other students enrolled in a 4-year university. Previous research indicates that individuals who perform significantly above average on this task also tend to be described as highly focused and persistent students by their teachers. Please press **Next** to continue.
Control	Please press **Next** to continue.

Appendix I

Numerical Series Task

Task II: Numerical Series

This is a test of your ability to identify patterns in a series of numbers. During this task, you will see three sets of number patterns, one at a time. You will be asked to determine which number should come next in the pattern. **You have up to 5 attempts on each item before you must move on. You may click "I give up," presented on the screen at any time.** You are also now permitted to use the scratch paper and pencil available to you to help identify the final number in the patterns. Click **Next** when you are ready.

---*page break*---

Numerical Series 1 of 3

4567, 2368, 3579, ?

Attempt 1 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 1 of 3

4567, 2368, 3579, ?

Attempt 2 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 1 of 3

4567, 2368, 3579, ?

Attempt 3 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 1 of 3

4567, 2368, 3579, ?

Attempt 4 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 1 of 3

4567, 2368, 3579, ?

Attempt 5 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Please click **Next** to move on to the item 2 of 3 in the Numerical Series task.

---*page break*---

Numerical Series 2 of 3

31, 8, 64, 27, ?

Attempt 1 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 2 of 3

31, 8, 64, 27, ?

Attempt 2 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 2 of 3

31, 8, 64, 27, ?

Attempt 3 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 2 of 3

31, 8, 64, 27, ?

Attempt 4 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 2 of 3

31, 8, 64, 27, ?

Attempt 5 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Please click **Next** to move on to the item 3 of 3 in the Numerical Series task.

---*page break*---

Numerical Series 3 of 3

1, 0, 1, 2, 2, 0, 3, ?

Attempt 1 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 3 of 3

1, 0, 1, 2, 2, 0, 3, ?

Attempt 2 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 3 of 3

1, 0, 1, 2, 2, 0, 3, ?

Attempt 3 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 3 of 3

1, 0, 1, 2, 2, 0, 3, ?

Attempt 4 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Would you like to try again?

___ Yes, I would like to try again.

___ No, I give up.

---*page break*---

Numerical Series 3 of 3

1, 0, 1, 2, 2, 0, 3, ?

Attempt 5 of 5: _____

___ I give up. I want to move on to the next item.

---*page break*---

Your answer is incorrect. Please click **Next** to review your results.

---*page break*---

Appendix J

Contrived Feedback on the Numerical Series Task

On the Numerical Series task, you answered 0 out of 3 items correctly. Your performance on this task significantly declined to compared to your previous performance on the Memory for Pictures task. Please click **Next** to continue.

Appendix K

Post-Failure Experience, Mindset, and Attribution Items

Please rate the accuracy of the following statements, from "Completely Disagree" to "Completely Agree."

	Completely Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Completely Agree
The Numerical Series task was challenging for me.					
I would enjoy attempting additional Numerical Series items if given the chance.					
I could be better at Numerical Series with more practice.					
People are either good at Numerical Series or they are not.					

My decline in performance on the Numerical Series task was because…

	Completely Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Completely Agree
I didn't work hard enough.					
I'm not a good problem solver.					
I found the task too challenging.					
I was unlucky in my attempts.					

Are there other reasons that would explain your decline in performance? If so, please describe them below:

_____

Appendix L

Post-Failure Performance- or Mastery-Orientation Selection

Task III: Selecting Additional Information

Below you will see one of two options. You may choose to either view 1) problem-solving strategies that could have helped on the Numerical Series task or 2) information about how other college students generally perform on the Numerical Series task. The optional bonus task involves similar Numerical Series items of lesser difficulty. Please make your selection below.

I would prefer to view…

___ Problem-solving strategies for the Numerical Series task

___ Information about how other EDPY 210 students perform on the Numerical Series task

---page break---

PROBLEM-SOLVING STRATEGIES FOR THE NUMERICAL SERIES TASK

Some numerical series patterns involve identifying relationships between number quantities that change consistently across the entire pattern. For example:

4, 7, 10, 13, **?**

The answer is **16** because you need to add 3 to each number in the series to get 16 as the answer. Patterns could be based on addition, subtraction, multiplication, division, or more advanced mathematical patterns, such as exponents or power.

Some patterns involve relationships between number quantities that involve two numbers at a time as you go across the pattern. For example:

0, 20, 25, 50, 80, **?**

The answer is **135** because you need to combine the first two numbers and add 5 to get your third number in the series. Then, you need to combine the second and third numbers and add 5 to get your fourth number in the series. Next, you need to combine the third and fourth numbers and add 5 to get your fifth number in the series. Finally, you need to combine the fourth and fifth numbers and add five to get 135 as the answer.

Some numerical series patterns have multiple patterns within them. For example:

22, 3, 20, 5, 18, **?**

The answer is **7**. Even and odd numbers are positioned in an even-odd-even-odd pattern. The even numbers are decreasing by 2, while the odd numbers are increasing by 2. The next number is odd, and the previous odd number is 5. Since 5 + 2 = 7, the answer is 7.

In some patterns, it is the relationship between the digits in the numbers and not the quantitative value of the numbers themselves. For example:

4789, 3678, 2567, **?**

The answer is **1456**. Each digit place value decreases by one for each number in the series. Therefore, the correct answer is 1456.

When you are done reviewing these strategies, please click **Next** to continue.

---page break---

RELATIVE PERFORMANCE ON THE NUMERICAL SERIES TASK

Below is a break down of performance on these three Numerical Series items for previous EDPY 210 students, based on former research in previous semesters.

Items Answered Correctly	Percentage of Sample
0	6%
1	19%
2	67%
3	8%

You answered 0 of the 3 items correctly and scored in the bottom 6th percentile on this task, compared to other EDPY 210 students.

Please click **Next** to continue.

Appendix M

Bonus Credit for Additional Problems

Task IV: Bonus Credit for Additional Problems (Optional)

For the last task, you will have the option of attempting another set of problems similar to the Numerical Series task for additional bonus credit beyond the 10 points awarded for participating in this study. However, there is also the potential to lose some credit if you do not answer any problems correctly.

You will see three sets of number patterns, just like last time. In the bonus task, you will select **one of four multiple-choice options** that you think correctly completes the series. If you answer *any* of the three problems correctly, you will be awarded an additional 5 bonus points and receive a total of 15 bonus points. If you answer *all three problems incorrectly*, you will lose 2 bonus points and *only* receive a total of 8 bonus points. **You can not go back to a previous problem once you decide to move on.** You may use scratch paper and pencil available to you to help identify the final number in the patterns.

Please make your selection below:

___ I want to attempt the additional problems to potentially increase the bonus credit I earn.

___ I **do not** want to attempt the additional problems and would like to skip them.

---*page break*---

Are there specific reasons why you don't want to attempt the bonus questions? If so, please describe them below:

_____

---*page break*---

Bonus Numerical Series 1 of 3

10, 1, 9, 2, ?

__ 4 __ 6 __ 8 __ 7 __ 12 __ I give up. I want to attempt the next series.

---*page break*---

Your answer is incorrect or you gave up. Would you like to attempt Bonus Numerical Series 2 of 3?

___ Yes, I would like to attempt the next series.

___ No, I give up. I want to finish this study.

---*page break*---

Bonus Numerical Series 2 of 3

2.6, 3.8, 5, ?

__ 4.6 __ 6.2 __ 6.8 __ 7.4 __ 8 __ I give up. I want to attempt the next series.

---*page break*---

Your answer is incorrect or you gave up. Would you like to attempt Bonus Numerical Series 3 of 3?

___ Yes, I would like to attempt the next series.

___ No, I give up. I want to finish this study.

---*page break*---

Bonus Numerical Series 3 of 3

6934, 5823, 4712, ?

__ 3456 __ 3489 __ 3601 __ 3622 __ 3661 __ I give up. I want to attempt the next series.

---*page break*---

Your answer is incorrect. You either skipped or answered all three bonus items incorrectly, and will lose two bonus points. You will receive a total of eight bonus points for your participation in this study. Please click Next to finish this study.

---*page break*---

You are correct! You will receive an additional five bonus points, for a total of fifteen points for your participation in this study. Please click **Next** to finish the study.

Appendix N

Debriefing Statement and Reconsent Selection

DEBRIEFING STATEMENT

Thank you for participating in our study. We would now like to tell you more about the study.

True Nature of the Study

You were told that this research study intended to examine the relationship between college students' beliefs about intelligence, problem-solving abilities, and decision making when engaging in challenging tasks. In truth, the tasks that you just completed and the feedback you received on your performance were contrived. We were not measuring problem-solving abilities in this study. Rather, this study aims to examine the combined effects of individual's beliefs about intelligence and examiner feedback on persistence during difficult tasks, attributions for failure, deciding what information is most important to review, and deciding whether to attempt additional challenges after failure.

True Nature of the Study Tasks

The first task involving memorizing pictures is an adapted version of an assessment meant to identify malingering behaviors. It is designed to appear challenging, but the majority of adults with typical cognitive abilities perform highly accurately on such memory tasks. Immediately afterward, you received a randomized feedback condition emphasizing participant effort, participant ability, or a statement prompting participants to move on to the next task. This study was also examining how different types of feedback, along with individuals' beliefs above intelligence, affect persistence and decision making when engaging in the task that followed.

The second task involving numerical series is an adapted version of an assessment of non-verbal reasoning. However, for the purposes of this study **numerical series items were intentionally designed to be impossible to solve**. No matter what response you provided, the experimental procedures involved always providing the feedback, "Your answer is incorrect," and asking participates to try again or give up. The purpose of this part of the study was to induce a failure scenario, so we can see how long participants would attempt a difficult task without giving up. We also wanted to see what participants thought was the reason why they could not solve the problems, and to study decision-making after experiencing failure. When asking participants to select either problem-solving strategies or information related to relative performance compared to peers, we wanted to see what type of information is most sought after by college students after experiencing failure. Finally, we also wanted to see if participants would choose to attempt another challenging task with the potential to earn additional credit.

True Nature of Compensation

Because we hypothesize that randomized feedback conditions would influence the likelihood of selecting to attempt the optional bonus credit task, all participants in this research study will get the maximum 15 bonus credit points for participating. **Even if you did not select to attempt the bonus task, or you did not get any of the items correct in the optional task, all participants will receive 15 total bonus points for your participation. There is no true penalty for skipping the bonus task or getting bonus task items incorrect.**

Justification for Deception

This type of deception was done so that we could measure persistence and decision making after experiencing "real" failure. This makes our study valid. We could have asked you to tell us how long you would try on an incredibly challenging problem, or what decisions you would make in a failure scenario. You most likely would have given us an honest guess of what you would do; however, this would still not be a "real" response. Also, what many people think they would do is not what they would really do. Thus, we needed to make you think the situation was real in order to measure real behavior. Again, you were not expected to successfully solve any of the numerical series items, including the items presented in the optional bonus task. Believing that you could have solved these items while completing this study is very normal and expected.

Distress Due to the Present Research Study

Some people may feel distressed when unable to successfully complete tasks presented to them. If you felt, or still feel, any distress because of this study, please tell the experimenter. Some people may still feel distressed because they were deceived. Once again, the deception involved in this study was used in an attempt to determine what behaviors and decisions individuals would really do when experiencing failure.

If you feel that this study has affected you in any of the ways stated above, please talk about this with the experimenter before you leave the office or computer lab. If you do not feel comfortable talking about this with the experimenter, please feel free to contact Dr. Williams, faculty advisor, or any other mental health expert or academic advisor. A list of mental health and academic advising resources will be listed after the completion of this debriefing statement. A physical copy of the debriefing statement and referral list will be handed to you before you leave.

IMPORTANT: Please help us by not talking about this study and its purpose with your friends or peers who may be possible research participants. By talking about the true intent of the study and/or the deception involved to other students, the validity of the study can be compromised. If you would like to discuss any part of the study before data collection is complete, if you want to know more about the results, and/or if you have any questions after leaving the office or computer lab, please feel free to contact Janet Schwartz-Micheaux (jschwa15@vols.utk.edu) or Dr. Williams (bobwilliams@utk.edu).

Please select one option below:

___ I **DO NOT** consent for my research information to be used for the purposes of the study. I understand that my research information will be erased immediately.

___ I **DO** consent for my research information to be used for the purposes of the study.

Signature (Typed Full Name):_____ Date: _____

Appendix O

Referral List

Referral List

In the event you experienced distress during the study and/or experience distress following completion of the study, please refer to available mental health resources below. Additionally, resources for ensuring your best academic success at the University of Tennessee-Knoxville are listed below.

UT Student Counseling Center
The UT Student Counseling Center is located on the second floor of the Student Health Building. The main entrance is at the intersection of Volunteer Boulevard and Pat Head Summitt Street, across from the rock.

Student Counseling Center
1800 Volunteer Blvd.
Knoxville, TN 37996-4250

Hours: Monday – Friday from 8AM-5PM (Closed on university holidays)
Phone: 865-974-2196
Fax: 865-974-7039
Email: counselingcenter@utk.edu

UT Psychological Clinic
The UT Psychological Clinic is located on the second floor of the UT Conference Center.

UT Conference Center Building
600 Henley Street, Suite 208
Knoxville, TN 37902

Hours: Monday – Thursday from 8AM-8PM, Friday from 9AM-12PM
Phone: 865-974-2161
Fax: 865-974-3330

In addition to the above resources, here is a list of supplementary mental health resources.

24 Hour Help Lines (confidential):
The National Suicide Prevention Lifeline: 1-800–273-8255
Family Violence Helpline: 865-521-6336
Sexual Assault Center of East Tennessee (Crisis): 865-522-7273
Domestic Violence Crisis Hotline: 865-637-8000

Helen Ross McNabb Center
The Helen Ross McNabb Center offers a full array of programs for mental health care, addiction and co-occurring treatment, recovery and social services to meet the needs of adults in our community.

Outpatient Services
Outpatient mental health services are provided at clinics located throughout East Tennessee. Services are provided to adults who have a significant impairment in functioning related to a mental health diagnosis. Services include psychosocial assessments, therapy, medication services, and case management. The goal is to improve the client's overall functioning and to help identify any barriers that compromise the client's emotional stability.

Counseling/Therapy
Therapy services are provided at outpatient clinics. Therapy clients demonstrate a need to work out their life problems in a one-on-one relationship with a helping professional. Each therapy session is tailored to the needs of each client.

The Helen Ross McNabb Center
201 W. Springdale Avenue
Knoxville, Tennessee 37917

Phone: 865-637-9711 or 1-800-255-9711

UT Student Success Center
Student Success Center
821 Volunteer Blvd (Greve Hall), Room 324
Knoxville, TN 37996

Hours: Monday from 8:30 AM – 6:30 PM, Tuesday – Frida from 8:30 AM – 4:30 PM (Closed on university holidays)

Phone: 865-974-6641
Fax: 865-974-8285
Email: studentsuccess@utk.edu

Appendix P

Post-Study Distress, Overall Experience, and Perception of Deception Items

Please answer the following questions by selecting the option that is most true for you. If you are currently distressed, please inform the experimenter.

	Not at All	Slightly	Quite a Bit	Extremely
While completing this study, I felt distressed due to the difficulty of the tasks.				
While completing the study, I felt distressed due to my inability to solve the difficult numerical series items.				
After the study was over and I read the debriefing statement, I felt distressed knowing that this study used deception.				
I understand why participants are not told the true intent of the study until the end.				
After reviewing the debriefing statement and referral list, I am leaving this experiment distressed.				

Please answer the following questions by selecting the option that is most true for you.

	Not at All	Slightly	Quite a Bit	Extremely
I enjoyed participating in this study.				
This study challenged me.				
This study made me reflect on my response to failure.				
Overall, I had a good experience participating in this study.				

Please answer the following question by selecting the option that is most true for you.

	Not at All	Slightly	Quite a Bit	Extremely
Before being debriefed, I had a sense that deception was involved in this study.				

Appendix Q

Results Tables

Table Q1

Sample Sizes of Performance Feedback Conditions

Performance Feedback Conditions	Sample Size
Ability	17
Effort	29
Control	28
Total (N)	74

Table Q2

Mean Number of Attempts Across Numerical Series (Induced Failure) Task Trials

	Mean	Standard Deviation	Minimum	Maximum
Trial 1	1.38	1.21	0	5
Trial 2	0.53	1.32	0	5
Trial 3	1.46	2.04	0	5
Total Attempts	7.07	3.70	0	15

Table Q3

Mean Likert-Scale Item Responses on Perceived Task Challenge, Enjoyment, Induced Growth Mindset, and Induced Fixed Mindset

Item	Mean	Standard Deviation	Min	Max
The Numerical Series Task was challenging for me.	4.99	0.12	4	5
I would enjoy attempting additional Numerical Series items if given the chance.	2.08	1.24	1	5
I could be better at Numerical Series with more practice.	3.78	1.01	1	5
People are either good at Numerical Series or they are not.	3.26	1.02	1	5

Note: Response options ranged from "1" (Completely disagree) to "5" (Completely Agree).

Table Q4

Correlations between Growth Mindset Scale, Challenge Rating, Enjoyment Rating, and Induced Mindset Following Numerical Series (Induced Failure) Task

	Mindset	Challenge Rating	Enjoyment Rating	Induced Growth Mindset	Induced Fixed Mindset
Mindset	1	-0.097	-0.184	-0.249*	0.430**
Challenge Rating	-0.097	1	0.103	-0.025	0.030
Enjoyment Rating	-0.184	0.103	1	0.365**	-0.266*
Induced Growth Mindset	-0.249*	-0.025	0.365**	1	-0.410**
Induced Fixed Mindset	0.430**	0.030	-0.266*	-0.410**	1

**$p < 0.01$
*$p < 0.05$

Table Q5

Mean Likert-Scale Item Responses for Failure Attributions

Item	Mean	Standard Deviation	Min	Max
I didn't work hard enough.	2.82	1.22	1	5
I'm not a good problem solver.	2.64	1.21	1	5
I found the task too challenging.	3.84	0.86	2	5
I was unlucky in my attempts.	2.70	1.11	1	5

Note: Response options ranged from "1" (Completely disagree) to "5" (Completely Agree).

Table Q6

Mean Likert-Scale Item Responses for Distress Scale

Distress Scale Items	Mean	Standard Deviation	Min	Max
While completing this study, I felt distressed due to the difficulty of the tasks.	1.73	0.63	1	4
While completing the study, I felt distressed due to my inability to solve the difficult Numerical Series Items.	2.32	0.92	1	4
After the study was over and I read the debriefing statement, I felt distressed knowing this study used deception.	1.20	0.52	1	4
I understand why participants are not told the true intent of the study until the end.*	1.74	0.90	1	4
After reviewing the debriefing statement and referral list, I am leaving this experiment distressed.	1.14	0.48	1	3

*Reverse-coded item

Note: Response options ranged from "1" (Not at All) to "4" (Extremely).

Table Q7

Mean Likert-Scale Item Responses for Participant Experience Scale

Participant Experience Scale Items	Mean	Standard Deviation	Min	Max
I enjoyed participating in the study.	2.92	0.72	1	4
This study challenged me.	3.05	0.55	2	4
This study made me reflect on my response to failure.	2.99	0.80	1	4
Overall, I had a good experience participating in this study.	3.32	0.64	2	4

Note: Response options ranged from "1" (Not at All) to "4" (Extremely).

Table Q8

Bivariate Pearson Correlation Between Mindset and Total Number of Attempts on Numerical Series (Induced Failure) Task

	r	Sig.
Mindset*Total Attempts	0.13	0.26

Table Q9

One-way ANOVA Comparing Mean Number of Numerical Series Attempts Made for Each Performance Feedback Condition

Feedback Condition	Mean	Standard Deviation
Ability	7.29	4.06
Effort	6.59	3.50
Control	7.43	3.77

	F	Sig.
Number of Attempts-Feedback	0.40	0.67

Table Q10

Linear Regression of Mindset and Performance Feedback Predicting Total Attempts Made on Numerical Series Task

	F	Sig.
Mindset*Feedback-Number of Attempts	0.70	0.56

Table Q11

Bivariate Pearson Correlations between Growth Mindset Scale and Attributions For Failure Following Numerical Series (Induced Failure) Task

	Mindset	Ability Attribution	Effort Attribution	Task Difficulty Attribution	Luck Attribution
Mindset	1	-0.144	0.138	-0.011	0.130
Effort Attribution	-0.144	1	0.021	-0.249*	0.042
Ability Attribution	-0.138	0.021	1	0.166	-0.092
Task Difficulty Attribution	-0.011	-0.249**	0.166	1	-0.109
Luck Attribution	0.130	0.042	-0.092	-0.109	1

**$p < 0.01$

Table Q12

One-way MANOVA Comparing Attributions for Failure for Each Performance Feedback Condition

Ability Feedback Condition	Mean	Standard Deviation
Effort Attribution	2.76	1.15
Ability Attribution	2.41	1.00
Task Difficulty Attribution	3.71	0.85
Luck Attribution	2.76	1.09

Effort Feedback Condition	Mean	Standard Deviation
Effort Attribution	2.83	1.20
Ability Attribution	2.76	1.12
Task Difficulty Attribution	3.66	0.90
Luck Attribution	2.76	0.99

Control Feedback Condition	Mean	Standard Deviation
Effort Attribution	2.86	1.33
Ability Attribution	2.64	1.42
Task Difficulty Attribution	4.11	0.79
Luck Attribution	2.61	1.26

Multivariate Test	*F*	Sig.
Wilk's Λ	.77	.63

	F	Sig.
Ability Attribution-Feedback	0.43	0.65
Effort Attribution-Feedback	0.03	0.97
Task Difficulty Attribution-Feedback	2.30	0.11
Luck Attribution-Feedback	0.16	0.85

Table Q13

One-way ANOVA Comparing Goal-Orientation Selection Based on Mindset

Goal Orientation Selection	N	GMS Mean	Standard Deviation	Min GMS	Max GMS
Problem Solving Strategies	40	2.57	0.85	1.00	4.33
Relative-Performance Information	34	3.21	1.02	1.00	5.00

	F	Sig.
Mindset-Goal-Orientation Selection	8.71	0.004

Table Q14

Pearson Chi-Square Test of Independence for Performance Feedback and Goal Orientation Selection

	Performance Feedback			
Goal Orientation Selection	Ability	Effort	Control	Total
Problem Solving Strategies	10	14	16	40
Relative-Performance Information	7	15	12	34
Total	17	29	28	74

	X^2	Sig.
Feedback-Goal-Orientation Selection	0.65	0.72

Table Q15

One-way ANOVA Comparing Risk-Aversion Task Decision Making Based on Mindset

Bonus Task Selection	N	GMS Mean	Standard Deviation	Min GMS	Max GMS
Attempt Bonus Task	52	2.75	0.93	1.00	4.33
Do Not Attempt Bonus Task	22	3.12	1.05	1.00	5.00

	F	Sig.
Mindset-Bonus Task Decision Making	2.28	0.14

Table Q16

Pearson Chi-Square Test of Independence for Performance Feedback and Risk-Aversion Task Decision Making

	Performance Feedback			
Bonus Task Selection	Ability	Effort	Control	Total
Attempt Bonus Task	12	19	21	52
Do Not Attempt Bonus Task	5	10	7	22
Total	17	29	28	74

	X^2	Sig.
Feedback-Goal-Orientation Selection	0.61	0.74

Table Q17

Descriptive Frequencies for Time in Minutes Spent on Part II Across Feedback Conditions

Feedback Condition	Mean	Median	Standard Deviation	Min.	Max.
Ability	21.48	21.43	6.65	9.17	33.07
Effort	19.24	16.72	7.45	10.93	42.52
Control	17.31	15.35	4.97	12.83	28.95

Table Q18

Exploratory Bivariate Pearson Correlation Between Mindset and Total Time in Minutes Spent on Part II of the Study

	r	Sig.
Mindset*Time in Minutes	-0.03	0.81

Table Q19

Exploratory Bivariate Spearman's Rho Correlation Between Mindset and Total Time in Minutes Spent on Part II of the Study

	r_s	Sig.
Mindset*Time in Minutes	-0.17	0.14

Table Q20

Exploratory One-way ANOVA Comparing Total Time Spent in Minutes on Part II Based on Feedback Conditions

Feedback Condition	Mean	Standard Deviation
Ability	21.48	6.65
Effort	19.24	7.45
Control	17.31	4.97

	F	Sig.
Total Time Spent-Feedback	2.26	0.11

Table Q21

Exploratory Kruskal-Wallis Chi Square Test Comparing Rank Order Total Time Spent in Minutes on Part II Based on Feedback Conditions

Feedback Condition	Mean Ranking
Ability	46.88
Effort	37.41
Control	31.89

	X^2	Sig.
Total Time Spent-Feedback	5.14	0.08

Table Q22

Exploratory One-way ANOVA Comparing Rank Order Total Time Spent in Minutes on Part II Based on Feedback Conditions

Feedback Condition	Mean Ranking	Standard Deviation
Ability	46.88	21.70
Effort	37.41	22.18
Control	31.89	19.31

	F	Sig.
Total Time Spent-Feedback	2.69	0.08

Table Q23

Exploratory Linear Regression of Mindset and Performance Feedback Predicting Total Rank Time Spent in Minutes on Part II of the Study

	F	Sig.
Mindset*Feedback-Total Time	2.71	0.051

Table Q24

Exploratory Chi-square Test of Independence for Goal Orientation and Risk-Aversion Task Decision Making

	Risk-Aversion Selection		
Goal-Orientation Selection	Attempt Bonus	Do Not Attempt Bonus	Total
Problem Solving Strategies	35	5	40
Relative Performance Information	17	17	34
Total	52	22	74

	X^2	Sig.
Goal Orientation-Bonus Task	12.37	< 0.001

Vita

Janet Elaine Schwartz-Micheaux was born in Mt. Vernon, New York. She spent most of her childhood and adolescence in Carmel, New York. Janet earned her B.A. in Psychology and Kinesiology at Rice University in May 2015. She spent one year working full time as a research assistant at Baylor College of Medicine in Houston, Texas after her undergraduate studies before beginning the University of Tennessee's School Psychology Ph.D. Program. In December 2018, Janet earned an M.S. in Applied Educational Psychology. Janet will earn her Ph.D. in August 2021 upon completion of a year-long pre-doctoral internship with the Munroe-Meyer Institute through the Nebraska Internship Consortium in Professional Psychology.