

Running head: GROUP CONTINGENCIES FOR COLLEGE STUDENTS

Comparing Independent and Interdependent Group Contingencies with  
Non-contingent Reinforcement on College Students' Academic Performance

by

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*This body of work is dedicated to my father, mother, and younger brother.*

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### Abstract

Effective teaching approaches are essential to students' learning outcomes and overall academic experiences. Low academic achievement (e.g., low homework or test scores) may lead an instructor to seek alternative approaches to strengthening students' acquisition of academic material. Group contingencies have been identified as effective behavioral interventions for strengthening students' academic performance within a classroom setting. The present study was conducted to examine the effectiveness of independent and interdependent group contingencies compared with non-contingent reinforcement (NCR) when used as behavioral interventions for college students' academic performance. Using a 3 x 3 factorial design, three randomly-assigned experimental groups of participants were simultaneously presented with counterbalanced orders of an independent group contingency, an interdependent group contingency, and an NCR condition in a contrived classroom setting. Subjective evaluation assessments measured participants' experiences with and preferences of the three types of reinforcement conditions. Post-tests and retention tests were used to measure participants' acquisition of academic material and retention effects of each reinforcement condition, respectively. Amongst the three types of reinforcement conditions, the majority of participants reported that their most preferred requirements for winning the \$5.00 cash reward (reinforcer) were those of the independent group contingency. No significant differences were found between participants' mean post-test and retention test scores for each reinforcement condition. However, possible significant differences between reinforcement conditions were revealed with participants' mean post-test scores in that the *p*-value for the analysis of variance conducted with this data approached statistical significance.

*Keywords: group contingencies, independent group contingency, interdependent group contingency, non-contingent reinforcement, academic performance, college students*

Comparing Independent and Interdependent Group Contingencies with Noncontingent Reinforcement on College Students' Academic Performance

It is essential to identify effective teaching methods that strengthen students' acquisition of academic material, while providing a positive learning experience. The decision to utilize one teaching approach over another may be impacted by a range of observable behaviors within the classroom setting, such as disruptive behaviors (Gresham & Gresham, 1982; Theodore, Bray, & Kehle, 2004), a lack of on-task behaviors (Heering & Wilder, 2006), low quiz and test scores (Popkin & Skinner, 2003), or low scores on homework assignments (Lynch, Theodore, Bray & Kehle, 2009; Reinhardt, Theodore, Bray, & Kehle, 2009). An instructor may enhance his/her students' current academic performance or reduce undesirable student behaviors that may interfere with students' ability to achieve optimal learning outcomes by using empirically-supported approaches to teaching and classroom management.

Instructional approaches based on various principles of applied behavior analysis may be used to facilitate changes in student behaviors in the classroom. Such teaching methods may include the implementation of a contingency intervention to increase the occurrence of (a) desirable behavior(s) or decrease the occurrence of (an) undesirable behavior(s). A contingency is an interrelationship between an antecedent, behavior, and consequence (Skinner, 1969, p. 7). Specifically, it is a circumstance under which the delivery of a specific reinforcing consequence is dependent upon the occurrence of a certain response. Contingency interventions oftentimes involve the use of positive reinforcement to increase the likelihood of future behavior occurrence or absence in similar situations. That is, a consequence in the form of a positive reinforcer follows the occurrence of a target behavior or absence of a problem behavior (or any other behavior) to strengthen the desired response (Cooper, Heron, & Heward, 2007). When

implemented as an intervention, a target individual is verbally informed that he/she must or must not engage in an identified target behavior for a specific consequence to occur.

Contingency interventions may be administered as an individual or group contingency (see Table 1). When implemented in a classroom setting, an individual contingency intervention may be applied to one or more target student(s) who struggle to meet classroom expectations (Turco & Elliott, 1990). This approach requires an instructor to develop and implement a personalized contingency intervention for each target student. Specifically, instructors must 1) identify target behaviors to be modified or replaced, 2) determine specific goals to be met, 3) set criteria to be met during the intervention, 4) deliver consequences upon the occurrence or absence of target behaviors, 5) record the occurrence or absence of the behavior, and 6) evaluate the effectiveness of the program and facilitate generalization of learned behaviors to other settings. When used with a large number of students, this type of contingency intervention may be time consuming, not economically feasible, and may create additional work for the instructor when designing and implementing the intervention (Skinner, Cashwell, & Dunn, 1996). It is possible to implement an individual contingency intervention for specific students who are engaging in problem behaviors or demonstrating difficulties with achieving high levels of academic performance. However, providing select students with the opportunity to receive reinforcement may be viewed as unfair in that not all students are receiving reinforcement for engaging in desirable behaviors or performing at a desired level (Turco & Elliott, 1990).

A more manageable approach to changing the behaviors of multiple students than an individual contingency intervention may be to use a group contingency intervention. When using a group contingency, a common preferred consequence (e.g., free time for students; Reinhardt et al., 2009) is available to all group members and is provided based on the occurrence

of target behaviors engaged in by one, some, or all members of the group (Cooper et al., 2007). Group contingencies are categorized into three different types: independent, interdependent, and dependent. An *independent group contingency* is when an entire group is presented with an opportunity to receive positive reinforcement by meeting a specific contingency criterion and only those who meet the criterion receive a positive reinforcer (Cooper et al., 2007). This type of group contingency has been shown to effectively increase the homework completion of fifth grade students with intellectual disabilities in a classroom setting (Lynch et al, 2009), improve the spelling performance of sixth grade students (Shapiro & Goldberg, 1986), reduce the disruptive behaviors of adolescent students in a classroom setting (Theodore et al., 2004), and reduce the inappropriate behaviors of adults with developmental disabilities living in a secure residential facility (Sloman, Reyes, & Vollmer, 2014). An *interdependent group contingency* is when an entire group is presented with an opportunity to receive positive reinforcement and all members of the group must meet a specific contingency criterion for anyone to receive reinforcement (Cooper et al., 2007). Successful fulfillment of the contingency criterion by all group members results in a positive reinforcer provided to everyone in the group. Failure to meet the contingency criterion by a minimum of one group member results in no positive reinforcer given to any members of the group. Interdependent group contingency interventions have been shown to effectively change a range of behaviors when implemented with a variety of populations in different treatment settings, including: decreasing the disruptive behaviors of elementary school-aged and adolescent students in a classroom setting (Gresham & Gresham, 1982; Theodore et al., 2004), improving the academic performance of fourth and fifth grade and middle school-aged students (Reinhardt et al., 2009; Lynch et al., 2009; Popkin & Skinner, 2003), improving the spelling performance of sixth grade students (Shapiro & Goldberg, 1986),

increasing third grade students' physical activity (Kuhl, Rudrud, Witts, & Schulze, 2015), and reducing noise levels of adult participants who attended a drug abstinence program in a therapeutic workplace (Ring, Sigurdsson, & Eubanks, 2014). A *dependent group contingency* is when an entire group is presented with an opportunity to receive positive reinforcement and is given a positive reinforcer if one person or a subgroup within the entire group meets a specific contingency criterion. With this type of contingency, reinforcement is dependent on one or a few target individuals' behaviors. If the target individual(s) meet(s) the specific criterion, everyone receives reinforcement. If the target individual(s) do(es) not meet the specific criterion, no one in the entire group receives reinforcement (Cooper et al., 2007). The dependent group contingency has been shown to be effective in reducing disruptive behaviors of elementary school-aged and adolescent students (Gresham & Gresham, 1982; Theodore et al., 2004), improving verbal interactions of middle school-aged students (specifically, increasing positive verbal interactions and decreasing negative verbal interactions; Hansen & Lignugaris-Kraft, 2005), increasing on-task behavior of third and fourth grade students (Heering & Wilder, 2006), increasing the homework completion of fifth grade students (Lynch et al., 2009), and improving the spelling performance of sixth grade students (Shapiro & Goldberg, 1986). However, it is possible that this type of group contingency may increase the undesirable behaviors of group members if the target individual(s) fulfill(s) the specific contingency criterion and the non-target individual(s) do(es) not. Thus, the dependent group contingency has been omitted from the present study on group contingencies because it may inadvertently negatively affect students who do not successfully fulfill a specific contingency criterion.

When selecting a group contingency to use within a classroom, it is advantageous for an instructor to consider empirical support for both the intervention's effectiveness in changing

behavior and students' experiences during the intervention. However, previous research studies that have compared the effectiveness of the three types of group contingencies in changing undesirable student behaviors have shown conflicting results. Gresham and Gresham (1982) used an ABCDABCD reversal replication research design to evaluate the effectiveness of each of the three types of group contingencies when used in a classroom setting to decrease the disruptive behaviors of elementary school-aged children with intellectual disabilities. Both the interdependent and dependent group contingencies effectively reduced participants' number of disruptive behaviors, with the interdependent group contingency being most effective. Participants' number of disruptive behaviors during the independent group contingency conditions was not significantly different from that of baseline. However, these findings may inaccurately reflect the effectiveness of each group contingency intervention due to poor experimental control across conditions. During the interdependent and dependent group contingency conditions, students were split into two teams and provided visual feedback on the classroom chalkboard regarding the number of disruptive behaviors of each team (for interdependent) and team captain (for dependent). This visual feedback was not available to students during independent group contingency conditions. Rather, the number of disruptive behaviors for each student was recorded by the teacher on a sheet of paper that the students did not see. This discrepancy in visual feedback across conditions may be a potential confound, thus limiting the interpretation of the effectiveness of each of the group contingency interventions. In addition, the use of an ABCDABCD reversal replication research design presents the possibility of order effects as a potential confound, which may have ultimately influenced the effectiveness of each of the group contingency conditions.

Although the research conducted by Gresham and Gresham (1982) supported the effectiveness of only the interdependent and dependent group contingencies and not the independent group contingency, a study conducted by Theodore et al. (2004) demonstrated different effects. Using an alternating treatment design (ATD), Theodore et al. (2004) examined the effectiveness of each of the three types of group contingencies when used in a classroom setting to reduce the disruptive behaviors of adolescent male students diagnosed with Serious Emotional Disturbance (SED). This study also included the use of randomized positive reinforcers to increase the likelihood of delivering a more potent reinforcer by surprising participants with a reinforcer that remained unknown until successful fulfillment of a contingency criterion. Student participants generated ideas for reinforcers (e.g., candy bars and a late to class pass) that were randomly selected by the teacher at the end of each treatment condition when a specific group contingency was met. Results revealed that compared to baseline, all three types of group contingencies effectively reduced participants' disruptive behaviors and no contingency intervention was shown to be more effective than another. The effectiveness of the independent group contingency in Theodore et al.'s (2004) study contradicts the findings of Gresham and Gresham (1982). While little change occurred in participants' behaviors when exposed to the independent group contingency in Gresham and Gresham (1982), Theodore et al. (2004) demonstrated this group contingency as being equally effective as the two superior contingencies in Gresham and Gresham (1982). However, it is possible that differences in the methodological procedures between these two studies may account for the discrepancy in these findings (e.g., the studies used two different populations of individuals to examine the effectiveness of the group contingencies and Theodore et al. (2004) included randomized reinforcers which may have increased the magnitude of reinforcement for each of the three types

of group contingencies). Additionally, participants in Theodore et al. (2004) were not provided any visual feedback regarding the occurrence of disruptive behaviors during any of the three types of group contingency conditions (all of which were found to be effective in reducing disruptive behaviors compared to baseline). Conversely, the participants in Gresham and Gresham's (1982) study were provided visual feedback only during interdependent and dependent group contingency conditions (which were the only group contingencies found to be effective in reducing disruptive behaviors). While this suggests that visual feedback may not be necessary for a group contingency intervention to be effective and that feedback should be kept constant across experimental conditions, the cause of the differences in the outcomes of both studies is unclear in that there are many inconsistencies between the experimental procedures.

Similar empirical outcomes were also demonstrated in a study by Shapiro and Goldberg (1986), in which an ATD was implemented to evaluate the effectiveness of independent, interdependent, and dependent group contingencies when used to improve the spelling performance of sixth grade students. Specifically, all three types of group contingencies were found to be equally effective in increasing students' percentage of correctly spelled vocabulary words on daily spelling tests from their baseline levels of spelling performance. It is important to note that the independent group contingency was initially shown to be more effective in changing students' spelling performance than the interdependent and dependent group contingencies. However, this greater level of effectiveness of the independent group contingency decreased over time, thus revealing equal levels of effectiveness between the three types of group contingencies. It is possible that these findings may have been influenced by the magnitude of the reinforcer used in this study. Specifically, participants were given the same positive reinforcer (five token economy points) for meeting the contingency criterion during all

experimental conditions throughout the entire course of the study. It is possible that the magnitude of this reinforcer may have declined over time due to satiation effects, which may have negatively impacted participants' motivation levels to achieve their highest level of spelling performance during the independent group contingency conditions. This may have ultimately reduced the effectiveness of the independent group contingency, leading to it be as equally effective as the interdependent and dependent group contingency conditions. It is possible that the inclusion of randomized reinforcers may have demonstrated different results in that participants may have been more motivated to work towards earning an unknown reward, particularly during a condition in which there is a lack of social pressure to achieve high levels of academic performance (as is seen in the independent group contingency).

Further comparative research on group contingencies was conducted by Lynch et al. (2009) in which an ATD was used to examine potential differences in the effectiveness of independent, interdependent, and dependent group contingencies as behavioral interventions for improving the homework completion and accuracy of six fifth grade students with intellectual disabilities in a self-contained classroom. Similarly, to Theodore et al. (2004), this study also included randomized reinforcers to increase the chances of delivering a positive reinforcer of a strong magnitude. The results of this study showed that each of the three group contingencies was effective in improving students' homework completion and accuracy. However, while all three types of group contingencies were determined to be equally effective for improving homework completion, the interdependent group contingency was slightly more effective than the independent and dependent group contingencies for improving students' accuracy of homework assignments. Thus, this study supported both the findings of both Gresham and Gresham (1982) which demonstrated the superior effects of an interdependent group

contingency, as well as Theodore et al. (2004) and Shapiro and Goldberg (1986), which showed each of the three types of group contingencies to be equally effective in changing students' behavior. It is possible that the effectiveness of each of these three group contingencies may have been affected by instances of delayed reinforcement throughout the course of the study. Specifically, reinforcers were not consistently randomly selected and delivered immediately following the grading of homework assignments in the morning and were sometimes randomly selected at varying times later in the school day. This delayed reinforcement may have diminished the effectiveness of the group contingency interventions in that as time between the occurrence of a target behavior and reinforcement increases, the effectiveness of the reinforcer decreases, and other behaviors may also be inadvertently reinforced (Cooper et al., 2007). Differences in the frequency of delayed reinforcement between the group contingency conditions may have impacted the effectiveness of the interventions (e.g., fewer instances of delayed reinforcement during the interdependent group contingency condition than the independent and dependent group contingency conditions may have led to an outcome in which the interdependent group contingency was more effective than the two other group contingency conditions). Nonetheless, differences in the three types of group contingencies are unclear. Further research using different populations and research designs may produce more transparent results.

Beyond the research that compares the effectiveness of the three types of group contingencies within a classroom setting, several studies examined the effectiveness of an interdependent group contingency alone as a classroom intervention to change student behavior. Popkin and Skinner (2003) evaluated the effectiveness of an interdependent group contingency on enhancing the academic performance of middle-school-aged male students with SED. Using

a modified multiple baseline across behaviors design, the intervention targeted the participants' accuracy of independently completed class assignments (including tests and quizzes) for English, spelling, and mathematics. Participants were required to meet a sequentially increasing number of possible contingency criteria to receive the positive reinforcer. Specifically, every nine days, new contingency criteria (possible percentages of correct responses on assignments) were added, according to a specific area of academia (spelling, mathematics, and English). In addition, contingency criteria and reinforcers were both randomly selected. Results showed that the participants' performance in all three academic subject areas improved from baseline. The effectiveness of an interdependent group contingency in enhancing student academic performance in multiple subject areas simultaneously, was demonstrated. However, utilizing an interdependent group contingency intervention with sequentially increasing contingency criteria may present several issues. The order in which the possible contingency criteria are presented to participants may impact the effectiveness of the intervention. Popkin and Skinner (2003) chose to sequence the contingency criteria from the participants' lowest to highest baseline performance levels in the three academic areas of interest to allow the participants to first focus solely on the academic material that was determined to be the most challenging. While this may have been advantageous to the participants' learning outcomes, it may have created a potential confound in the research in that it is possible that the order in which the sequential contingency criteria were presented may have contributed to the effectiveness of the interdependent group contingency. It is possible that a different sequential order of contingency criteria may have reduced the effectiveness of the interdependent group contingency (e.g., sequencing the contingency criteria from the least to most difficult academic material). In addition, this type of contingency criteria may have affected the potency of the positive reinforcers (becoming less

potent as more criteria are added) as well as the amount of time the teacher and teacher assistant had available to teach the material for each academic subject and accurately grade the independently completed class assignments each school day. Relatedly, while participants were informed whether they met the randomly selected contingency criterion at the end of each school day, reinforcement was oftentimes provided the following day. This delayed reinforcement may have reduced the effectiveness of the interdependent group contingency intervention. An interdependent group contingency intervention in which positive reinforcement is immediately delivered following a target behavior (e.g., providing accurate answers to in-class assignments) may yield different results.

Similarly, Reinhardt et al. (2009) examined the effectiveness of an interdependent group contingency used to increase the homework accuracy (percent of correct answers) of six fourth grade students in a general education classroom who had been identified as having difficulty with accurate completion of homework assignments. Using a multiple baseline across behaviors design, the interdependent group contingency was administered to the entire fourth grade class and data was collected on the homework accuracy of the six target students. Consistent with the methodological procedures of Popkin and Skinner (2003), Reinhardt et al. (2009) included new possible contingency criteria (percent of correct answers on homework assignments) pertaining to three academic areas of interest (reading comprehension, mathematics, and spelling), which were sequentially introduced approximately every two to three weeks. This sequential introduction of contingency criteria was ordered from students' lowest to highest performance on homework assignments for each academic subject during baseline. Contingency criteria and reinforcers were both randomly selected. Results of this study indicate an increase in the participants' homework accuracy when the contingency was introduced in each of the three

academic areas of interest compared to baseline. Effect sizes calculated for each participant's homework accuracy during the intervention further indicates that the largest effect occurred in reading comprehension, followed by mathematics and spelling, respectively. In addition, follow-up data collected in two-week intervals over an eight-week period, also showed continued improvement for each of the three targeted academic areas of interest after the removal of the interdependent group contingency intervention, which demonstrates that this type of reinforcement has positive residual effects that are maintained post-treatment. However, the quality of the feedback provided throughout different phases of the study may have impacted the effectiveness of the interdependent group contingency. During baseline and follow-up, participants received written feedback indicating any questions that may have been answered incorrectly. Conversely, during the intervention phase, participants received written feedback on their homework assignments indicating their grade on the assignment, any questions that may have been answered incorrectly, and the correct responses to the incorrectly answered question(s). Additionally, much like Popkin and Skinner (2003), it is possible that the selected order of the sequential introduction of contingency criteria may have impacted the effectiveness of the interdependent group contingency in that the students were given the opportunity to focus on strengthening their homework accuracy on their most difficult academic material before the introduction of less challenging areas of academia. It is possible that a different sequence may have shown a different effect of the interdependent group contingency on students' accurate completion of homework assignments. This study's findings extend the research on the effectiveness of an interdependent group contingency when used to improve student academic performance in that it was designed to allow for immediate reinforcement following the determination of whether participants fulfilled the randomly selected contingency criterion. In

Popkin and Skinner's (2003) study, participants typically received delayed reinforcement in that the researchers assessed the participants' accuracy on in-class assignments, which limited the time in which positive reinforcement could be provided and forced the teacher to provide the positive reinforcer at the beginning of the following school day. Reinhardt et al. (2009), however, assessed participants' accuracy on homework assignments which reduced time restraints and allowed for same-day reinforcement. Despite the differences in time at which reinforcement was provided to participants, both interventions successfully increased student academic performance.

In addition to identifying empirical support for the effectiveness of a specific type of group contingency, it may also be advantageous to consider whether a group contingency is perceived favorably by its recipients. Previous research in which comparisons were made between student participants' acceptability ratings of independent, interdependent, and dependent group contingencies as classroom interventions revealed that students provided significantly higher ratings of acceptability for the independent group contingency than the interdependent and dependent group contingencies (Shapiro and Goldberg, 1986). Additionally, informal indications of a preference for an independent group contingency as a behavioral intervention have been shown by staff and adult residents in a living facility (Sloman et al., 2014). Specifically, staff members who administered an independent group contingency shared positive statements with researchers about this behavior management approach, while residents who received the treatment continuously thanked the researchers for providing them with an intervention which allowed them to actively work toward earning a reward for engaging in appropriate behaviors. Interdependent group contingencies have been described as preferable approaches to managing student behaviors by teachers, teacher assistants, and students (Popkin

& Skinner, 2003). Specifically, Popkin and Skinner (2003) note that during unstructured interviews conducted with participants at the end of their study, a teacher and teacher assistant each reported that interdependent group contingency programs are easy to administer to students and that they as well as their students (who were also interviewed) liked using the interdependent group contingency during class. However, it is possible that participants in these studies may have provided researchers with socially desirable responses, which inaccurately reflect their true perceptions and preferences of each of the group contingencies. This may mislead instructors to choose a teaching approach that may not foster an optimal learning experience in that the selected group contingency may not be well-received by their students.

While there is extensive research on the effectiveness of interdependent group contingencies, further research examining the effectiveness of an independent group contingency is needed. The range in effectiveness of the interdependent group contingency may be due to the great level of cooperation among participants required to meet a common goal (e.g., peer encouragement and peer support; Kuhl et al., 2015). Although in all three types of group contingencies, the entire group shares a common goal and consequence, an independent group contingency does not necessarily promote cooperation amongst individuals in that a group member's own performance does not affect the consequence of another group member. Thus, it may be advantageous to expand the current research to determine whether differences exist between the effectiveness of an independent group contingency and one of the group contingencies which may promote more cooperation amongst members of a group. An interdependent group contingency may be an appropriate group contingency comparison in that it encourages all members of a group to work together to achieve a common goal, which is not characteristic of an independent group contingency. Although collaborative teamwork is also a

key component of a dependent group contingency, an interdependent group contingency eliminates the possibility of any group members who did not successfully meet a contingency criterion from receiving positive reinforcement. In a dependent group contingency, it is possible for multiple group members to fail to meet a contingency criterion but still receive positive reinforcement if they were not selected as the target individual whose performance reinforcement is dependent. Using an interdependent group contingency also reduces the criticism by other students that may occur when reinforcement is contingent upon the performance of a target individual. While an interdependent group contingency may have negative implications of its own in that it is possible that any individual who fails to meet a contingency criterion may be blamed for the lack of reinforcement, this approach does not place the group failure solely upon one specific individual. Although with an interdependent group contingency, it is possible for only one group member to fail to meet a contingency criterion, no specific individual is targeted, therefore making it more difficult for group members to determine whether one or more individuals failed to meet a criterion. Thus, an interdependent group contingency was selected as the behavioral intervention with which an independent group contingency was compared in the present study.

Additionally, a non-contingent reinforcement (NCR) intervention was implemented during the present study to determine whether independent and interdependent group contingencies are equally effective. NCR is a procedure in which reinforcement is provided independent of the occurrence of a target behavior and based on a fixed- or variable-time schedule (Cooper et al., 2007). The inclusion of an NCR intervention is advantageous to the examination of group contingencies in that when used as a comparison condition, conclusions can be drawn regarding whether the contingent reinforcement of each type of group contingency

intervention was the reason for changes in behavior, rather than simply presenting the participants with a positive reinforcer. A greater level of responding during independent and interdependent group contingency conditions than during the NCR condition, indicates that changes in the target behavior are due to the contingencies, rather than the presentation of a specific stimulus. While previous research concerning group contingencies has compared intervention conditions with baseline measurements (Coogan et al., 2007; Gresham & Gresham, 1982; Kuhl et al., 2015; Popkin & Skinner, 2003; Reinhardt et al., 2009; Ring et al., 2014; Theodore et al., 2004), there is a lack of research in which NCR is used as a comparison condition with group contingencies. NCR has been identified as an effective reinforcement control condition for research on contingent reinforcement of child behaviors (Hart, Reynolds, Baer, Brawley, & Harris, 1968). Specifically, when used to examine the contingent relationship between a child's engagement in cooperative play and teacher attention, NCR of teacher attention was determined to have an insignificant impact on the child's engagement in cooperative play. That is, the child engaged in longer periods of cooperative play during experimental conditions in which contingent reinforcement of teacher attention was implemented. Thus, this type of reinforcement control condition was determined to be appropriate for inclusion as a third intervention in the present study in that it allowed for comparisons to be made between the independent and interdependent group contingencies, while providing support for whether the contingent relationships of the two types of group contingencies were the underlying factors for the participants' achieved levels of academic performance.

## **The Present Study**

The present study was conducted to examine potential differences in the effectiveness of independent and interdependent group contingencies compared with NCR as behavioral interventions for college students' academic performance within a contrived classroom setting. Using a 3 x 3 factorial design, three different groups of randomly assigned participants were exposed to one within-subjects independent variable (type of reinforcement) with three levels (independent group contingency, interdependent group contingency, and NCR) and one between-subjects independent variable (experimental group reflecting a counterbalanced sequence combination of type of reinforcement and academic material) with three levels (Groups 1, 2, and 3). It was hypothesized that there would be significant differences in the mean post-test and retention test scores between each of the three types of reinforcement conditions (independent and interdependent group contingencies and NCR). Additionally, the mean post-test and retention test scores of each of the two types of group contingency conditions were expected to be significantly higher than those of the NCR condition.

## **Method**

### **Participants**

A total of 40 participants were recruited for this study from a Northeastern state school through a Participant Pool SONA System (N = 40). However, only the data from participants who attended all four experimental sessions (N = 23) were analyzed to draw the most accurate conclusions regarding the effectiveness of each of the three types of reinforcement. Recruitment entailed the researcher providing written details regarding participation requirements, dates, times, and a brief description of the procedures of the study, on the SONA system registry page (see Appendix A). Participants' ages ranged from 18 – 27 years. All participants were required

to be 1) first-time participants, 2) enrolled in a Principles of Psychology course at the university, and 3) to have no background education in the psychology of sustainability. This study was originally conducted during the Spring 2017 semester. However, due to several procedural errors, the study was conducted again during the Fall 2017 semester after modifications were made to improve the study's methodology as reported herein. All students who volunteered to be included in the study provided written informed consent to participate on an IRB-approved consent form and were given the opportunity to ask questions regarding their rights as a participant in the study during the first experimental session, prior to randomization of experimental groups (see Appendix B). Participants received up to four research participation credits for participating in this study (one credit for each experimental session attended) and were given several opportunities to receive a \$5.00 cash reward by earning raffle tickets that were placed into drawings that occurred during Sessions 1 – 3 (a maximum of two drawings for each of the three experimental conditions; a maximum of six total drawings occurred per session). Descriptive statistics regarding participant demographics are displayed in Table 2.

### **Setting**

The study was conducted in three classrooms in one of the buildings at a Northeastern state university. Two of the classrooms were similar in size and could seat approximately 30 students. The third classroom was larger and seated approximately 50 students, which was necessary to fit all participants during the consenting procedure during Session 1. At the front of each classroom, there was a dry-erase white board, a computer, and a desk for the experimenter. Additionally, each classroom was filled with rows of desks at which participants sat with their assigned small group member(s) as well as a video projector, which displayed the academic material presented to participants during each of the three reinforcement conditions.

## Materials

The materials used in this study included: three audio-recorded PowerPoint® lectures from a psychology of sustainability textbook (academic material), two three-question multiple-choice training quizzes per reinforcement condition (six total), one six-question multiple-choice post-test per reinforcement condition (three total), one 18-question multiple-choice retention test, Experimenter Answer Sheets, raffle tickets, reinforcers, demographic information sheets, two six-item subjective evaluation sheets, one 10-item subjective evaluation sheet, and three voice recorders.

**Academic Material.** Three audio-recorded PowerPoint® lectures were presented to each of the three experimental groups of participants. Each PowerPoint® lecture contained information from a chapter of *Psychology of Sustainability (4<sup>th</sup> Edition*; Scott, Amel, Koger, & Manning, 2016). Specifically, information from *Chapter 8: To Be (Green) or Not to Be (Green)...It's a Question of Motivation*, *Chapter 9: Making Ourselves Sick*, and *Chapter 10: Healing the Split Between Planet and Self*, was used as academic material. Each lecture contained PowerPoint® slides created by Scott et al. (2016) and an audio voice-recording of a researcher explaining the psychology of sustainability concepts related to one of the three selected textbook chapters. Each audio-recording was approximately 10-minutes in total duration and was split into two approximately 5-minute segments. The audio-recorded PowerPoint® lectures were presented to participants on a video projection screen that was connected to a computer controlled by the experimenter in her assigned classroom.

**Training Quizzes.** Two multiple-choice quizzes per reinforcement condition (six total) were administered during Sessions 1 – 3. Each training quiz contained three multiple-choice questions in which each had one correct answer and three distractor answers related to the presented academic material. Quiz questions were variations of chapter questions created by

Scott et al. (2016) and were edited by a researcher to be used as training materials during each of the three reinforcement conditions. Each training quiz was scored out of three total points (each quiz question was worth one point; see Appendix C).

**Post-tests.** One post-test per reinforcement condition (three total) was administered during Sessions 1 – 3. This test was used as a measure of student academic performance when exposed to a specific reinforcement condition. The post-test questions were developed using the same source of materials and procedure as the training quiz questions. Each test question had one correct answer and three distractor answers. The post-test was scored out of six total points (each quiz question was worth one point; see Appendix D).

**Retention Test.** An 18-question multiple-choice test was administered to participants during Session 4 to measure the retention effects of each of the three reinforcement conditions. Each test question had one correct answer and three distractor answers and was a variation of one of the 18 total post-test questions previously presented during the three reinforcement conditions. Variations of the post-test questions from each of the reinforcement conditions were mixed in a random order throughout the retention test. This test was split into three separate, six-question sections during scoring in that each part of the test assessed the retention effects of the one of the three types of reinforcement conditions. Each retention test question was worth one point (six total possible points per test section, see Appendix D).

**Raffle Tickets.** Raffle tickets were provided to participants, according to the reinforcement condition in place, and were used to randomly select the winner of the positive reinforcer.

**Reinforcers.** A \$5.00 cash reward was used as a positive reinforcer during each of the three reinforcement conditions.

**Experimenter Answer Sheet.** The Experimenter Answer Sheet was used during the three reinforcement conditions to record the total number of correct responses to quiz questions provided by each small group of participants on each of the first two training quizzes as well as the group number of the small group(s) that won each of the \$5.00 cash rewards (see Appendix E).

**Demographic Information Sheet.** The demographic information sheet was used to obtain information regarding participant gender, age, race/ethnicity, year in college, college major, college minor, cumulative GPA, Psychology GPA, average number of hours spent studying per week for college classes in general, and average number of hours spent studying per week for (a) psychology class(es) (see Appendix F).

**Subjective Evaluation.** Three total subjective evaluation sheets were used to obtain information regarding participants' preferences of and experiences with each of the reinforcement conditions. Two of the subjective evaluations contained six items that were rated along a seven-point Likert Scale. A third subjective evaluation, which contained ten items, included all items that were on the two previous subjective evaluation sheets as well as four additional items to obtain supplemental information from participants. Two of these additional items were rated along a seven-point Likert Scale to obtain information regarding participants' own typical quiz/test performance as well as their preference of group assignments. One additional item was included to inquire about participants' most preferred type of reinforcement requirements for winning the \$5.00 cash reward and another item asked participants to explain their reasoning for their preference (see Appendix G)

**Voice Recorders.** Three OLYMPUS® Digital Voice Recorders (Model: WS-852) were used to audio-record each of the three reinforcement conditions to allow procedural reliability to be determined.

### **Procedure**

A 3 x 3 factorial design was used to determine differences in the effectiveness of an independent and an interdependent group contingency compared with NCR when used as behavioral interventions for college students' academic performance. Participants were exposed to one between-subjects independent variable (experimental group reflecting counterbalanced sequence combinations of type of reinforcement and academic material) with three levels (Groups 1, 2, and 3) and one within-subjects independent variable (type of reinforcement) with three levels (independent group contingency, interdependent group contingency, and NCR). Partial Latin square counterbalancing was used with the between-subjects independent variable to simultaneously present three randomly assigned experimental groups of participants with each type of reinforcement and academic material during the same experimental session. This counterbalancing technique was used to control for potential order effects that could occur due to the sequence in which participants were exposed to both the reinforcement conditions and academic material. Two possible counterbalanced sequence options for each of these two components of the experimental conditions were developed and those that were used for the partial Latin squares were randomly selected prior to the start of the study through random drawing without replacement (see Appendix H). Each of the partial Latin squares used in the study included a total of three counterbalanced sequences, which allowed for each type of reinforcement and academic material to be implemented during Sessions 1 – 3. Thus, these counterbalanced sequences differed between the three experimental groups. To decrease

carryover effects, one week passed between participants' exposure to each of the reinforcement conditions. Reminder emails were sent to participants on the mornings of days of experimental sessions to reduce possible attrition (see Appendix I).

The dependent variable (student academic performance) was measured using a six-question, multiple-choice post-test during Sessions 1 – 3 as well as an 18-question multiple choice retention test during Session 4. Comparisons were made between participants' scores on the post-test for each of the three types of reinforcement conditions to 1) identify potential differences in the effectiveness of each when used as behavioral interventions for student academic performance and 2) to determine whether the contingent relationships of the group contingencies were the underlying factors for participants' achieved levels of academic performance. The 18-question multiple-choice retention test was used to determine whether the learning outcomes that occurred in relation to a specific reinforcement condition were maintained over time.

This study took place over the course of four 1-hour experimental sessions. One experimental session was held per week for four consecutive weeks. Sessions 1 – 3 consisted of exposing each of the three randomly assigned experimental groups of participants to a specific reinforcement condition, assessing participants' knowledge, and administering a subjective evaluation to participants. A fourth experimental session was included to assess the retention effects of each of the three types of reinforcement conditions as well as to collect participants' demographic information.

The experimental procedures used in this study were administered by a total of three experimenters; each of whom worked with one specific experimental group of participants during all four experimental sessions. During Session 1, 40 participants met in the largest of the

three designated classrooms. In this room, one of the experimenters provided the participants with a verbal and textual description of the study, as well as information regarding the ethical procedures that were in place (Appendix J). Participants who provided their consent were then randomly assigned using a random number drawing without replacement to an experimental group, in which they would be exposed to one of the three predetermined, counterbalanced sequences of reinforcement conditions and academic material. Participants who randomly selected the same number formed an experimental group (Group 1 (n = 13), Group 2 (n = 12), Group 3 (n = 15)). Participants assigned to Group 1 remained in the classroom in which all participants initially met and those assigned to Groups 2 and 3 were taken to their respective classrooms by their assigned experimenters. The experimental group, assigned experimenters, and assigned classrooms remained the same for each participant during all four experimental sessions.

After the participants were taken to their appropriate classrooms, the experimenter turned on her assigned voice recorder and used a random number drawing without replacement to assign participants to small groups of two to three members with whom they worked during the current experimental session (see Appendix K). Participants who randomly selected the same numbers formed a small group. Each experimental group had a maximum of five small groups of three. The number of small groups as well as the number of participants assigned to each small group varied according to the number of participants within an experimental group who attended a given experimental session (e.g., in a situation in which 10 participants in an experimental group attended a session, two small groups of three and two small groups of two participants were made to ensure that no participant worked alone on any of the training quizzes). In each of the reinforcement conditions, each small group was assigned a group name

based on the number they had drawn (e.g., three participants randomly selected the number ‘5’ and formed a small group which was referred to as, ‘Group 5’). This group name was used by the experimenter later in the study when recording the number of correct answers to training quiz questions on the Experimenter Answer Sheet (as described below). Participants each sat at their own desk with their assigned group member(s) during Sessions 1 – 3. This procedure was repeated at the beginning of Sessions 2 and 3 to randomly assign participants to new small groups. During Session 1, after participants were assigned to their small groups, the experimenter randomly assigned ID numbers to each participant. The experimenter told the participants to keep track of their ID number in that they would be using it to sign into each session as well as to write on every quiz, test, subjective evaluation, and demographic information sheet that they would complete over the course of the four experimental sessions. The experimenter then passed around a sign-in sheet to track participant attendance. During each of the remaining sessions, participants signed in upon their arrival.

The experimenter then provided participants with verbal instructions regarding specific guidelines, expectations, and consequences of the condition to which they were assigned (see Appendix K and Figure 1). During the independent and interdependent group contingency conditions, participants were told that they would be required to fulfill a contingency criterion to receive a raffle ticket to be shared with their assigned small group member(s) that would be put into a drawing for a small group of participants to each receive a \$5.00 cash reward. The contingency criterion that participants were required to fulfill was a predetermined number of correct answers (either 1 or 2) on each of the two training quizzes, which remained unknown to participants until the completion of a given training quiz. The contingency criteria were the same for each of the group contingency conditions during the same experimental session as a

means of reducing potential participant cross talk that may have occurred after the completion of a specific reinforcement condition. The number of correct responses that participants were required to answer for each training quiz was determined through a random number drawing with replacement prior to the start of the study.

Participants in the independent group contingency condition were told that during each training trial, the small groups that successfully fulfilled the contingency criterion would be given a raffle ticket to be shared with their assigned group member(s) after each of the two training quizzes. Raffle tickets would not be provided to small groups that failed to meet the contingency criterion. During Sessions 1 – 3, each of the three experimental groups had at least one small group that successfully fulfilled the contingency criterion for each training trial.

Participants in the interdependent group contingency condition were told that during each training trial, all small groups of participants would be required to fulfill a contingency criterion to receive raffle tickets. Instances in which all small groups of participants met the contingency criterion, resulted in all small groups to each receive a raffle ticket to be shared between assigned small group members. Failure to fulfill the contingency criterion by at least one of the small groups of participants, resulted in no raffle tickets being provided to any of the small groups. Across Sessions 1 – 3, there was only one out of six total training trials in which small groups failed to meet the contingency criterion and did not receive raffle tickets.

In the NCR condition, participants were told that during each training trial, all small groups of participants would receive a raffle ticket to be shared between assigned small group members, after each of the two training quizzes. Throughout Sessions 1 – 3, each of the three experimental groups shared an experience in which the same small group of participants was randomly selected as the winner for each of the two drawings for the \$5.00 cash reward.

After the experimenter explained the instructions for a given reinforcement condition, the participants were then presented with the academic material and were given two training quizzes to complete with their assigned small group members (one quiz to complete after the first half of the academic material was presented and one quiz to complete after the second half of the academic material was presented). The experimenter told the participants that they would have five minutes to complete each of the training quizzes and set a timer for five minutes each time a training quiz was administered to indicate the start and end of each quiz period. The experimenter watched the participants during each quiz period and stopped the timer early if the participants appeared to be done with their quizzes before the five-minute period ended.

During the independent and interdependent group contingency conditions, the experimenter announced the contingency criterion that participants needed to fulfill to receive a raffle ticket, at the completion of each quiz period. The experimenter then walked around to each small group of participants, provided written feedback indicating any questions that may have been answered incorrectly as well as the correct answers to those questions, and recorded the total number of correct answers for each small group on the Experimenter Answer Sheet. Raffle tickets were then provided to small groups of participants based on whether they had successfully fulfilled the contingency criterion of their respective group contingency condition. During instances in which raffle tickets were distributed, the experimenter put her half of the raffle ticket(s) in a paper bag and randomly selected a small group of participants that would each receive a \$5.00 cash reward. Participants in the NCR condition followed the same procedure as the other two reinforcement conditions. However, the experimenter provided a raffle ticket to all small groups of participants after the completion of each of the two training quizzes, regardless of their performance on each of these quizzes.

After the two training trials were completed, participants were administered a post-test. The experimenter announced that they would be completing this test independently and that they had 10 minutes to do so. Additionally, participants were told that once they had finished their test, they would be given a subjective evaluation to complete (a six-item subjective evaluation was administered during Sessions 1 and 2 and a 10-item subjective evaluation was administered during Session 3). Participants were told by the experimenter that they could leave after completing both their quiz and subjective evaluation. The experimenter set a timer for 10 minutes to indicate the start and end of the testing period. No reinforcement was given for correct answers on this quiz. During Sessions 2 and 3, the same procedures were used with the same participants. However, each experimental group was presented with the subsequent reinforcement condition and academic material based on its assigned predetermined sequence.

During the fourth experimental session, all participants were given an 18-question multiple-choice retention test ( $N = 29$ ). The participants were told by the experimenter that they would have 30 minutes to complete this test and that once they had finished their test, they would complete a demographic information sheet (see Appendix L). The experimenter told participants that they would be allowed to leave after completing both their test and demographic information sheet. The experimenter set a timer to indicate the start and end of the test session. All test measures were collected from participants upon their departure from the experiment. At this time, the participants were given a debriefing form to further disclose the purpose of the study (see Appendix M). Debriefing was included to ensure that participants were aware that it was not the purpose of the study to create feelings of self-blame when exposed to the experimental procedures but to determine effective teaching methods that may be beneficial to their learning outcomes in future collegiate experiences.

### **Interrater Reliability**

Each of the three experimental conditions for all four experimental sessions were audio-recorded by experimenters using their assigned voice recorder (12 total audio-recordings). However, only ten audio-recordings were reviewed to determine interrater reliability (IRR) in that the voice recorder for Group 3 was lost following the fourth experimental session. Audio-recordings from Sessions 1 and 2 from Group 3 (along with all other audio-recordings for Groups 1 and 2 for each of the four experimental sessions) were uploaded onto a computer before the voice recorder was lost and were included in the calculation of IRR. Audio-recordings were reviewed by two experimenters who provided ratings for the number of procedural items that were executed as written during the experimental sessions. The IRR was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying that value by 100 ( $(10 \text{ (agreements)} / 10 \text{ (agreements} + \text{ disagreements)}) \times 100 = 100\%$ ). Across all four experimental sessions, the procedures for each of the three experimental conditions were implemented as intended.

### **Results**

The present study showed that there was no statistically significant difference in the effectiveness of the independent and interdependent group contingencies and NCR conditions. A statistically significant difference was identified in participants' responses to a subjective evaluation assessment item regarding their most preferred type of reinforcement requirements. Potential differences between participants' mean scores for post-tests completed during the independent and interdependent group contingency, and NCR conditions were examined using a two-way mixed-measures analysis of variance (ANOVA) with three levels for experimental group (1, 2, or 3; reflecting counterbalanced combinations of orders of reinforcement conditions

and academic material) and three levels for type of reinforcement condition (independent group contingency, interdependent group contingency, or NCR). The results of this analysis revealed that there was no statistically significant interaction effect,  $F(4, 40) = 2.24, p = .081, \eta_p^2 = .18$  or difference between participants' mean post-test scores for any of the three reinforcement conditions,  $F(2, 40) = 3.12, p = .055, \eta_p^2 = .14$  (see Table 3). The three experimental participant groups achieved the highest mean post-test scores during the interdependent group contingency condition, followed by the independent group contingency and NCR conditions, respectively (see Figure 2).

A two-way 3 x 3 mixed-measures ANOVA was also used to determine differences between participants' mean retention test scores for each of the group contingency conditions and the NCR condition. This analysis revealed a significant interaction between type of reinforcement and experimental group,  $F(4, 40) = 4.79, p = .003, \eta_p^2 = .32$  (see Table 3 and Figure 3). The experimental groups to which participants were randomly assigned were representative of both the orders in which participants were exposed to each of the three types of reinforcement and academic material. It was determined that participants' retention test scores for each of the three reinforcement conditions were dependent on the academic material to which they were presented during the conditions. That is, participants consistently achieved the highest retention test scores for reinforcement conditions in which they were exposed to the academic material for Chapter 9, followed by Chapters 10 and 8, respectively. To eliminate noise from the original analysis, new variables were computed in which the participants' retention test scores for each reinforcement condition were centered around the grand mean of the academic material. A second mixed-measures ANOVA was used to analyze the newly transformed retention test scores from each of the three reinforcement conditions to evaluate the enduring effects of each

type of reinforcement condition on academic performance. The results of this analysis showed that there was no statistically significant interaction effect,  $F(4, 40) = 0.33, p = .86, \eta_p^2 = .032$  or difference between the mean retention test scores for each of the three types of reinforcement conditions,  $F(2, 40) = 0.033, p = .97, \eta_p^2 = .002$  (see Table 3). The experimental participant groups achieved the highest mean retention test scores on academic material presented during the independent group contingency condition, followed by the NCR and interdependent group contingency conditions, respectively (see Figure 4).

Subjective evaluation assessments were administered to evaluate participants' experiences with and preferences of the reinforcement conditions. Only 19 participants completed items 1 – 6 in that Questions 5 and 6 were not printed on four participants' subjective evaluation assessments for one of their reinforcement conditions (two participants from Group 1 during the independent group contingency condition, one participant from Group 1 during the NCR condition, and one participant from Group 2 during the interdependent group contingency condition). All three experimental groups provided high ratings for subjective evaluation items 1 – 6 for each reinforcement condition. New variables were created by calculating the overall means of each participant's ratings of subjective evaluation items 1 – 6 for each reinforcement condition to change the data from ordinal to continuous, as this allowed for the appropriate statistical analysis to be conducted (an ANOVA cannot be performed with ordinal data; see Figure 5). A two-way 3 x 3 mixed-measures ANOVA revealed that there was no statistically significant interaction effect,  $F(4, 40) = 2.23, p = .087, \eta_p^2 = .22$  or difference between participants' mean rating scores for subjective evaluation items 1 – 6 for any of the three reinforcement conditions,  $F(2, 40) = 0.94, p = 0.40, \eta_p^2 = .055$  (see Table 4).

Two of the supplemental items on the final subjective evaluation assessment administered during Session 3 (Questions 7 and 8) were each analyzed with a Kruskal-Wallis test. No significant differences were found between each of the three experimental groups regarding participants' perception of their own typical quiz/test performance,  $\chi^2(2) = 2.81, p = .25$  or enjoyment of working with peers to complete class assignments,  $\chi^2(2) = 3.24, p = .20$  (see Table 5). Across all three experimental groups, participants provided ratings indicating that they typically perform well on quizzes/tests and shared a slight preference for completing group work with their college peers. A chi-square test for goodness-of-fit was used to evaluate participants' responses to Question 9 on the final subjective evaluation assessment, which asked participants to identify which of the three types of reinforcement requirements for winning the \$5.00 cash reward they preferred most. This analysis revealed that the frequencies of participants' responses to this assessment item were not equally distributed across the sample,  $\chi^2(3, n = 23) = 40.83, p < .01$  (see Table 6). Based upon the observed frequencies of participants' responses to Question 9, the majority of the participants reported a preference for the independent group contingency requirements for winning the \$5.00 cash reward, while two participants reported a preference for NCR requirements, one participant responded in favor of the interdependent group contingency requirements, and one participant indicated that he/she did not prefer any of the three types of reinforcement requirements.

### **Discussion**

The present study showed that majority of the participants reported the greatest preference for the reinforcement requirements of the independent group contingency compared to those of the interdependent group contingency and NCR conditions. This finding is consistent with the research of Shapiro and Goldberg (1986), in which student participants provided

significantly higher acceptability ratings for an independent group contingency than interdependent and dependent group contingencies, as a classroom intervention for improving spelling performance. Participants' stronger preference for the independent group contingency than the interdependent group contingency was consistent between those who were familiar and unfamiliar with the other participants with whom they worked to meet the group contingency requirements (e.g., familiar student participants in the same class (Shapiro and Goldberg, 1986) and unfamiliar participants who were randomly assigned to experimental and small groups (the present study)). Additionally, this preference was consistent between groups of participants who significantly differed in age (e.g., sixth grade students (Shapiro and Goldberg, 1986) and college students, ages 18 – 27 years (the present study)). Many of the participants in the present study who selected the reinforcement requirements of the independent group contingency as their most preferred, provided a written explanation on the final subjective evaluation in which they described how they believed that the requirements of the independent group contingency were the fairest and that they should be responsible for their own performance and should not be penalized for the suboptimal performance of their peers. Yet, the participants provided high ratings on the subjective evaluation items for each reinforcement condition, which indicated positive experiences with and preferences of each. These findings support previous studies in which the recipients of independent and interdependent group contingencies reported having positive experiences during these behavioral interventions (Popkin & Skinner, 2003; Sloman et al., 2014). Thus, while the independent group contingency may be the most preferred type of reinforcement intervention, students seem to have positive experiences with both independent and interdependent group contingencies when implemented as classroom interventions for improving their academic performance. Future instructors may benefit from considering such

findings when choosing a teaching approach to use with college students to foster both a positive and supportive learning environment.

The present study did not demonstrate a statistically significant difference between participants' mean post-test or retention test scores for each of the three types of reinforcement conditions. This suggests that the contingent relationships of the independent and interdependent group contingencies were not the underlying cause of participants' achieved levels of academic performance, as the test scores for each of these conditions were not significantly greater than those achieved for the NCR condition. It is possible that positive reinforcement did not occur during the group contingency conditions, therefore leading to the nonsignificant differences between the three reinforcement conditions. Specifically, evidence of reinforcement would be indicated by a strengthened behavioral response (e.g., high test scores) by participants after they were presented with a stimulus (e.g., reinforcer) following the occurrence of their target behavior (e.g., fulfillment of a contingency criterion by achieving a specific level of academic performance). The scores achieved by participants on tests which assess their knowledge of the academic material presented during the group contingency conditions would therefore, be greater than those achieved for a condition in which reinforcement is provided independent of their academic performance (NCR condition). However, the results of this study revealed nonsignificant differences between the three types of reinforcement conditions, which suggests that the reinforcement of academic behavior did not occur. Yet, this research may be advantageous to the current understanding of effective teaching methods in that it reveals indications of potential empirical support for independent and interdependent group contingencies as teaching approaches in college classrooms. It is important to acknowledge that the results of the statistical analysis used to assess the main effect of participants' mean post-test

scores for each reinforcement condition revealed a  $p$ -value that approaches statistical significance ( $p = .055$ ). This result as well as several others (including, the interaction effect of participants' mean post-test scores for each reinforcement condition and experimental group, the interaction effect of participants' mean retention test scores for each reinforcement condition and experimental group, and the interaction effect of participants' mean subjective evaluation ratings for items 1 – 6 and experimental group) had large effect sizes ( $\eta_p^2 = .18$ ,  $\eta_p^2 = .32$ , and  $\eta_p^2 = .22$ , respectively). It is possible that greater statistical power may have been necessary to reveal a statistically significant result. A power analysis for a mixed-measures ANOVA with a large effect size ( $\eta_p^2 = .14$ ) and a  $p$ -value of .05 revealed that a sample size of 24 participants is necessary to determine a statistically significant result. Only 23 participants attended all four experimental sessions of the study, which may have ultimately reduced the statistical power of the analyses used with this dataset. Thus, a larger sample of participants may have provided the necessary statistical power to reveal a significant result. Nonetheless, it is critical to remain mindful that no definitive conclusions can be made regarding the effectiveness of the independent and interdependent group contingencies as behavioral interventions for academic achievement due to the lack of statistical significance in the findings.

Despite a lack of statistically significant differences between the independent and interdependent group contingencies and NCR conditions, the pattern of observed differences in participants' mean post-test scores for each reinforcement condition is consistent with the findings of Gresham and Gresham's (1982) study and Lynch et al.'s (2009) study, in which an interdependent group contingency was determined to be more effective in changing students' behavior than an independent group contingency. Specifically, participants of the present study achieved the highest post-test scores during the interdependent group contingency, followed by

the independent group contingency, and NCR conditions respectively. It is possible that a similar significant result could have been revealed, had the statistical power of the study been greater. Yet, even with statistical significance to demonstrate differences in effectiveness between reinforcement conditions, participants' mean post-test scores for each condition did not exceed an average of 3 out of 6 correct responses to test questions, which may indicate that the group contingencies did not effectively impact students' academic performance. However, it is possible that limited exposure to each type of reinforcement contingency or lack of reinforcement may have influenced participants' levels of academic achievement during each condition and ultimately reduced the effectiveness of these behavioral interventions.

The pattern observed in participants' mean post-test scores is inconsistent with the pattern of mean retention test scores for each reinforcement condition. Rather than achieving the highest scores for the interdependent group contingency, followed by the independent group contingency and NCR conditions, participants achieved the highest retention test scores for the independent group contingency, followed by the NCR and interdependent group contingency conditions, respectively. Although there was no statistically significant difference between participants' mean retention test scores for each reinforcement condition, the observed differences between the patterns of mean post-test and retention test scores may provide insight regarding the immediate and maintenance effects of independent and interdependent group contingencies. While participants achieved the highest post-test scores during the interdependent group contingency condition, they achieved the lowest retention test scores for this condition. This indicates that the interdependent group contingency may potentially have immediate impacts on students' academic performance but once the intervention has concluded, the effects of this group contingency may subside. It is possible that during this condition, participants experienced

social pressure to achieve a high level of academic performance in that failure to do so would result in no small groups receiving raffle tickets to be put into the drawing for the \$5.00 cash reward. This may have influenced the amount of effort that participants put into answering the quiz questions in that they all needed to perform at their highest level to increase their chances of receiving reinforcement. Thus, these contingency requirements may have strengthened the participants' academic performance and facilitated high academic achievement immediately following the practice quiz trials. However, after the conclusion of this reinforcement condition, the effects of the interdependent group contingency diminished. This finding would challenge the previous research conducted by Reinhardt et al. (2009), which demonstrated that after the removal of the interdependent group contingency, the effects of the intervention were maintained, and students continued to experience improvement in their academic performance. It is likely that procedural differences between these two studies contributed to differences in the maintenance effects of the interdependent group contingency. Specifically, in Reinhardt et al.'s (2009) study, the interdependent group contingency was administered for multiple days and included the use of randomized reinforcers to strengthen students' performance on academic material that they were required to learn and were taught on a regular basis. In contrast, participants in the present study were administered the interdependent group contingency in a contrived classroom setting, given known reinforcers that remained constant across all experimental conditions and sessions, and only exposed to both the academic material and the interdependent group contingency, once. Thus, it is possible that the magnitude of reinforcement and limited exposure to both the academic material and interdependent group contingency may have impacted the maintenance effects of this type of reinforcement. The opposite pattern was found in participants' post-test and retention test scores for the independent group contingency.

Specifically, participants achieved the second highest post-test scores and the highest retention test scores for the independent group contingency condition. While it appears that the independent group contingency may have stronger maintenance effects than the interdependent group contingency, the participants' mean retention test scores were lower than their mean post-test scores for the independent group contingency, which indicates that the effects of the intervention were not maintained over time. Participants may have achieved lower post-test scores on the academic material presented during the independent group contingency than the interdependent group contingency due to a lack of social pressure for participants to achieve their highest possible level of academic performance to receive a chance for reinforcement. While participants still needed to perform well on their quizzes to receive a raffle ticket to be entered in the drawing for the \$5.00 cash reward, the participants' own performance did not affect the outcomes experienced by others, which may have lowered the amount of effort that they put into accurately answering quiz questions. Much like the interdependent group contingency, low maintenance effects of the independent group contingency may be attributed to an inadequate magnitude of reinforcement or limited exposure to both the academic material and group contingency condition. However, conclusions regarding the observed differences in participants' patterns of mean post-test and retention test scores should be made with caution. It is possible that reinforcement did not occur during the group contingency conditions and if it did occur, it may not have been due to the contingent relationships of the independent and interdependent group contingencies, as indicated by the nonsignificant differences between participants' achieved test scores for the group contingency and NCR conditions. It is also possible that the patterns of mean post-test and retention test scores may have been spurious effects that occurred due to chance.

The present study adds to the current literature on independent and interdependent group contingencies in that it is the first to use a 3 x 3 factorial design to simultaneously present two different group contingencies to multiple groups of participants in a counterbalanced order. Previous research has evaluated the effectiveness of independent group contingencies using reversal designs (Gresham & Gresham, 1982), alternating treatment designs (Theodore et al., 2004), and multi-element designs (Sloman et al., 2014) and interdependent group contingencies have been evaluated using reversal designs (Gresham & Gresham, 1982), alternating treatment designs (Theodore et al., 2004), and multiple baseline designs (Popkin & Skinner, 2003). The use of a 3 x 3 factorial design with partial Latin square counterbalancing reduced the possibility of order and carryover effects as potential confounds in that each of the three experimental groups was assigned its own counterbalanced order of reinforcement interventions to allow each type of reinforcement to be administered during Sessions 1 – 3. Relatedly, the present study is also the first to include NCR as a comparison condition to determine whether the contingent relationships of each group contingency were the underlying factors which influenced participants' behavior. Much of the previous research has compared students' behaviors during experimental conditions to their baseline measurement of behavior to demonstrate whether a given group contingency has successfully changed behavior (Gresham & Gresham, 1982; Popkin & Skinner, 2003; Theodore et al., 2004; and Reinhardt et al., 2009). However, comparison to a baseline measurement does not distinguish whether the change in students' behavior was due to the contingent reinforcement of a given group contingency or simply the presentation of a stimulus. The present study demonstrated an insignificant difference between the effectiveness of independent and interdependent group contingencies and NCR conditions as behavioral interventions for college students' academic behavior. Thus, the previous research supporting

the effectiveness of group contingencies may be questionable in that the underlying reason for behavioral change in previous studies remains unclear.

The present study may have benefited from the inclusion of a baseline measurement in addition to the NCR comparison condition to allow for stronger conclusions to be made regarding the effectiveness of each type of group contingency. Due to time restraints, no baseline measurement of academic performance was included. The participation requirements were designed to prevent the inclusion of students who had an educational background in the psychology of sustainability by only allowing students to participate if they were enrolled in a principles of psychology course at the time of the study (which is a prerequisite to taking coursework in the psychology of sustainability at the university). However, it is possible that a participant may have had prior knowledge of the psychological concepts taught during the reinforcement conditions without having learned them in an academic setting. The inclusion of the NCR condition allowed for conclusions to be made regarding whether reinforcement occurred and whether the contingent relationships of the group contingencies were the underlying reason for participants' achieved level of academic performance. Yet, a baseline measurement would provide additional information regarding participants' starting knowledge of the academic material. Baseline data would allow conclusions to be drawn regarding the amount of increase in participants' academic performance during the reinforcement conditions. Additionally, the present study may have benefitted from the inclusion of randomized reinforcers. Several studies that have demonstrated the effectiveness of independent and interdependent group contingencies have used randomized reinforcers to increase the likelihood of delivering a reinforcer of a greater magnitude by surprising participants with an unknown reinforcer after they have successfully fulfilled a contingency criterion (Popkin & Skinner, 2003;

Theodore et al., 2004; and Reinhardt et al., 2009). The participants in the current study reported on their subjective evaluations that the \$5.00 cash reward was desirable during each of the three reinforcement conditions. However, it is possible that the participants may have found randomized reinforcers to be more desirable than only being given the opportunity to receive a \$5.00 cash reward for engaging in high levels of academic performance. Thus, the inclusion of unknown reinforcers could have positively impacted participants' academic performance and ultimately contributed to different experimental outcomes. Lastly, it may have been advantageous to conduct a pilot test to assess the level of difficulty for post-test and retention test questions. Participants from each of the three experimental groups were found to consistently achieve the highest retention test scores on the academic material from Chapter 9, followed by Chapter 10 and Chapter 8, respectively. It is possible that this pattern of retention test scores may be due to differences in the level of difficulty for the test questions of each of the three chapters of academic material (e.g., questions that assess participants' knowledge of content vs. questions that assess participants' understanding of theoretical concepts). The inclusion of a pilot test would have allowed for test questions to be equated in level of difficulty between the selected chapters of academic material, which may have reduced the possibility of academic material as a potential confound when evaluating the effectiveness of group contingencies as behavioral interventions for academic performance.

Given the findings of the present study, future research should be conducted to further compare the effectiveness of independent and interdependent group contingencies as behavioral interventions for college students' academic performance. Consistent with the present study, it may be advantageous for future research to include the use of a 3 x 3 factorial design with partial Latin square counterbalancing to simultaneously present three experimental group of participants

with an independent and an interdependent group contingency and NCR conditions, in that this procedure provides experimental control for both order and carryover effects. However, future research may benefit from administering such study procedures within a real classroom setting with three different classes of college students who are taking the same academic course.

Academic performance may be measured with brief, in-class quizzes that may be given at the end of the week and can be graded during class to allow for the appropriate amount of time to provide immediate reinforcement to participants during the group contingency conditions.

Randomized contingency criteria should be used to increase participants' efforts for striving to fulfill a criterion to receive positive reinforcement. Reinforcement conditions may change after students have completed a specific academic unit. Additionally, future research should consider the inclusion of both a baseline measurement and NCR comparison condition to determine whether reinforcement has occurred, the specific amount of change in students' academic performance (e.g., number of points increased or decreased on students' quiz scores), and whether students' behavioral change is due to the contingent relationships of a specific group contingency. Lastly, future research may benefit from the use of randomized reinforcers to maintain the effectiveness of reinforcement when administered over a prolonged period of time. A future study containing these procedures may allow for stronger conclusions to be made regarding the effectiveness of each of these three types of reinforcement as behavioral intervention for college students' academic performance and the findings may be generalizable to other populations of students and classroom settings.

The identification of effective teaching approaches is critical to students' academic experiences and achievements. While the effectiveness of independent and interdependent group contingencies as alternative teaching approaches for college students remains unclear, the present

study provides empirical support for the reinforcement requirements of the independent group contingency as being the most preferred by students. Continued refinement of the current understanding of college students' academic performance will allow instructors to make empirically-informed decisions when selecting teaching approaches that may facilitate both positive educational experiences and optimal academic outcomes.

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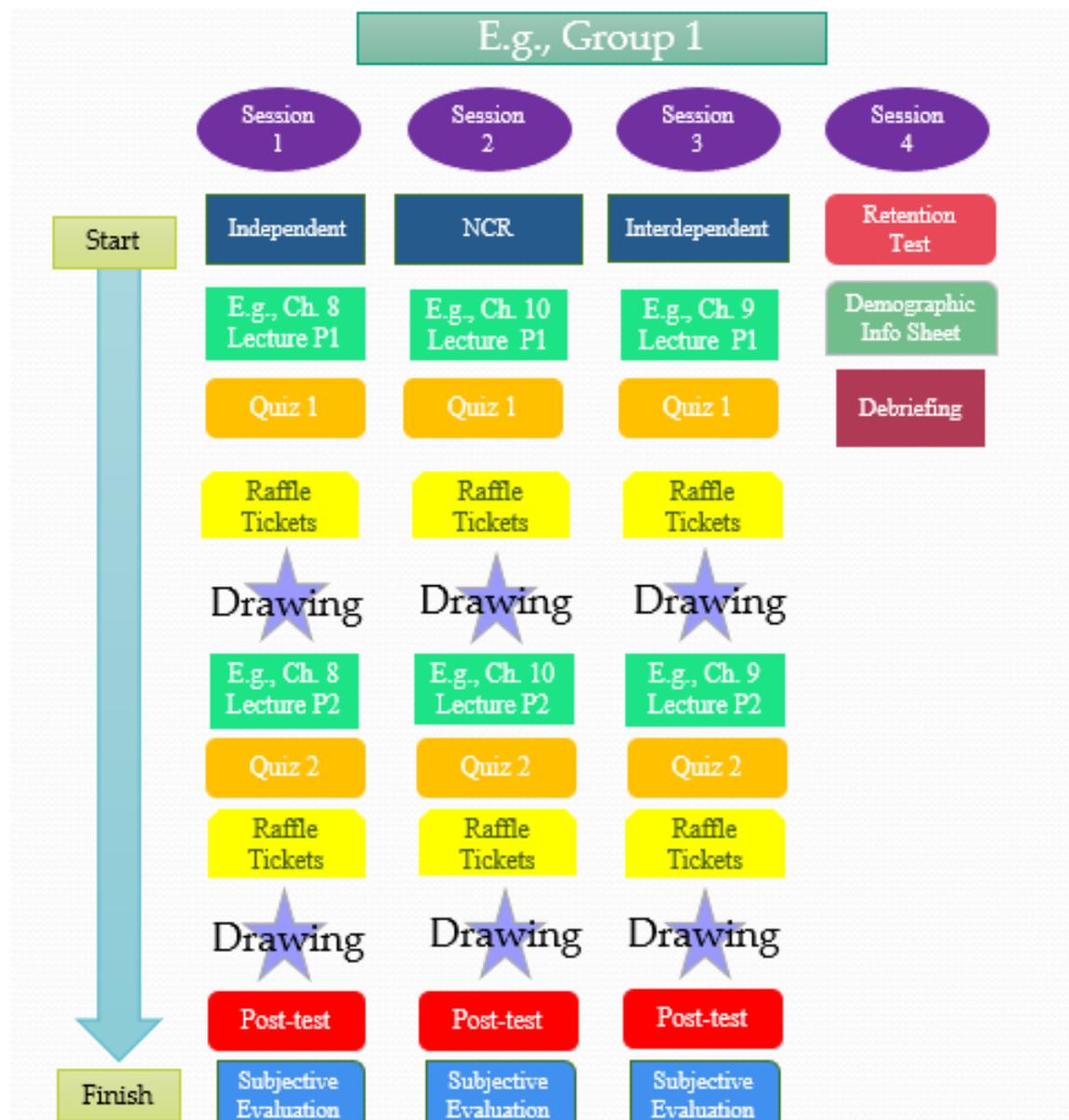
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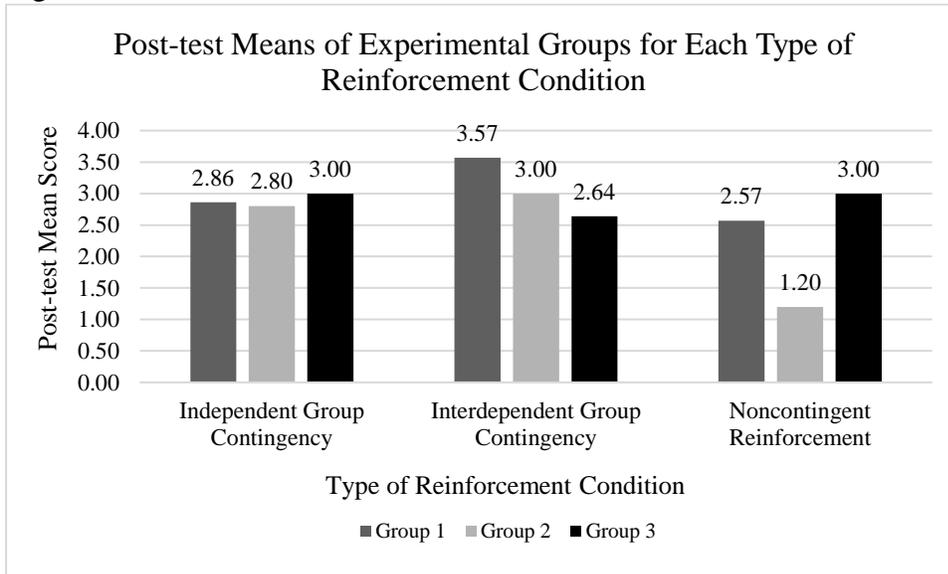
Figures

Figure 1. Procedure Flow Chart



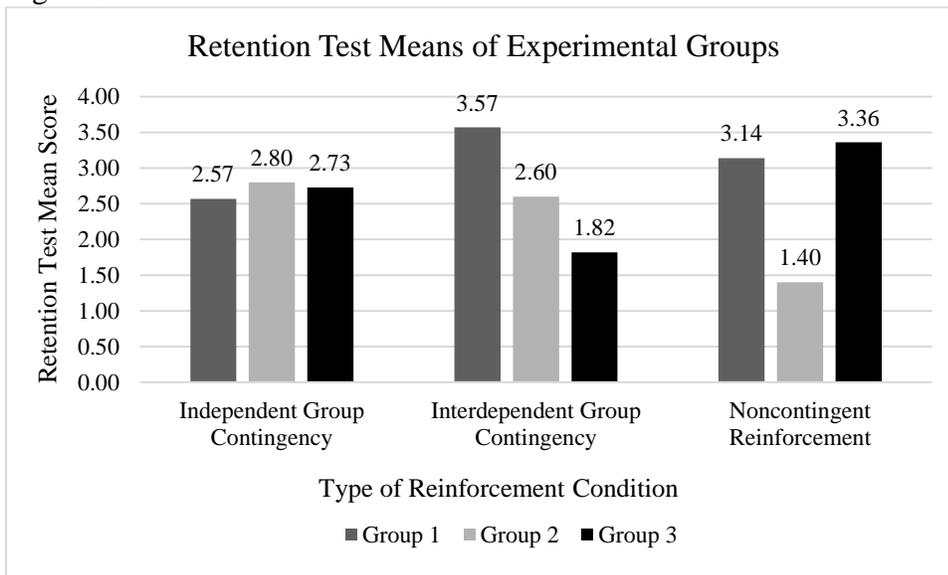
Note. Each of the three randomized groups of participants were exposed to their own counterbalanced sequence of reinforcement conditions and academic material during Sessions 1 – 3.

Figure 2.



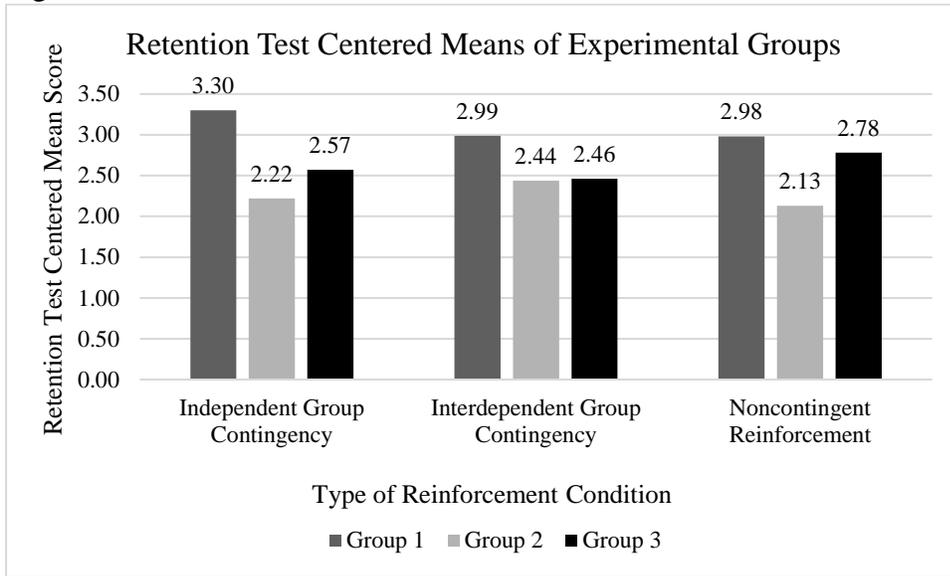
Note.  $N = 23$ , Group 1:  $n = 7$ , Group 2:  $n = 5$ , Group 3:  $n = 11$ .

Figure 3.



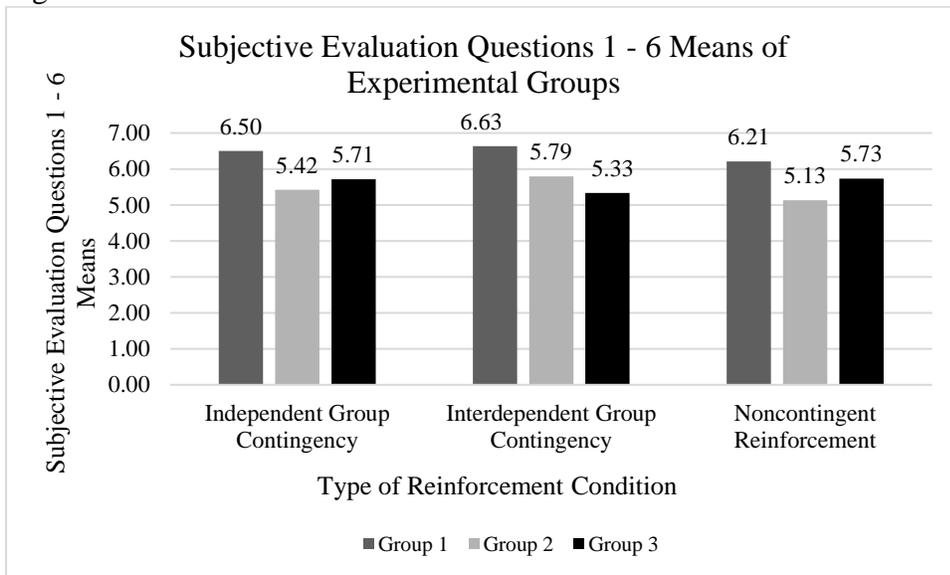
Note.  $N = 23$ , Group 1:  $n = 7$ , Group 2:  $n = 5$ , Group 3:  $n = 11$ ,  $p < .01$ .

Figure 4.



Note.  $N = 23$ , Group 1:  $n = 7$ , Group 2:  $n = 5$ , Group 3:  $n = 11$ .

Figure 5.



Note.  $N = 23$ , Group 1:  $n = 4$ , Group 2:  $n = 4$ , Group 3:  $n = 11$ ,  $p = .05$ .

### Tables

Table 1. *Contingencies Description Table*

	Individual	Independent	Dependent	Interdependent
<b>Definition</b>	-Reinforcement delivered immediately following a specific individual's desired behavior when a contingency is met  -Provided based on use of a specified target behavior	-Only those who meet contingency criterion receive reinforcement	-Reinforcement is provided based on one person's or subgroup's attainment of a contingency criterion	-All group members must meet contingency criterion to receive reinforcement
<b>Advantages</b>	-Tailored  -Flexible	-Economically feasible  -Fair	-Economically feasible  -Promotes cooperation	-Economically feasible  -Promotes cooperation  -Fair
<b>Disadvantages</b>	-Not economically feasible  -Time consuming  -May not be perceived as inequitable by other class members	-Does not promote cooperation	-Possible criticism from peers  -May reinforce behaviors of (a) group member(s) who do not meet the contingency criterion	-Possible criticism from peers  -Group member(s) may meet the contingency criterion individually but may not receive reinforcement due to the group as a whole not meeting the contingency criterion

## Support

Crow and Cheney (1977)	Shapiro and Goldberg (1986); Theodore, Bray, and Kehle (2004); Lynch, Theodore, Bray, and Kehle (2009); Sloman, Reyes, and Vollmer (2014)	Gresham and Gresham (1982); Shapiro and Goldberg (1986); Theodore et al. (2004); Hansen & Lignugaris- Kraft (2005); Heering & Wilder (2006); Lynch et al. (2009)	Gresham and Gresham (1982); Popkin and Skinner (2003); Theodore et al. (2004); Lynch et al. (2009); Reinhardt, Theodore, Bray, and Kehle (2009); Ring, Sigurdsson, & Eubanks (2014)
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Table 2. *Descriptive Statistics of Participants' Demographic Information*

Demographic Information	Descriptive Statistics	
	Frequency	Percent
Gender		
Female	17	73.9
Male	6	26.1
Age		
18	8	34.8
19	7	65.2
20	5	21.7
22	1	4.3
26	1	4.3
27	1	4.3
Race/Ethnicity		
White	14	60.9
Black/African American	6	26.1
Latino/Hispanic American	1	4.3
Biracial or Other	1	4.3
Not Specified	1	4.3
Asian	0	0
Year in College		
Freshman	8	34.8
Sophomore	6	26.1
Junior	7	30.4
Senior	0	0
Not Specified	2	8.7
College Major		
Nursing	5	21.7
Athletic Training	2	8.7
Psychology	2	8.7
Social Work	2	8.7
Broadcast Journalism	1	4.3
Biochemistry	1	4.3
Exercise Science	1	4.3
Healthcare Administration and Public Health	1	4.3
Kinesiology	1	4.3
Physical Education	1	4.3
Political Science	1	4.3
Rec and Leisure	1	4.3
Double Major	1	4.3
Intended Major	1	4.3

Undeclared Major	2	8.7
College Minor		
Not Specified	15	65.2
Undeclared	2	8.7
Art Studio	1	4.3
Business Management	1	4.3
Criminal Justice	1	4.3
Education Certification	1	4.3
Music	1	4.3
Preprofessional Health	1	4.3
Cumulative GPA		
First semester, no cumulative GPA	9	39.1
< 2.0	0	0
2.0 – 2.5	1	4.3
2.6 – 3.0	1	4.3
3.1 – 3.5	6	26.1
3.6 – 4.0	4	17.4
Not specified	2	8.7
Psychology GPA		
First semester, no psychology GPA	11	47.8
< 2.0	0	0
2.0 – 2.5	0	0
2.6 – 3.0	3	13.0
3.1 – 3.5	4	17.4
3.6 – 4.0	4	17.4
Not specified	1	4.3
Average Number of Hours Spent Studying for Classes in General		
0 – 2 hours	5	21.7
3 – 5 hours	8	34.8
6 – 8 hours	5	21.7
>8 hours	5	21.7
Not specified	0	0
Average Number of Hours Spent Studying for (a) Psychology Class(es)		
0 – 2 hours	18	78.3
3 – 5 hours	3	13.0

6 – 8 hours	1	4.3
>8 hours	1	4.3
Not specified	0	0

Note.  $N = 23$ .

Table 3. *Descriptive Statistics of Participants' Scores on Post Tests and Retention Tests and Centered Scores on Retention Tests for Each Type of Reinforcement Condition*

Type of Reinforcement Condition	Test Measure								
	Post Test			Retention Test			Retention Test Centered Scores		
	<i>M</i>	<i>(SD)</i>	<i>SE</i>	<i>M</i>	<i>(SD)</i>	<i>SE</i>	<i>M</i>	<i>(SD)</i>	<i>SE</i>
Independent Group Contingency	2.91	(1.04)	.22	2.70*	(.97)	.20	2.72	(1.06)	.22
Interdependent Group Contingency	3.00	(1.28)	.27	2.52*	(1.34)	.28	2.62	(1.01)	.21
Noncontingent Reinforcement	2.48	(1.28)	.27	2.87*	(1.33)	.28	2.70	(1.11)	.23

Note.  $M$  = Mean,  $SD$  = Standard Deviation,  $SE$  = Standard Error.  $N = 23$ , \*  $p < .01$ .

Table 4. *Descriptive Statistics of Participants' Mean Scores for Subjective Evaluation Items 1-6 for Each Type of Reinforcement Condition*

Subjective Evaluation	Experimental Groups					
	Group 1		Group 2		Group 3	
	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>
Independent Group Contingency	6.50	(0.36)	5.42	(0.52)	5.71	(0.80)
Interdependent Group Contingency	6.63	(0.44)	5.79	(0.63)	5.33	(0.72)
Noncontingent Reinforcement	6.21	(0.57)	5.13	(0.60)	5.73	(1.05)

Note.  $M$  = Mean,  $SD$  = Standard Deviation,  $N = 19$ , Group 1:  $n = 4$ , Group 2:  $n = 4$ , Group 3:  $n = 11$ .

Table 5. *Descriptive Statistics of Participants Scores on Supplemental Items Included in a Final Subjective Evaluation of Experimental Groups*

Subjective Evaluation	Experimental Groups		
	Group 1	Group 2	Group 3
	<i>M</i> Rank Score	<i>M</i> Rank Score	<i>M</i> Rank Score
Q7: I usually do not perform well on quizzes or tests, even if I study. (1 = Disagree completely, 7 = Agree completely)	8.50	12.90	13.82
Q8: When given the opportunity, I enjoy working with a group of my peers to complete class assignments. (1 = Disagree completely, 7 = Agree completely).	13.07	15.80	9.59

*Note.* Q = Question, *M* = Mean, *N* = 23, Group 1: *n* = 7, Group 2: *n* = 5, Group 3: *n* = 11.

Table 6. *Descriptive Statistics of Participants' Scores on a Supplemental Item Included in a Final Subjective Evaluation*

Subjective Evaluation	Descriptive Statistics	
	Frequency	Percent
Q9: Which requirements for winning the \$5.00 cash reward did you prefer most?		
Independent Group Contingency	19	82.6
Interdependent Group Contingency	1	4.3
Noncontingent Reinforcement	2	8.7
None of the above	1	4.3

*Note.* Q = Question, *N* = 23, *p* = .01.

## Appendices

### Appendix A

SONA System Registry Announcement

#### **Title of Study: Comparing Independent and Interdependent Group Contingencies with Non-contingent Reinforcement on College Students' Academic Performance**

In this study, we will be examining the effectiveness of independent and interdependent group contingency interventions compared to a non-contingent reinforcement intervention when used in a contrived classroom context. This study will include **four experimental sessions** that participants should attend. Each experimental session will be approximately one-hour in length and will occur once per week. During the first three experimental sessions, participants will watch a ten-minute audio-recorded PowerPoint lecture on the psychology of sustainability, work together with a randomly assigned small group to answer questions on two three-question multiple-choice quizzes, and will also work independently on a third six-question multiple-choice quiz and a subjective evaluation. During the fourth session, participants will complete an 18-question multiple-choice test as well as provide demographic information on a self-report measure.

**This study is worth four research participation credits.** Participants will also be given the chance to enter several raffles to win a \$5.00 cash reward by earning raffle tickets throughout the first three experimental sessions.

In order to participate in this study, you **must**:

**Be 18 years or older**

**Have no background education in the psychology of sustainability**

**Have no previous experience as a participant in this study (during Spring 2017)**

Dates, times, and locations of this study will be as follows:

**Session 1: Date, time, location**

**Session 2: Date, time, location**

**Session 3: Date, time, location**

**Session 4: Date, time, location**

Signing up for this study indicates that you are a potential participant in this study. Please record the information regarding the four sessions as listed above in order to attend the experimental sessions.

Thank you.

**Appendix B**

## Consent Form



The College at  
**BROCKPORT**  
STATE UNIVERSITY OF NEW YORK

**Institutional Review Board****FORM A—STATEMENT OF INFORMED CONSENT  
FOR PARTICIPANTS 18 AND OVER**

Comparing Independent and Interdependent Group Contingencies with Non-contingent Reinforcement  
on College Students' Academic Performance

You are invited to be in a research study of three different teaching approaches used to increase college student academic performance when applied in a contrived classroom setting. You were selected as a possible participant because you have indicated that you are 18 years of age or older, have no educational background in the psychology of sustainability, and have no previous experience as a participant in this study. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by graduate student, Stacey Caron, and Dr. Marcie Desrochers of the Psychology Department at The College at Brockport.

**BACKGROUND INFORMATION**

The purpose of this study is to compare three different teaching approaches in a contrived classroom setting to determine possible effects on college students' academic performance.

A maximum of 45 people will take part in this study. The results will be used for the foundation of a Master's thesis of one of the primary investigators

**PROCEDURES:**

If you agree to be in this study, I would ask you to do the following: attend four approximately 1-hour sessions over the course of the study. During the first three sessions (each of which take place once per week over the course of a four-week period), you will watch two audio-recorded PowerPoint lectures containing material regarding the psychology of sustainability, work together with a small group to answer questions to two multiple-choice quizzes, work independently on one short multiple-choice quiz, and complete a subjective evaluation. You will also be asked to return for a fourth session to complete a short multiple choice test. During this session, you will also be asked to provide demographic information. The in-class

procedure will take about 1 hour per session to complete. The multiple-choice test and demographic information sheet will take about 30 minutes to 1 hour to complete. Additionally, each experimental session will be audio-recorded to ensure that the experimenter follows the protocol accordingly. We ask that you please give your consent to be audio-recorded in that it is likely your voice will be recorded during small group discussions when deliberating quiz answers. If you do not provide your consent to be audio-recorded, you will not be permitted to participate in this study.

### **COMPENSATION/INCENTIVES:**

You will receive compensation in the form of up to 4 research participation credit points for participating in this study (1 research credit per experimental session you attend). You will also be entered into several raffles for a \$5.00 cash reward if you successfully achieve a specific level of performance during the study. Specifically, you will be working with a small group towards earning raffle tickets for answering a specific number of questions correctly on two of the quizzes you will be taking. The winners of the \$5.00 cash reward will be randomly selected through the raffle.

### **RISKS AND BENEFITS OF BEING IN THE STUDY**

The risks of this study are potentially experiencing feelings of unfairness of the reward system involved in the intervention. A minimal risk of time will occur; specifically, the total time to participate in this study may range from 3 ½ to 4 hours (1 hour for each of the first three experimental sessions and 30 minutes to 1 hour for the fourth experimental session).

The direct benefits to participation are expanding your current knowledge of environmental sustainability and helping to contribute to determining ways to improve the educational format of college classrooms.

### **CONFIDENTIALITY:**

The records of this study will be kept private and your confidentiality will be protected. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject.

Research records will be stored securely and only researchers will have access to the records. All data will be kept locked in a filing cabinet in the office of one of the primary investigators. Your data will be coded with a randomized identification number and your data cannot be traced back to you. Data will be inputted into a computer with an encrypted password of which only the primary investigators have knowledge and access. This computer will also be locked in the office of one of the primary investigators. All study records, including approved IRB documents, tapes, transcripts, and consent forms, will be destroyed by shredding and/or deleting after 7 years.

### **VOLUNTARY NATURE OF THE STUDY:**

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with The College at Brockport or with other cooperating

institutions. If you decide to participate, you are free to skip any question. You may also withdraw from this study at any time without penalty

In order to participate in this study, your informed consent is required. If you wish to participate in the project and agree with the statements below, please provide your written signature and the date of your consent in the appropriate spaces listed below. Again, you may change your mind at any time and leave the study without penalty, even after the study has begun.

#### **Contacts and Questions:**

The researchers conducting this study are: graduate student, Stacey Caron and Dr. Marcie Desrochers. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact me via email at [scaro2@u.brockport.edu](mailto:scaro2@u.brockport.edu) or Dr. Desrochers via email at [mdesrochers@brockport.edu](mailto:mdesrochers@brockport.edu) or by phone (585) 395-2779. You may also contact Counseling Services at Hazen Hall at The College at Brockport via email [askacounselor@brockport.ed](mailto:askacounselor@brockport.ed) or by phone 585-395-2207 if you would like to discuss any feelings of unfairness or associated negative emotions regarding your experience as a participant in this study.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researchers, please contact The College at Brockport IRB compliance officer, Julie Wilkens, at (585) 395-2779 or [jwilkens@brockport.edu](mailto:jwilkens@brockport.edu).

#### **Statement of Consent:**

I am 18 years of age or older. I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

*I agree to be audio-recorded*     Yes  No

Signature of Investigator: \_\_\_\_\_ Date: \_\_\_\_\_

***Please keep a copy of this informed consent for your records.***

**Appendix C**

## Training Quiz Sample Questions

Listed below are sample questions for the training quizzes for each chapter.

## Chapter 8 Quiz 1:

**1. As predicted by the Theory of Planned Behavior, perceived situational constraints the effect of attitudes and values on behavioral intentions.**

(A)	are no match for
(B)	can override
(C)	enhance
(D)	nullify

**Answer: (B) can override**

## Chapter 8 Quiz 2:

**1. According to Equity Theory, which of the following behavioral responses would an individual engage in after learning that he/she has put forth more effort than others into a specific task?**

(A)	He/she may reduce his/her efforts
(B)	He/she will work even harder so as to pick up the slack for others
(C)	He/she may encourage others to put forth a greater effort to save the planet
(D)	Both A and C

**Answer: (D) Both A and C**

## Chapter 9 Quiz 1:

**1. Which of the following is not a side effect of elevated stress hormones?**

(A)	Impaired memory and concentration.
(B)	High blood pressure.
(C)	Digestive distress.
(D)	None of the above; all of the side effects listed above may occur as a result of having elevated stress hormones.

**Answer: (D) None of the above; all of the side effects listed above may occur as a result of having elevated stress hormones.**

## Chapter 9 Quiz 2:

**1. Which of the following does not accurately describe industrial agricultural practices?**

(A)	Healthier food has been produced during the age of industrial agriculture than during pre-industrial agriculture.
(B)	Industrial agriculture uses 70% of the world's supply of freshwater.
(C)	Industrial agriculture is dependent on fossil fuels.
(D)	Industrial agriculture requires the use of chemical fertilizers and pesticides.

**Answer: (A) Healthier food has been produced during the age of industrial agriculture than during pre-industrial agriculture.**

## Chapter 10 Quiz 1:

**1. Which of the following is true about fear and aversion to elements of the natural world?**

(A)	It is unnatural to experience fear or aversion to other living things.
(B)	Fear and aversion are not compatible with biophilia.
(C)	Frightening experiences in nature are not always perceived as negative experiences.
(D)	Only humans experience aversion to other species.

**Answer: (C) Frightening experiences in nature are not always perceived as negative experiences.**

## Chapter 10 Quiz 2:

**1. Each of the following has been described as a benefit of a restorative environment except:**

(A)	Promote restful sleep.
(B)	Relieve mental fatigue.
(C)	Alleviate negative emotions and stress.
(D)	Replenish attentional capacity.

**Answer: (A) promote restful sleep.**

**Appendix D**

## Post-test and Retention Test Sample Questions

**Listed below are sample questions for the post-tests for each chapter. Retention test questions were variations of the questions used for chapter post-tests.**

Chapter 8:

**1. According to Equity Theory, which of the following behaviors would not be used by an individual who is trying to conserve electricity?**

(A)	Alexandra feels she is doing more than her roommate to conserve electricity, so Alexandra pressures her roommate to do more.
(B)	Alexandra feels she is doing more than her roommate to conserve electricity, so Alexandra stops trying so hard.
(C)	Alexandra feels she is doing more than her roommate to conserve electricity, but she convinces herself it is because she has more ideas than her roommate does about where to cut back.
(D)	Alexandra feels she is doing more than her roommate to conserve electricity, but to maintain their friendship, she accepts her roommate's behavior.

**Answer: (D) Alexandra feels she is doing more than her roommate to conserve electricity but to maintain their friendship, she accepts her roommate's behavior.**

Chapter 9:

**1. Which of the following best illustrates the effects of the Standard American Diet on the environment?**

(A)	The Standard American Diet is beneficial to the environment in that there is a high demand for fruits and vegetables grown by farmers who use sustainable farming techniques.
(B)	The Standard American Diet creates a greater demand for food produced and packaged via resource-intensive processes.
(C)	The Standard American Diet creates a greater demand for food produced and packaged via resource-preserving processes.
(D)	Both A and C.

**Answer: (B) The Standard American Diet creates a greater demand for food produced and packaged via resource-intensive processes.**

Chapter 10:

**1. A group of participants is exposed to cognitively demanding tasks as a means of tiring their minds. This leads the participants to become distractible. The participants are then exposed to natural environments to restore their minds. It is likely that these participants are involved in a study on which of the following theories:**

(A)	attention restoration theory
(B)	psycho-evolutionary theory
(C)	both A and B
(D)	neither A nor B

**Answer: (A) attention restoration theory**

**Appendix E**

Experimenter Answer Sheet

*Record the correct number of responses to quiz questions for each group of participants (according to quiz number).*

Quiz 1:

Learning Criterion: \_\_\_\_\_

Group 1: \_\_\_\_\_

Winning Group: \_\_\_\_\_

Group 2: \_\_\_\_\_

Group 3: \_\_\_\_\_

Group 4: \_\_\_\_\_

Group 5: \_\_\_\_\_

Quiz 2:

Learning Criterion: \_\_\_\_\_

Group 1: \_\_\_\_\_

Winning Group: \_\_\_\_\_

Group 2: \_\_\_\_\_

Group 3: \_\_\_\_\_

Group 4: \_\_\_\_\_

Group 5: \_\_\_\_\_

**Appendix F**

## Demographic Information Sheet

**Demographic Information**

ID #: \_\_\_\_\_

**PLEASE USE THE ID # ASSIGNED TO YOU DURING SESSION 1****Date:****Experimenter:**

Gender:

 Female Male

Age: \_\_\_\_\_

Race/Ethnicity (Optional):

 White Black or African American Latino/Hispanic Native American or Alaska Native Asian Native Hawaiian or Pacific Islander Biracial or Other (Please describe): \_\_\_\_\_

Year in College: \_\_\_\_\_

Major: \_\_\_\_\_

Minor: \_\_\_\_\_

Cumulative GPA:

\_\_\_ First semester, no cumulative GPA

\_\_\_ &lt; 2.0

\_\_\_ 2.0 – 2.5

\_\_\_ 2.6 – 3.0

\_\_\_ 3.1 – 3.5

\_\_\_ 3.6 – 4.0

Psychology GPA:

\_\_\_ First semester, no cumulative GPA

\_\_\_ &lt; 2.0

\_\_\_ 2.0 – 2.5

\_\_\_ 2.6 – 3.0

\_\_\_ 3.1 – 3.5

\_\_\_ 3.6 – 4.0

Average number of hours spent studying per week for classes in general:

Average number of hours spent studying per week for (a) psychology class(es):

- 0 -2 hours
- 3 - 5 hours
- 6 - 8 hours
- >8 hours

- 0 - 2 hours
- 3 - 5 hours
- 6 - 8 hours
- >8 hours

**Appendix G**

## Subjective Evaluation

The Subjective Evaluation measure administered to participants during Sessions 1 – 3 is shown below. Items 1 – 6 were included on the measure administered during Sessions 1 – 3. Items 7 – 10 were only included on the measure administered during Session 3.

**Date:****Experimenter:****Condition:****Group # for today's session:** \_\_\_\_\_**ID #:** \_\_\_\_\_**Subjective Evaluation**

Please evaluate your experience during the intervention used in today's experimental session by filling out this form.

1. How helpful were the requirements for winning the \$5.00 cash reward in this session in relation to learning the material from the lecture video?

Not at all helpful				Neither helpful nor unhelpful			Extremely helpful
1	2	3	4	5	6	7	

2. How much do you think you learned about the material included in the lecture videos when following today's requirements for winning the \$5.00 cash reward?

Not much at all			A moderate amount		A large amount
1	2	3	4	5	6

3. How easy/difficult was it to fulfill the requirements to receive a raffle ticket today?

Very difficult			Neither easy nor difficult		Very easy
1	2	3	4	5	6

4. I enjoyed the requirements that were in place today to earn the \$5.00 cash reward.

Disagree completely				Neither agree nor disagree			Agree completely
1	2	3	4	5	6	7	

5. Would you like to use today's requirements for winning the \$5.00 cash reward in your college classes?

Definitely would not			May or may not			Definitely would
1	2	3	4	5	6	7

6. How desirable was the \$5.00 as a reward in today's experimental session?

Very undesirable			Neither desirable or undesirable			Very desirable
1	2	3	4	5	6	7

For the following questions, please indicate how much you agree or disagree with the statement.

7. I usually do not perform well on quizzes or tests, even if I study.

Disagree completely			Neither agree nor disagree			Agree completely
1	2	3	4	5	6	7

8. When given the opportunity, I enjoy working with a group of my peers to complete class assignments.

Disagree completely			Neither agree nor disagree			Agree completely
1	2	3	4	5	6	7

Please indicate the following by **circling one response**:

9. Which requirements for winning the \$5.00 cash reward did you prefer most?

All groups of participants are given the same opportunity to earn raffle tickets and only those who successfully fulfill the requirements, receive a raffle ticket for the drawing of the \$5.00 cash reward.

All groups of participants are given the same opportunity to earn raffle tickets and raffle tickets are only distributed when all groups successfully fulfill the requirements.

All groups of participants will be given the same opportunity to earn raffle tickets and each group will receive a raffle ticket regardless of their performance.

None of the above

10. Explain your reasoning for the choice you selected in Question 9.

**Appendix H**

## Between-groups Counterbalancing of Type of Reinforcement Intervention and Academic Material across Experimental Sessions

There were two possible options for the partial Latin Square counterbalancing combinations for the reinforcement conditions and academic material used in the present study. The option used in the study was randomly selected by a researcher prior to the start of the study. Option 2 was chosen and administered to participants.

## Type of Reinforcement

A = Independent Group Contingency

B = Interdependent Group Contingency

C = Non-Contingent Reinforcement

## Audio-recorded PowerPoint Lecture

D = Chapter 8 Audio-recorded PowerPoint Lecture

E = Chapter 9 Audio-recorded PowerPoint Lecture

F = Chapter 10 Audio-recorded PowerPoint Lecture

## Option 1:

---

Group 1	
Experimental Session 1	A/D
Experimental Session 2	B/E
Experimental Session 3	C/F

---

Group 2	
Experimental Session 1	B/F
Experimental Session 2	C/D
Experimental Session 3	A/E

---

Group 3	
Experimental Session 1	C/E
Experimental Session 2	A/F
Experimental Session 3	B/D

## \*Option 2:

---

Group 1	
Experimental Session 1	A/D
Experimental Session 2	C/F
Experimental Session 3	B/E

---

Group 2	
Experimental Session 1	B/F
Experimental Session 2	A/E
Experimental Session 3	C/D

---

Group 3	
Experimental Session 1	C/E
Experimental Session 2	B/D
Experimental Session 3	A/F

**Appendix I**

## Reminder Email

Reminder:

You have volunteered to participate in the research study, A Comparison of Types of Reinforcement on College Students' Academic Performance. **This study is worth up to 4 research participation credits (1 for each experimental session you attend)** and you will also receive the opportunity to be entered into multiple drawings to win a \$5.00 cash reward (on intervention session days).

We ask that you please come to the scheduled experimental session on:

**\*Date\* (today), from \*time frame\*.**

Locations are as follows:

**Experimental Group 1: Room number (if \*name of experimenter\* was your experimenter)**

**Experimental Group 2: Room number (if \*name of experimenter\* was your experimenter)**

**Experimental Group 3: Room number (if \*name of experimenter\* was your experimenter)**

**Appendix J**

## Script for Consent Form

Read aloud all script in italics.

*To participate in this study, you must be 18 years of age or older, have no background education in the psychology of sustainability, or have previous experience as a participant in this study. This study was previously conducted last semester during Spring 2017. If you participated in the spring, you cannot participate now. This is important to the results of the study. This study will take place over the course of four experimental sessions, thus it is worth four research participation credits. The first three experimental sessions will involve different in-class interventions in a contrived classroom setting (each experimental session having a different intervention taking place). We will be evaluating the effectiveness of each of these interventions based on your performance on several quizzes. You will be watching audio-recorded PowerPoint lectures on the psychology of sustainability and working with a small group to complete two of the quizzes and working independently on one, during each of the intervention sessions. You will also complete a subjective evaluation at the end of each intervention session. You will be given the opportunity to be entered into two raffles to win a \$5.00 cash reward during each of the intervention sessions. During the fourth experimental session you will work independently to complete an 18-question multiple-choice test and provide demographic information. Additionally, each experimental session will be audio-recorded to ensure that the experimenter is following the protocol accordingly. If you do not provide your consent to be audio-recorded, you will not be permitted to participate in this study.*

*This study is not meant to make anyone feel poorly about their performance on the quizzes and test measures. It is meant to determine more effective approaches to providing education to college students. If you do, however, begin to experience any negative emotions regarding your role as a participant in this study, you may contact Counseling Services at Hazen Hall for additional services. This contact information is provided to you on the consent form and if you do so choose to participate, you will receive one for your own records. You may also contact myself or Dr. Desrochers at the email addresses provided on your consent form, to learn more about the purpose of each of the three different types of reinforcement interventions used in this study as a means of reducing any negative feelings you may experience. Please take the next five minutes to read over the consent form, thoroughly consider whether you would like to participate in this study, and then if you would like to participate, please indicate that you would like to be a participant in our study by signing your name and providing today's date in the spaces provided.*

*Thank you.*

**Appendix K**

Scripts for Sessions 1 – 3

Script for Independent Group Contingency

*Please read aloud all script written in bold-faced font.*

*\*For Session 1 only*

*\*1. Hand out consent forms/Collect consent forms/answer any questions participants may have.*

*\*2. Participants (N=45) are randomly assigned to intervention conditions based on a random number drawing without replacement—10 squares of paper numbered “1,” 10 squares of paper numbered “2,” and 10 squares of paper numbered “3.” will be placed into a paper bag and drawn for each participant after signing the informed consent form. Participants who are randomly drawn “1” will be assigned to Group 1, participants who are randomly drawn “2” will be assigned to Group 2, and those who are randomly drawn “3” will be assigned to Group 3. Each of these groups will have a predetermined randomly assigned counterbalanced sequence of each of the three intervention conditions as well as audio-recorded PowerPoint lectures.*

*\*3. Participants will be taken to their appropriate classroom for the experiment.*

- 1. You will be working with a small group throughout this experiment. I will assign you to small groups now.**
- 2. Participants will then be randomly assigned a small group through a random number drawing without replacement. Three sets of squares of paper will be numbered “1-5” and placed into a paper bag. Participants who receive the same numbers will be in a small group. There will be 5 pairs of 3. Each group will be assigned a group name based on the number they have drawn (e.g., a pair of students has been formed in that they have both drawn the number 5; their assigned group name is Group 5). A second paper bag which we will refer to as the Raffle bag, will be used to place raffle tickets in for the random drawing of the prize.*
- 3. Now that you are in your small groups, I will be assigning you an ID number that you must remember throughout the entire course of the study. This is the number that you will be signing into each session with, putting on every quiz and test you take, and on the subjective evaluation and demographic information sheets you will**

**complete. Do not forget this number! Please write it down, take a photo of it with your phone, or add it into the notes app on your phone.**

4. *Each participant will randomly select a number from a paper bag. There will be 15 ID numbers written on individual squares of paper. Numbers will include “0101-0115” for Experimental Group 1, “0201-0215” for Experimental Group 2, and “0301-0315” for Experimental Group 3.*
5. **Has everyone recorded their ID number in a place that you will remember? Wait for confirmation. Great, thank you. I will have you sign in now. Please write your ID number that I just gave you next to your name on the sign in sheet. Pass out sign in sheet and collect after all participants have signed in. Thank you.**
6. **You will be watching two short audio-recorded PowerPoint lectures on the Psychology of Sustainability. After each of the lectures, you will be answering questions on a short multiple-choice quiz; 3 quizzes in all. You will work with your small groups to complete the first two quizzes and you will work independently when completing the third quiz. After each quiz, I will check your quiz, provide written feedback indicating any questions answered incorrectly, and will record your total number of correct answers on my own worksheet. After each of the first two quizzes, I will be providing raffle tickets for the chance to win a prize for those of you who have met a specified criterion.**
7. **During this session, you will be learning while an independent group contingency is in place. During this contingency condition, you will all have the opportunity to earn raffle tickets for the chance to win a reward. In order to receive a raffle ticket, each of you will be required to fulfill a predetermined learning criterion. Each criterion is a specific number of quiz questions that you and your group members will be required to get correct on each of your first two quizzes, in order to receive a ticket. Any group who meets this learning criterion will be given a raffle ticket. For example, if I state that the learning criterion is to get *at least 2* questions correct on the quiz, each group who is able to provide 2 or more correct answers, will receive a raffle ticket that will be shared between you and your group members. If you fail to answer 2 questions correctly, your group will not be given the raffle ticket. Do you have any questions?**
8. *Answer any questions participants may have.*
9. *Start PowerPoint lecture 1.*
10. *At the end of PowerPoint lecture 1, pass out Quiz 1.*
11. **You may begin to work on your quiz with your group. You will have 5 minutes and only 5 minutes to answer the questions on Quiz 1. You may begin.**

12. *Set alarm/timer for 5 minutes.*
13. **When the 5 minute period has ended: Your work period has ended. The learning criterion that must be fulfilled in order to receive a raffle ticket is to answer Quiz 1: at least \*number\* question correctly | Quiz 2: at least \*number\* questions correctly.**
14. *Go to each group check each of the quizzes. Provide written feedback indicating any questions answered incorrectly. Record the number of correct answers on the Experimenter Answer Sheet next to each group's assigned name. Check to see which of the groups on the Experimenter Answer Sheet have met the learning criterion and pass out raffle tickets to those who have fulfilled the learning criterion. One raffle ticket will be shared between members of the reinforced small group. After passing out raffle tickets, collect the quizzes from each group.*
15. *After passing out the raffle tickets to groups of participants, place the experimenter's half of the raffle ticket into the Raffle bag, and randomly select the winners of the prize.*
16. **The winner of the prize is (read the number on the selected raffle ticket).** *Distribute the five dollar cash reward to winners (each winner receives his/her own \$5.00 cash reward). Record winning group number in space provided on the Experimenter Answer Sheet.*
17. **We will now watch the second PowerPoint lecture.**
18. *Start PowerPoint lecture 2. Repeat steps 9-16, but in reference to PowerPoint lecture 2.*
19. *Pass out Quiz 3.*
20. **You will now be completing this quiz on your own. You will have 10 minutes and only 10 minutes to complete this quiz.**
21. *Set alarm/timer for 10 minutes.*
22. **When the work period has ended: Your work period has ended. I will now collect your quizzes.**
23. *Collect quizzes from participants.*
24. **You will now complete a short subjective evaluation regarding the intervention used in today's session. If you come across a question that you do not feel**

**comfortable answering, you may skip it and move on. Once you have finished your evaluation, flip it over on your desk and you may leave.**

*25. Place all quizzes, tests, and subjective evaluations in the materials folder.*

## Script for Interdependent Group Contingency

*Please read aloud all script written in bold-faced font.*

*\*For Session 1 only*

*\*1. Hand out consent forms/Collect consent forms/answer any questions participants may have.*

*\*2. Participants (N=45) are randomly assigned to intervention conditions based on a random number drawing without replacement—10 squares of paper numbered “1,” 10 squares of paper numbered “2,” and 10 squares of paper numbered “3.” will be placed into a paper bag and drawn for each participant after signing the informed consent form. Participants who are randomly drawn “1” will be assigned to Group 1, participants who are randomly drawn “2” will be assigned to Group 2, and those who are randomly drawn “3” will be assigned to Group 3. Each of these groups will have a predetermined randomly assigned counterbalanced sequence of each of the three intervention conditions as well as audio-recorded PowerPoint lectures.*

*\*3. Participants will be taken to their appropriate classroom for the experiment.*

- 1. You will be working with a small group throughout this experiment. I will assign you to small groups now.**
- 2. Participants will then be randomly assigned a small group through a random number drawing without replacement. Three sets of squares of paper will be numbered “1-5” and placed into a paper bag. Participants who receive the same numbers will be in a small group. There will be 5 pairs of 3. Each group will be assigned a group name based on the number they have drawn (e.g., a pair of students has been formed in that they have both drawn the number 5; their assigned group name is Group 5). A second paper bag which we will refer to as the Raffle bag, will be used to place raffle tickets in for the random drawing of the prize.*
- 3. Now that you are in your small groups, I will be assigning you an ID number that you must remember throughout the entire course of the study. This is the number that you will be signing into each session with, putting on every quiz and test you take, and on the subjective evaluation and demographic information sheets you will complete. Do not forget this number! Please write it down, take a photo of it with your phone, or add it into the notes app on your phone.**

4. *Each participant will randomly select a number from a paper bag. There will be 15 ID numbers written on individual squares of paper. Numbers will include “0101-0115” for Experimental Group 1, “0201-0215” for Experimental Group 2, and “0301-0315” for Experimental Group 3.*
5. **Has everyone recorded their ID number in a place that you will remember? Wait for confirmation. Great, thank you. I will have you sign in now. Please write your ID number that I just gave you next to your name on the sign in sheet. Pass out sign in sheet and collect after all participants have signed in. Thank you.**
6. **You will be watching two short audio-recorded PowerPoint lectures on the Psychology of Sustainability. After each of the lectures, you will be answering questions on a short multiple-choice quiz; 3 quizzes in all. You will work with your small groups to complete the first two quizzes and you will work independently when completing the third quiz. After each quiz, I will check your quiz, provide written feedback indicating any questions answered incorrectly, and will record your total number of correct answers on my own worksheet. After each of the first two quizzes, I will be providing raffle tickets for the chance to win a prize for those of you who have met a specified criterion.**
7. **During this session, you will be learning while an interdependent group contingency is in place. During this contingency condition, you will all have the opportunity to earn raffle tickets for the chance to earn a reward. In order to receive a raffle ticket, each of you will be required to fulfill a predetermined learning criterion. Each criterion is a specific number of quiz questions that you and your group will be required to get correct on each of your first two quizzes in order for any of you to receive a raffle ticket. All groups must fulfill the learning criterion. If you fail to do so, no one will receive a raffle ticket. For example, if I state that the learning criterion is to get *at least 2* questions correct on the quiz, each group must provide 2 or more correct answers, in order for anyone to receive a raffle ticket. If you are able to do so, you will all receive a raffle ticket that will be shared between you and your group members. If any of you fail to answer 2 questions correctly, no one will receive a raffle ticket. Do you have any questions?**
8. *Answer any questions participants may have.*
9. *Start PowerPoint lecture 1.*
10. *At the end of PowerPoint lecture 1, pass out Quiz 1.*
11. **You may begin to work on your quiz with your group. You will have 5 minutes and only 5 minutes to answer the questions on Quiz 1. You may begin.**

12. *Set alarm/timer for 5 minutes.*
13. **When the 5 minute period has ended: Your work period has ended. The learning criterion that must be fulfilled in order to receive the raffle tickets is to answer Quiz 1: at least \*number\* questions correctly | Quiz 2: at least \*number\* questions correctly.**
14. *Go to each group check each of the quizzes. Provide written feedback indicating any questions answered incorrectly. Record the number of correct answers on the Experimenter Answer Sheet next to each group's assigned name. Check to see which of the groups on the Experimenter Answer Sheet have met the learning criterion and pass out raffle tickets to those who have fulfilled the learning criterion. One raffle ticket will be shared between members of the reinforced small group. After passing out raffle tickets, collect the quizzes from each group.*
15. *After passing out the raffle tickets to groups of participants, place the experimenter's half of the raffle ticket into the Raffle bag, and randomly select the winners of the prize.*
16. **The winner of the prize is (read the number on the selected raffle ticket).** *Distribute the five dollar cash reward to winners (each winner receives his/her own \$5.00 cash reward). Record winning group number in space provided on the Experimenter Answer Sheet.*
17. **We will now watch the second PowerPoint lecture.**
18. *Start PowerPoint lecture 2. Repeat steps 9-16, but in reference to PowerPoint lecture 2*
19. *Pass out Quiz 3.*
20. **You will now be completing this quiz on your own. You will have 10 minutes and only 10 minutes to complete this quiz.**
21. *Set alarm/timer for 10 minutes.*
22. **When the work period has ended: Your work period has ended. I will now collect your quizzes.**
23. *Collect quizzes from participants.*

**24. You will now complete a short subjective evaluation regarding the intervention used in today's session. If you come across a question that you do not feel comfortable answering, you may skip it and move on. Once you have finished your evaluation, flip it over on your desk and you may leave.**

*25. Place all quizzes, tests, and subjective evaluations in the materials folder.*

## Script for Non-Contingent Reinforcement

*Please read aloud all script written in bold-faced font.*

*\*For Session 1 only*

*\*1. Hand out consent forms/Collect consent forms/answer any questions participants may have.*

*\*2. Participants (N=45) are randomly assigned to intervention conditions based on a random number drawing without replacement—10 squares of paper numbered “1,” 10 squares of paper numbered “2,” and 10 squares of paper numbered “3.” will be placed into a paper bag and drawn for each participant after signing the informed consent form. Participants who are randomly drawn “1” will be assigned to Group 1, participants who are randomly drawn “2” will be assigned to Group 2, and those who are randomly drawn “3” will be assigned to Group 3. Each of these groups will have a predetermined randomly assigned counterbalanced sequence of each of the three intervention conditions as well as audio-recorded PowerPoint lectures.*

*\*3. Participants will be taken to their appropriate classroom for the experiment.*

- 1. You will be working with a small group throughout this experiment. I will assign you to small groups now.**
- 2. Participants will then be randomly assigned a small group through a random number drawing without replacement. Three sets of squares of paper will be numbered “1-5” and placed into a paper bag. Participants who receive the same numbers will be in a small group. There will be 5 pairs of 3. Each group will be assigned a group name based on the number they have drawn (e.g., a pair of students has been formed in that they have both drawn the number 5; their assigned group name is Group 5). A second paper bag which we will refer to as the Raffle bag, will be used to place raffle tickets in for the random drawing of the prize.*
- 3. Now that you are in your small groups, I will be assigning you an ID number that you must remember throughout the entire course of the study. This is the number that you will be signing into each session with, putting on every quiz and test you take, and on the subjective evaluation and demographic information sheets you will**

**complete. Do not forget this number! Please write it down, take a photo of it with your phone, or add it into the notes app on your phone.**

4. *Each participant will randomly select a number from a paper bag. There will be 15 ID numbers written on individual squares of paper. Numbers will include “0101-0115” for Experimental Group 1, “0201-0215” for Experimental Group 2, and “0301-0315” for Experimental Group 3.*
5. **Has everyone recorded their ID number in a place that you will remember? Wait for confirmation. Great, thank you. I will have you sign in now. Please write your ID number that I just gave you next to your name on the sign in sheet. Pass out sign in sheet and collect after all participants have signed in. Thank you.**
6. **You will be watching two short audio-recorded PowerPoint lectures on the Psychology of Sustainability. After each of the lectures, you will be answering questions on a short multiple-choice quiz; 3 quizzes in all. You will work with your small groups to complete the first two quizzes and you will work independently when completing the third quiz. After each quiz, I will check your quiz, provide written feedback indicating any questions answered incorrectly, and will record your total number of correct answers on my own worksheet. After each of the first two quizzes, I will be providing raffle tickets for the chance to win a prize.**
7. **During this session, you will be learning while non-contingent reinforcement is in place. During this condition, you will all receive a raffle ticket to share between you and your group members after completing each of the first two quizzes. Do you have any questions?**
8. *Answer any questions participants may have.*
9. *Start PowerPoint lecture 1.*
10. *At the end of PowerPoint lecture 1, pass out Quiz 1.*
11. **You may begin to work on your quiz with your group. You will have 5 minutes and only 5 minutes to answer the questions on Quiz 1. You may begin.**
12. *Set alarm/timer for 5 minutes.*
13. **When the 5 minute period has ended: Your work period has ended.**
14. *Go to each group check each of the quizzes. Provide written feedback indicating any questions answered incorrectly. Record the number of correct answers on the*

*Experimenter Answer Sheet next to each group's assigned name. Pass out a raffle ticket to each small group. One raffle ticket will be shared between members of the reinforced small group. After passing out raffle tickets, collect the quizzes from each group.*

15. *After passing out the raffle tickets to groups of participants, place the experimenter's half of the raffle ticket into the Raffle bag, and randomly select the winners of the prize.*
16. **The winner of the prize is (read the number on the selected raffle ticket).** *Distribute the five dollar cash reward to winners (each winner receives his/her own \$5.00 cash reward). Record winning group number in space provided on the Experimenter Answer Sheet.*
17. **We will now watch the second PowerPoint lecture.**
18. *Start PowerPoint lecture 2. Repeat steps 9-16, but in reference to PowerPoint lecture 2*
19. *Pass out Quiz 3.*
20. **You will now be completing this quiz on your own. You will have 10 minutes and only 10 minutes to complete this quiz.**
21. *Set alarm/timer for 10 minutes.*
22. **When the work period has ended: Your work period has ended. I will now collect your quizzes.**
23. *Collect quizzes from participants.*
24. **You will now complete a short subjective evaluation regarding the intervention used in today's session. If you come across a question that you do not feel comfortable answering, you may skip it and move on. Once you have finished your evaluation, flip it over on your desk and you may leave.**
25. *Place all quizzes, tests, and subjective evaluations in the materials folder.*

**Appendix L**

## Experimental Session 4 Script

Read all script in bold font.

**Thank you for attending our final experimental session. During this session, you will be taking an 18-question multiple-choice test. *Please* take your time and answer these questions to the best of your ability. You will have thirty minutes to work on this. I will be setting a timer to indicate the start and end of your test period. Please raise your hand once you have completed your test and I will collect it. Additionally, I ask that you complete the demographic information sheet. You may complete this as soon as you finish your test, even if you finish the test before the thirty-minute test period has ended. Once you have finished each of these, please bring them to me and you may leave.**

**Again, thank you for your time and good luck with the rest of your semester!**

## Appendix M

### Debriefing Form

#### Debriefing

Thank you for participating in the study, A Comparison of Types of Reinforcement on College Students' Academic Performance. The purpose of this study is to determine possible differences that may exist in the effectiveness of independent and interdependent group contingencies compared to non-contingent reinforcement, when applied in a college classroom context. Specifically, this study has been conducted to compare a group contingency in which each small group of participants had the opportunity to earn a prize based on each small group's *own* success in providing a specific number of correct answers to quiz questions (an independent group contingency) with a group contingency in which each small group of participants had the opportunity to earn a prize based on *all* small groups success in providing a specific number of correct answers to quiz questions (an interdependent group contingency). Further, these two types of group contingencies will be compared with a non-contingent reinforcement intervention in which reinforcement was provided to all small groups of participants, regardless of their quiz performance. This study will allow the primary investigators to identify effective approaches to educating college students. This study is important in that it will provide the primary investigators with novel implications of the use of each of these group contingencies. More specifically, this study will be the first of its kind in that the effectiveness of these group contingencies have not been tested in a college classroom context or using a within-subject experimental design. The information from this study will serve as a foundation for a thesis of one of the primary investigators. In this study, we asked participants to watch three PowerPoint lecture videos, work with a partner on six quizzes, work independently on three quizzes, and complete a follow-up test as well as demographic and subjective evaluation self-reports. Past research has demonstrated an interdependent group contingency as being more effective than an independent group contingency in changing behaviors used by students in a grade school classroom context, while other research has found each of these group contingency interventions to be equally effective. We expect to find a significant difference between independent and interdependent group contingencies when used to improve the academic performance of college students.

If you would like to learn more about the independent and interdependent group contingencies and non-contingent reinforcement, learn about the results of this study, or discuss any negative emotions you may have experienced due to any of the reinforcement interventions used, you may contact primary investigators, Stacey Caron ([scaro2@u.brockport.edu](mailto:scaro2@u.brockport.edu)) or Dr. Marcie Desrochers ([mdesrochers@brockport.edu](mailto:mdesrochers@brockport.edu)) for additional information. Additionally, if you would like to discuss the experimental conditions, any negative emotions regarding the reinforcement interventions used, or your role as a participant in this study, you may also contact the primary investigators as well as Counseling Services at Hazen Hall at 585-395-2207 or [askacounselor@brockport.edu](mailto:askacounselor@brockport.edu).

Thank you for your participation!