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Problem Solving and Functional Fixedness: A Comparison Between Eco-Reps and Non Eco-Reps

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Author Note

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Abstract

A quasi experiment was conducted to examine functional fixedness and creative problem solving. The purpose of this research was to attempt to identify differences in cognitive ability between recyclers and non recyclers. This researcher investigated whether recycling group affiliation or priming for functional fixedness would affect task performance among college students. A tower building activity was developed for this study to determine if members of a college recycling group, the Eco-Reps, would complete a problem solving activity faster than non Eco-Reps. Some participants in each group were primed for functional fixedness. This researcher hypothesized that Eco-Reps would complete the task faster than non Eco-Reps. A second hypothesis was that participants primed for functional fixedness would complete the task slower than participants who were not primed for functional fixedness. A 2x2 factorial design was used to examine Eco-Rep group affiliation and priming for functional fixedness. The results of a two-factor ANOVA calculation revealed a statistically significant main effect for task completion time between participants primed and not primed for functional fixedness. The times were faster for the not primed for functional fixedness group. The ANOVA did not reveal differences in task completion times between Eco-Reps and non Eco-Reps and the interaction was also not significant. Some results of this study imply that those who participate in a university recycling program may not be more readily able to utilize objects in atypical manners. The results of this study may be valuable to organizations with members who wish to increase recycling by encouraging individuals to reuse disposable objects in atypical ways. These results also indicate that specific training related to reusing disposable items as a form of recycling is necessary to decrease functional fixedness which could increase recycling behaviors.

Keywords: functional fixedness, Eco-Rep, recycling, problem solving, creativity

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A society that lacks human creativity would be drastically different than the one Americans live in today. Without individual creativity artistic products would lack the essence that makes one form of expression unique from another. Businesses could be affected and technology may progress much slower. A world without creativity is difficult to envision because creative thinking is practiced by the majority and may be necessary for human survival.

From an evolutionary standpoint creativity has been essential since the beginning of humankind. Those who could not develop innovative ways to hunt or gather food and build shelter did not survive. Creative thinking allowed some of the first humans to develop weapons for hunting and strategies for effective shelter building. When communication was lacking between groups or societies, it was necessary for an individual to establish his or her own means of survival. Through zooarchaeological and skeletochronological analyses Rendu (2010) determined that the Neanderthals who inhabited southwestern France adapted their hunting techniques and settlement patterns with the change of seasons in order to maximize chances of survival. With few tools and no documented forms of effective survival strategies to reference, these individuals survived because of their own creative approaches to strategic hunting and shelter usage.

In modern society tools are essential to survival. Tools are used on a daily basis to solve problems and make life easier. Many tools are designed and created specifically for a particular function. When a specialized tool is not available to complete an activity, objects can be used in an atypical manner to achieve the same solution. The concept of functional fixedness was originally described by Karl Duncker (1945) who defined it as "…a mental block against using an object in a new way that is required to solve a problem" (p. 87). Functional fixedness can further be explained as “The tendency in problem-solving to evaluate objects or devices only in terms of their conventional use rather than in terms of all potential uses” (Academic Press Dictionary of Science and Technology, 1992). If an individual demonstrates functional fixedness the person is unable to utilize an object in an atypical manner. Functional fixedness plays a large role in problem solving. Oftentimes individuals are challenged to perform tasks without the availability of a wide variety of tools. In these instances where there is no specific tool designed for the purpose of performing that task, the problem solver must overcome functional fixedness and use a creative approach to solve the problem using readily available objects in an unusual manner as problem solving tools.

Adamson (1952) replicated a study that included three functional fixedness problems that were originally created by Duncker (1945). In the original experiment referred to as The Candle Problem, participants were instructed to attach a candle to a wall using a book of matches, a candle, and a box of tacks. In order to successfully solve the problem participants needed to attach the lid of the tack box to the wall to create a platform on which to place the candle. When presentation of materials included a box filled with tacks as opposed to an empty box next to a pile of tacks, participants were primed for functional fixedness because they perceived the box as a container. Adamson’s results replicated Duncker’s in that participants primed for functional fixedness solved The Candle Problem significantly slower than those who were not primed for functional fixedness. The research of Adamson (1952) and Duncker (1945) indicate that presentation of materials can affect functional fixedness. When an individual encounters an object that is demonstrating its design characteristics, which is referred to as a preutilization condition (Adamson, 1952), the person is less likely to perceive alternative uses for the object.

While presentation of materials can induce functional fixedness in a problem solving activity, there are other factors than can increase the likelihood of functional fixedness occurring. Glucksberg (1964) conducted research on the influence of drive on functional fixedness. The researcher sought to determine if rewards decreased or intensified functional fixedness in a problem solving activity. Participants were required to create a wire circuit without enough wire and could only complete the circuit using a screwdriver, which was the object of interest in this task. Participants were either primed or not primed for functional fixedness, referred to as preutilization or non preutilization condition respectively. A second independent variable was high or low drive. Individuals in the high drive condition were motivated to perform the task by being offered a monetary reward for fast completion of the task. Participants in the low drive condition were instructed to complete the task but were not offered any reward. Drive significantly influenced task performance but only in the primed for functional fixedness condition. Performance was significantly slower in the high drive functional fixedness condition compared to the low drive functional fixedness condition. These results indicate that when an individual is primed for functional fixedness rewards and incentives may hinder creativity and performance. When a problem solving task is relatively easy because the individual is not primed for functional fixedness, level of drive does not affect performance.

Age may play a unique role in problem solving activities when functional fixedness is a factor. German and Defeyter (2000) observed 5, 6, and 7 year old children attempting to complete a functional fixedness task that included either a preutilization or a non preutilization condition. Five year olds did not perform significantly different when primed for functional fixedness compared to those who were not primed. This was contrary to the performance of 6 and 7 year olds, who performed slower in the preutilization condition. In addition, 5 year olds in the functional fixedness condition completed the task significantly faster than 6- and 7-year-olds in the same preutilization condition. These results are contrary to the notion that intelligence and problem solving abilities improve with mental development. Defeyter and German (2003) created a novel functional fixedness task and the results of this study replicated the findings of their previous research. For this experiment the researchers controlled for the participant's prior knowledge about the function of the object because all of the materials used for the problem solving activity in this research were created solely for that experiment. Participants were taught about the function of each novel object, and then subsequently were required to use one of the objects in an atypical manner to solve the problem.

The results of German and Defeyter (2000) and Defeyter and German (2003) may be explained by the notion that younger children perceive the function of an item in terms of the user's goal for a task, while older children perceive the function of an item in terms of the creator's goals for the use of that item. German and Johnson (2002) found that 5 year old children believe an object's purpose is based on how an individual intentionally uses a particular item. The 5 year olds in the experiment defined an object's function in terms of the creator's intended use and then redefined the use of the same object after it had been used alternatively by a new user.

Functional fixedness has been observed cross-culturally. German and Barrett (2005) administered a functional fixedness task to members of the Shuar tribe, a group that lives in a non industrialized region of the Amazon in Ecuador. The Shuar are raised in a community without objects with highly specialized functions and must therefore creatively utilize the objects in their surroundings for multiple purposes. The results revealed that even though the Shuar have a limited variety of objects in their culture, they were still prone to functional fixedness with objects such as a box.

Research by Maddux, Adam and Galinsky (2010) indicates that American and French students who have lived abroad and understand cultural differences have increased creativity and perform better on functional fixedness tasks such as The Candle Problem. The researchers collected data from 135 MBA students at a Midwestern university in the United States. Two thirds of the participants had previously lived abroad. Participants were instructed to write about a personal multicultural experience that involved foreign behaviors, social expectations, or traditions in which the participant learned something new about a foreign culture. In one group participants were instructed to choose a cross-cultural experience with underlying causes that could be explained. Each participant in the alternative group was instructed to write about a cross-cultural experience for which the participant was not able to identify the underlying reasons. After completing this priming task all participants attempted a computer based version of The Candle Problem. The group that had lived abroad and were primed to think of a learning experience that could be explained in the context of the foreign country were significantly more successful at solving The Candle Problem. The researchers suggest that certain multicultural experiences allow students to understand that the same problems can be solved with various approaches. The process of adapting to a new culture heightens cognitive flexibility which contributes to the ability to solve problems with a multitude of creative strategies. Behaviors, attitudes, and social cues must be adapted and relearned in order to increase successful socialization in a new culture. Open mindedness and understanding new cultural traditions are associated with overcoming functional fixedness. In order to perceive objects as functioning in a manner that is different than how participants previously learned to use the object, individuals must adapt their perceptions to all potential uses of an object.

Fixation refers to referencing examples from a similar situation or modeling the solutions of a similar task to solve the present problem (Duncker, 1945). Fixation can hinder creativity because it can cause an individual to apply strategies that are not useful to a specific problem and limit the diversity of problem solving strategies utilized. Chrysikou and Weisberg (2005) investigated the effects of providing pictorial examples of flawed products when asking individuals to design a product without similar flaws. In the study participants in the control condition were given a set of instructions for the product they were to design. The fixation group was given the same instructions, a picture of the flawed product, and a description of its problematic features. The defixation group was given directions, a picture of the flawed design, and specific instructions to avoid using certain elements of the flawed design. Upon redesigning the product participants in the fixation group included elements of the original design that had previously been indicated as flawed. In the defixation condition however, participants developed products that were more different from the original design. The results of this research reveal that fixation effects can be reduced with the use of defixating instructions in a problem solving task.

The results of Chrysikou and Weisberg's study provide evidence that fixation can be avoided. More specifically, object function fixation can be avoided in a particular problem solving scenario with instruction of what strategies to avoid. Therefore, it may be possible to decrease object function fixation by educating individuals about the versatility of objects. One predominant industry that promotes object versatility is the recycling industry. Recycling groups and education programs educate people about the importance of and how to recycle, reduce, and reuse.

Vining and Ebreo (1990) investigated differences between recyclers and non recyclers. Differences in demographic characteristics and recycling knowledge and motives were compared in a sample of 197 Illinois households where residents had the opportunity to recycle. Both recyclers and non recyclers indicated concern for sustaining the environment. Although there were no significant differences in demographic characteristics, researchers noted differences in recycling knowledge and motivational factors to recycle. Recyclers in this study were more knowledgeable about what items could be recycled and how to recycle. Non recyclers had a greater concern than recyclers for the convenience of recycling and the financial incentives associated with recycling.

Although monetary incentives can be a motivational factor to recycle, recycling behaviors have been observed without financial motivation. Recycling behavior can increase as a result of pledging to recycle. Wang and Katzev (1990) observed a 47% increase in paper recycling among elderly adults in a retirement home when the individuals agreed to and signed a commitment pledge to recycle paper. The researchers also observed an increase in recycling among college students who agreed to either an individual commitment, group commitment, or had been offered token reinforcers to recycle. Students agreed to recycle during a four week period, and recycling behavior increased three to five times more for these students when compared to those in a control condition. After the four week period however, recycling only persisted among those who pledged individual commitments.

Hornik, Cherian, Madansky, and Narayana (1995) conducted a meta-analysis of 67 research studies conducted since 1968 in order to investigate the internal incentives, external incentives, internal facilitators, and external facilitators affecting consumer recycling behavior. Analyses indicated that on average internal facilitators were the most predictive of continual recycling behavior, followed by external incentives, then internal incentives, and finally external facilitators. Results revealed that internal facilitators such as knowledge about and commitment to recycling are the best predictors of recycling behavior. Those who were knowledgeable about the importance of recycling and convenient means to recycle were likely to recycle. Satisfaction with recycling and locus of control were also strong intrinsic motivators to recycle. Social influences from family members, friends, and neighbors were significant motivators as well. A monetary reward was a strong external incentive, however it would not sustain the same degree of recycling behavior after the payment was no longer offered. The researchers noted that the interaction between multiple variables contributes to overall recycling behavior. It is unlikely that a single factor is responsible for initiating and sustaining recycling behaviors.

Previous research has addressed the motivational factors associated with recycling behaviors but few studies have examined the psychological differences between recyclers and non recyclers. The present study was designed to investigate cognitive abilities and problem solving flexibility of individuals who engage in recycling, reducing, and reusing. This research was designed to determine if individuals educated about recycling are more readily able to utilize items for alternative purposes in a functional fixedness problem solving task. In this study the educated individuals were members of a campus organization referred to as the Eco-Reps. Susceptibility to functional fixedness was measured by recording time to complete the task. This researcher hypothesized that students who were currently or previously members of the Eco-Reps would perform better on a functional fixedness problem solving task. The Eco-Reps are a student organization that promotes and facilitates recycling on campus and at university events. Eco-Reps are educated about recycling during weekly meetings and on excursions to locations such as the local recycling center and landfill. Eco-Reps are expected to recycle in their own homes as a requirement of group membership. Time required for task completion for a functional fixedness task was compared between Eco-Reps and non Eco-Reps. This researcher predicted that task completion times would be faster for Eco-Reps than non Eco-Reps for the problem solving activity. This researcher also predicted that task completion times would be longer in the functional fixedness primed condition compared to the not primed condition for both groups (Eco-Reps and non Eco-Reps).

Method

Design

This research was quasi-experimental and involved use of a 2 x 2 factorial design. Partial random assignment technique was used to assign Eco-Rep and non Eco-Rep participants to one to one of two experimental conditions, either primed for functional fixedness or not primed.

Participants

The research included students attending a liberal arts university in the southeastern United States. A non-random convenience sample of 22 non Eco-Rep (NER) students participated in this study. A non-random convenience sample of 16 Eco-Reps (ER) was included as the other experimental group for research. Thirteen of the ERs were currently members of the Eco-Rep student organization, and three ERs had been members of the organization in a previous semester. Data were analyzed for all participants who participated in this study. Participants ranged in age from 18 to 56 years and the mean age was 21.87 years. There were 12 men, 25 women, and 1 participant who did not indicate gender. Of the non Eco-Reps there were 13 psychology majors, 2 marine science majors, 2 communication majors, 2 early childhood education majors, 1 economic major, 1 exercise and sports science major, and 1 sociology major. This group included two sophomores, ten juniors, ten seniors, and no freshmen. Fifteen non

Eco-Reps indicated that they currently recycle. The Eco-Rep group included 10 marine science majors, 1 communication major, 1 elementary education major, 1 history major, 1 English major, 1 biology major, and 1 sociology/ marine science double major. Participants in this group included three sophomores, nine juniors, three seniors, one graduate student, and no freshmen. All of the 16 Eco-Reps claimed to recycle.

Materials

All testing took place in a psychology testing room in a science building, or in a specific classroom in a second science building on campus. The testing rooms were selected based on convenience for the researcher. Both testing facilities included a table where participants could perform the task, and a table near where the researcher was seated. Three chairs were in each testing room; one for the participant, one for the experimenter, and one on which to place the participant's personal belongings. A stop watch was used to time the participant's performance. The participants were required to build a tower 16 inches tall using specific materials provided for them. The nature of this task was similar to the box problem developed by German and Defeyter (2000). A white towel (length = 34.5 in., width = 19 in.) was used to cover the objects on the table prior to the start of data collection. The potential tower building objects included three wooden cubes of equal dimensions (length = 4 in., width = 3.5 in., height = 4 in.) and a small, rubber, ball (circumference = 3 ¼ in.). Other objects included a flat, metal circle that was manufactured to be part of the lid for a Mason jar (diameter = 2 5/8 in.), a cotton swab (length = 3 in.) and a gallon-sized Ziploc bag. A demographic survey developed by this researcher was used to collect participant information pertinent to this research (see Appendix A for survey copy). A standard informed consent form was also developed by the researcher for use in this study (see Appendix B for informed consent copy).

Procedure

This investigator met with the university's Sustainability Coordinator who is the leader of the ERs in order to obtain permission to solicit participants from the ER student group. The researcher attended an Eco-Rep group meeting and solicited participants from the group. Upon entering the meeting room the researcher informed students that he was conducting research to investigate problem solving and participation would require about 20 minutes. Eco-Rep students could individually participate in the research in a nearby classroom during the time of the group meeting. The students who did not participate in the study during this time period were asked at the conclusion of the Eco-Rep meeting to schedule an appointment time to meet for testing at a future date.

Participation of NER students was acquired by soliciting students in two different university classes. These classes were selected based on convenience for the researcher's schedule. Students in one of these classes were offered by their professor 10 extra credit points on a grade for participation in this research. Students in these classes were read a similar solicitation statement as for the ER group and selected times convenient for their schedules in which to participate in the study. Students recorded their appointment times in a scheduling book provided by the researcher. A copy of the researcher's contact information and the appointment time was provided for each student. Additional students were solicited by the investigator by approaching groups or individuals in areas in close proximity to the testing facility. These areas included the student lounge and an outdoor study area. Individuals who agreed to speak with the researcher were read the solicitation statement and could either participate immediately or schedule an appointment time for testing.

Based on the quasi-experimental nature of this research participants were initially separated based on their student group status: Eco-Rep and non Eco-Rep. A partial random assignment technique was used to assign participants to either the functional fixedness or non functional fixedness condition. This type of assignment ensured equal sample sizes for the two priming groups. Priming for functional fixedness or not was manipulated based on the presentation of the materials. The functional fixedness group was established by presenting to the participant the tower building objects which had been placed inside the Ziploc bag. This technique was intended to prime the participants to consider the bag as a container. For the non functional fixedness group all of the items, including the bag, were placed on the table and the objects were placed on top of the empty Ziploc bag. See Appendices C and D accordingly for images of the presentation of materials. When the tower building objects were placed inside the Ziploc bag the intent was for the participant to be primed to be functionally fixated on the possible uses of the bag. When the other tower building objects were displayed alongside the bag the intent was for the participant to be less likely to be functionally fixated on potential uses for the bag.

Participants were individually tested. Prior to every data collection session the tower building materials were arranged on the table where the participant was to build the tower. The objects were covered with a white towel to maintain ambiguity of what materials were available prior to the start of testing. At the start of each data collection session the participant was greeted and thanked for coming to the appointment. Only the researcher and participant occupied the room during testing and the door was closed to reduce noise from outside the testing room. The participant was instructed to place any personal belongings on a chair in the corner of the room. The participant was then asked to be seated at the table where covered objects were placed. Next, the participant was asked to read an informed consent form and sign it. A copy of the form was offered to the participant. Next, the participant completed the demographic survey. The participant was then read instructions to inform him or her of the task. The participant was told: “For this experiment I will ask you to build a freestanding tower using the materials I provide for you. You may use any of the materials on the table. The goal of this task is to build a freestanding tower high enough to exceed the bottom of the tape mark on the wall in front of you. You may not use the wall for support. Your task will be completed once you have constructed the tower. I will record how long it takes you to complete the tower building activity. You may remain seated or stand during this activity, whichever you prefer. Once you begin the task, please do not talk to me or ask questions. If you have not solved the problem within 15 minutes I will ask you to stop. Please continue trying the problem until I ask you to stop. Do you have any questions? Are you ready to start? Ok, you may begin.”

After the participant was read the instructions and indicated he or she understood the nature of the task, the towel was removed from the objects on the table. At this time the stopwatch was activated to record the length of time for task completion. This investigator silently observed the participant but remained seated at the researcher’s table and did not maintain eye contact with the participant. The researcher attempted to appear busy by working with a laptop computer while the participant attempted the problem solving activity in order to reduce the chance that the participant would ask the researcher for help or clues. The researcher maintained silence unless certain questions were asked by the participant. If the participant asked, “Is this possible?” the response, “Yes, it is possible” was provided. If the participant asked a question about which materials could be used, the following response was provided: “You may use any of the materials provided to you on the table.” Finally, if the participant asked if the tower he or she had created was tall enough, the researcher responded with “yes” or “no”.

The task was completed when the participant successfully constructed a free standing tower that was 16 inches or higher. Time to complete the task was recorded. Data were recorded on an Excel spreadsheet on the laptop computer during the testing session.

In order to successfully complete the tower building task all of the blocks had to be stacked to serve as the foundation for the tower. The object of interest for this task involved the use of the gallon-sized Ziploc bag. The bag had to be inflated, sealed, and placed at the top of the tower in order to achieve the height requirements (see Appendix E for photograph of this solution). Alternatively, the bag could be opened and attached to the top block of the tower. By sealing the bag around the top block, the bag was held in place and could be upright to exceed the height requirements as shown in Appendix F. The lid, ball, and cotton swab were intended to serve no purpose in building the tower and were used to increase the difficulty of the task. The task could not be completed without use of the Ziploc bag.

Testing was completed when the participant had either successfully completed the activity or exceeded the 15 minute time limit. Participants who did not successfully complete the activity were told that the task was possible but a solution was not provided to them. All participants were asked not to discuss the experiment with any other students because that could affect the results of the study. The participant was then asked if he or she would like a copy of the results when the study was completed and if so was subsequently instructed to provide contact information on a sheet of paper provided by the researcher. At this time the participant was informed that testing was completed and the researcher thanked the participant for participating before the participant left the testing room.

Results

Data were collected from 38 participants who were included in one of the following groups: Eco-Reps primed for functional fixedness (ER-FF), Eco-Reps not primed for functional fixedness (ER-NFF), non Eco-Reps primed for functional fixedness (NER-FF), and non Eco-Reps not primed for functional fixedness (NER-NFF). The dependent variable for all participants was time in seconds to complete the problem solving activity. The maximum time for task completion was 900 seconds and the actual range of scores in this study was 52 to 900 seconds. Low scores reflect more creativity and less susceptibility to functional fixedness. Included in the ER-FF group were six women and two men who ranged in age from 19 to 22 years (mean = 20.13). The range of scores reflecting problem solving times for this group was 288 to 900 seconds, the mean score was 640.88 and the standard deviation was 266.20. In the ER-NFF group there were four women and four men whose ages ranged from 19 to 21 years (mean = 20.38). The actual range of scores for this group was 91 to 900 seconds, the mean score was 364.88 seconds and the standard deviation was 273.96. The NER-FF group included seven women, three men, and one participant who did not indicate gender. Participants' ages ranged from 19 to 56 years (mean = 25.00). Scores for participants in this group ranged from 84 to 900 seconds, the mean score was 544.73 and the standard deviation was 236.43. The NER-NFF group included eight women and three men whose ages ranged from 21 to 24 years (mean = 21.10). In this group the scores ranged from 52 to 900 seconds, the mean was 449.18 seconds and the standard deviation was 329.17 seconds. Mean problem solving times for the four groups are shown in Figure 1. The mean problem solving score for all of the Eco-Reps was 502.88 seconds and the standard deviation was 297.33. For all of the non Eco-Reps the mean score was 496.95 and the standard deviation was 283.91. The mean time for all of the participants who were primed for functional fixedness was 585.21 seconds and the standard deviation was 246.96 seconds. For all of the participants who were not primed for functional fixedness the mean was 413.68 and the standard deviation was 302.01. A summary of the mean times, standard deviations, and ranges of times for all groups can be viewed in Table 1. A 1-tailed 2 x 2 factorial ANOVA was calculated to compare mean problem solving times as a function of group, ER and NER, and priming condition, FF and NFF. There is no significant main effect for Eco-Rep affiliation, $F(1, 34) = 0$, $p > .05$, $d = 02$. There was a statistically significant main effect for functional fixedness primed (mean = 585.21) and non functional fixedness primed groups (mean = 413.68), $F(1, 34) = 3.57$, ($p = .034$), $d = .64$. Participants in the FF group performed significantly slower than participants in the NFF group. There was no significant interaction between the two independent variables, $F(1, 34) = .96$, ($p = .167$).

Discussion

The times required to complete the tower building activity for Eco-Reps and non Eco-Reps that were either primed or not primed for functional fixedness were recorded for this research. The hypothesis for this research was that participants primed for functional fixedness would complete the task significantly slower than participants who were not primed. The second hypothesis was that Eco-Reps would complete the task significantly faster than non Eco-Reps. Results of a factorial ANOVA indicated that there was nearly a statistically significant difference between the primed for functional fixedness and not primed for functional fixedness conditions ($p = .067$). A post-hoc t test was calculated to statistically analyze the difference between the groups primed or not primed for functional fixedness. The t test indicated significant group differences consistent with the hypothesis ($p = .031$). These results indicate that the pre utilization factor established by the presentation of materials differentially affected performance between groups which is consistent with previous research and could be explained by functional fixedness (Duncker, 1945; Adamson, 1952; Glucksburg 1964; German and Defeyter, 2000).

Further, results of this study indicated no statistically significant differences in time to complete the task between the Eco-Rep and non Eco-Rep groups. Apparently Eco-Reps were not more readily able to utilize objects in an atypical manner than non Eco-Reps. This finding is contradictory to the hypothesis. Based on the non significant interaction it appears that Eco-Reps are no less susceptible to functional fixedness than non Eco-Reps.

The results of this research reflect some methodological problems. One problem was that the sample size was small. In this experiment there were only 16 Eco-Reps and 22 non Eco-Reps. The small sample size was primarily due to the limited number of Eco-Rep group members. This group is limited to about 15 to 20 students per semester. In order to increase the Eco-Rep sample size students who had previously been members of this group could have been solicited. In fact three of the Eco-Reps in this research were not currently Eco-Reps but had been during the previous school semester. Due to the nature of the group one might expect that individuals who are not currently Eco-Reps still maintain the knowledge about recycling and recycling behaviors of a current Eco-Rep.

Another problem in this research involved imprecise measurements. Some of the times recorded for participants may not have accurately represented the time in which the participant overcame functional fixedness. A psychologist trained in cognition and learning noted that the tower building task developed for this experiment had face validity as a measure of problem solving creativity and functional fixedness. The dependent variable for this experiment was time required to successfully construct a tower of the required height. This score is a good measure of functional fixedness assuming that immediately or shortly after utilizing the object of interest in an atypical manner the participant completes the task. However, data collection revealed some participants recognized the bag as an item that was necessary for task completion but did not successfully solve to the problem immediately after making this realization. The researcher observed participants using three different strategies to complete the task. One method to complete the problem was to inflate the bag and seal it, and then place the inflated bag on top of the three stacked blocks. Another solution was to stack the three blocks and use the Ziploc bag in a manner similar to using a hat. The open side of the bag was placed around the top block of the stack and was sealed around the block. Thus the bag was snug on the block. The closed end of the bag dangled freely and could be propped upward and remain stiff. Both of these solutions were used by the participants. In some cases, participants utilized these methods but were unable to solve the problem or complete the task in a timely manner. Lack of immediate success was observed because participants either under inflated the bag or they did not carefully prop the bag. According to some definitions of FF, the participant overcame functional fixedness without completing the task. Therefore in future studies caution should be taken when determining when the participant overcame functional fixedness during the problem solving activity. The third strategy used to solve the problem was to fold the bag into a shape similar to a tube or pencil. Participants who used this strategy also used the distracter items (ball, lid, cotton swab) to complete the task. This method required precision and hand-eye coordination in regards to balancing the distracter items on the bag in order to successfully build the tower. The time difference between initially using the bag and completing the task in this manner was greater than in the two other solutions. In a future study extra measures should be recorded such as the time the bag is used in an atypical manner as well as the task completion time. This would help identify differences in task completion time as a result of poor hand-eye coordination or inability to properly inflate or prop the bag.

Another aspect of imprecise measures of time related to the height requirement for the tower. In this experiment the required height of the tower was demonstrated to the participant with a tape mark on the wall. In order to prevent the wall from interfering with the participant's tower building activities, the table on which the participant worked was moved approximately six inches from the wall. This may have made it difficult for some participants to identify if the tower exceeded the tape mark. Some participants asked the researcher if the task was completed, apparently unsure if their tower height met the requirements. The question, ensuring answer, and overall uncertainty about tower height required some time and thus increased task completion scores for some participants. This researcher suggests utilizing a different and more efficient indicator for the tower height requirement. A string could be attached from the ceiling to hang vertically and end at the height requirement above the table, or a model could be placed on the table to indicate the required height. A segment of PVC pipe cut to the proper length or a free standing tape measure extended to the proper height could be positioned to the proper height. Instructions would have to be changed in order to make clear to the participant that the model items could not be used to complete the tower building activity.

The results of this experiment may have been affected by participant- investigator interactions during data collection. The task instructions informed the participant not to talk or ask questions during the activity. However, not all of the participants complied with this instruction. Some participants asked if all of the materials could be used and were informed that "All of the materials presented to you on the table may be used to complete this task." Other participants did not ask questions. Participants who complied with the instructions may have had this same question but followed instructions and did not ask the question. This question is pivotal in regards to solving the problem. In order to control for this problem no questions should be answered during data collection. An alternative solution is to eliminate the instruction that talking and questions are not allowed during data collection.

This researcher suggests that the non significant results between Eco-Rep and non Eco-Rep completion times were obtained because the Eco-Reps have been taught about recycling waste products but not about reusing products. Furthermore, this researcher suggests that it may be essential to emphasize the importance of reuse in recycling education programs in order to reduce functional fixedness. In order to further examine this notion a research study could be designed to educate Eco-Reps about reuse and then test them for functional fixedness. A presentation could be developed that emphasizes the benefits of reusing products in atypical ways as opposed to buying new products. On a large scale the benefits of this education may include consumers saving money by not buying new products, reduced trips to stores to buy new items, and reduced impact on the environment as a result of less production of new materials and reuse of old materials that would otherwise contribute to landfill waste. Eco-Reps could be tested using the same functional fixedness task after participating in a reuse education program and compared to Eco-Reps who did not participate in the program. The program could include the benefits of reuse, ways to reuse, and examples of common reuse strategies.

In order to further examine whether recycling group affiliation affects functional fixedness data could be collected from a recycling group at another university or from any groups that are devoted to recycling, sustainability, or environmental consciousness such as local government funded recycling agencies, the Sierra Club, and Grassroots groups. These groups may include members who are avid recyclers trained about recycling and who incorporate recycling into many aspects of their daily lives.

The implications of this research could be beneficial to groups or individuals who wish to increase recycling behavior or creativity. If further research reveals that education about reuse strategies decreases functional fixedness, this would be valuable information for agencies that intend to promote recycling by advertising the cognitive benefits of recycling. As recycling in this country continues to increase, groups and agencies are implementing different strategies to increase recycling among consumers. Research has shown that extrinsic motivators can be used to increase recycling behaviors (Hornik, Cherian, Madansky, and Narayana, 1995). Individuals are more likely to recycle if they are given monetary rewards for this activity, but are only likely to maintain the recycling behavior if the compensation is provided. It is difficult for recycling groups or government agencies to provide rewards to all those who recycle. The ability to overcome functional fixedness and be more creative may be extrinsic motivators that could replace monetary rewards. It is beneficial to the individual and society in general to foster creativity and creative problem solving. Additionally, overcoming functional fixedness is beneficial to individuals who wish to save money by reusing objects in atypical ways instead of purchasing objects with highly specialized functions which consequentially reduces the amount of landfill waste. These personal, societal, and environmental benefits could be marketed to encourage and sustain recycling efforts.

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Table 1

Mean Scores, Standard Deviations, and Ranges for all Groups for the Functional Fixedness Task

Task completion time, in seconds			
Groups	*Means*	*SDs*	*Ranges*
ER-FF	640.88	266.20	288-900
ER-NFF	364.88	273.96	91-900
NER-FF	544.73	236.43	84-900
NER-NFF	449.18	329.17	52-900
Eco-reps	502.88	297.33	91-900
Non eco-reps	496.95	283.91	52-900
FF primed	585.21	264.96	84-900
Non FF primed	413.68	302.01	52-900

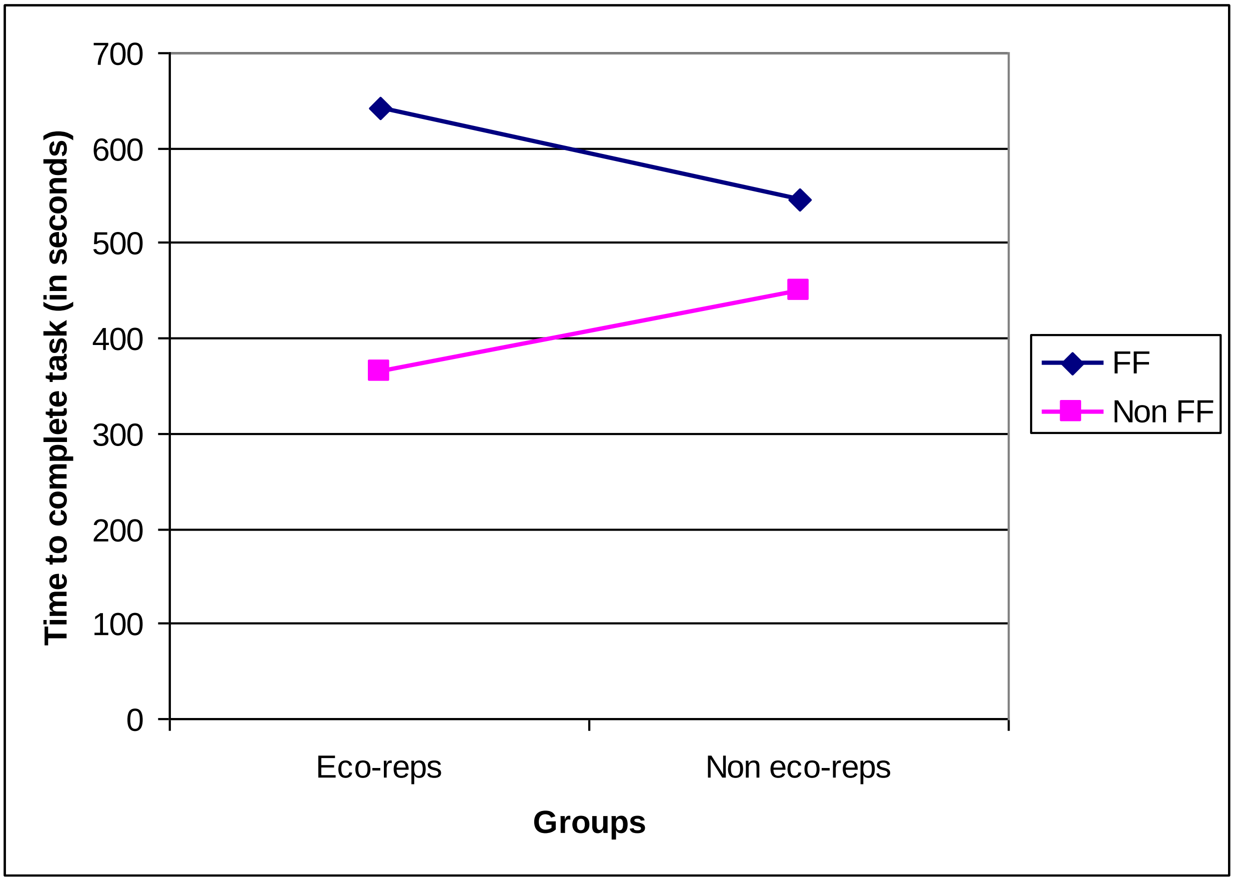

Figure 1. Problem solving task performance times in seconds among eco-reps and non eco-reps primed and not primed for functional fixedness.

Appendices

Appendix A

Demographic Survey

Please circle your response or provide your response for every item.

Age: __________

Gender: Male Female

Class Standing: Freshman Sophomore Junior Senior Other ___________________

Cumulative GPA (approximate): __________

Race: a) American Indian or Alaska Native b) Asian c) Black or African American
d) White e) Hispanic or Latino f) Other (please specify):___________________

Academic Major: ____

Academic Minor (if applicable): _____________________________________

In what state did you spend most of your life? __________________________
How many years did you live there? ______

Do you currently recycle any items? Yes No

Please place a check next to the following items you recycle:

_____ Plastic _____Glass _____Paper _____Cardboard _____Metal

_____Other (please specify): ____

What percentage of the recyclable materials that you use do you recycle? ________%

Prior to attending college did you practice recycling? Yes No

Prior to attending college what percentage of the recyclable materials that you used did you recycle? ________%

Has encouragement from or modeling recycling practices of parents/guardians influenced you to recycle? Yes No

Has encouragement from or modeling recycling practices of friends/roommates influenced you to recycle? Yes No
List reasons or people that have influenced you to recycle:
____

____

____

Are you currently a member of the Eco-Reps student group at Coastal Carolina University?
Yes No

Have you ever been a member of the Eco-Reps student group at Coastal Carolina University?
Yes No

Have you ever been a member of the Boy Scouts or Girl Scouts? Yes No

Have you ever been a member of the military? Yes No

If yes, which branch? ____

Are you now or have you ever been a member of a club or organization that promotes or encourages recycling? Yes No

If yes, please list the name(s) of the organization(s):

____

____

____

Appendix B

INFORMED CONSENT FORM

Thank you for agreeing to participate in my research. The purpose of this study is to investigate problem solving activities in college students. I will first ask that you complete a brief demographic survey. Then I will ask you to build a tower using the materials I provide for you. You may use any of the materials on the table. The goal of this task is to build a tower high enough to exceed the mark on the wall in front of you. Your task will be completed once you have constructed the tower. I will record how long it takes you to complete the tower building activity. This activity should take about 15 minutes. There is no risk or harm involved in this study and all of your data will be confidential. I will be analyzing and reporting on group data only. Your participation in this study is voluntary and you may withdraw from this study at any time so if you feel as if you do not want to continue participating in my study, just say so and we'll stop data collection. If you would like to obtain the results of my study just let me know and I'll be happy to contact you via email later in the semester once my data are collected and analyzed. Hopefully my study will allow us to have a better understanding of human problem solving. Do you have any questions? Please ask them now before we begin data collection. For future reference you many contact me, Keith Richard via email at kgrichar@coastal.edu. For your information, Dr. Joan Piroch in the psychology department is supervising my research, and you may also contact her if you have questions. Her phone number and email address are: 843 349-2271, pirochj@coastal.edu.

Thank you so much for helping me with my research.

I have read this informed consent and have been fully advised of the purpose of the study. I understand that there are no risks or potential harm involved in this study and I voluntarily agree to serve as a participant in this study. Upon request I may receive a copy of this informed consent form for my records.

Participant's signature__________________________________ Date_______________

Appendix C

Appendix D

Appendix E

Appendix F