INFLUENCE OF WORKING MEMORY, STRATEGY, EXPERIENCE, AND EMOTIONALITY ON A PRISONER'S DILEMMA TASK

A Thesis
by
WILSON C. TUCKER

Submitted to the Graduate School
Appalachian State University
in partial fulfillment of the requirements for the degree
MASTER OF ARTS

August 2012
Department of Psychology

INFLUENCE OF WORKING MEMORY, STRATEGY, EXPERIENCE, AND EMOTIONALITY ON A PRISONER'S DILEMMA TASK

A Thesis
by
WILSON C. TUCKER
August 2012

APPROVED BY:

_____
G. Todd McElroy
Chair, Thesis Committee

_____
Hall P. Beck
Member, Thesis Committee

_____
David L. Dickinson
Member, Thesis Committee

_____
James C. Denniston
Chair, Department of Psychology

_____
Edelma D. Huntley
Dean, Research and Graduate Studies

FOREWORD

This thesis is written in accordance with the style of the *Publication Manual of the American Psychological Association (6th Edition)* as required by the Department of Psychology at Appalachian State University

DEDICATION

I would like to dedicate this thesis to my parents, Karen and Larry, who have always encouraged me and cheered me on in everything I have done. I would not have been able to achieve my goals without them.

ACKNOWLEDGMENTS

I would like to thank my thesis chair, Dr. McElroy, for his help and guidance throughout this thesis process. I would also like to thank Dr. Beck for all of his help in improving my professional writing and understanding of the research process. Finally I would like to thank Dr. Dickinson for his additional advice and insight.

Influence of Working Memory, Strategy, Experience, and Emotionality on a Prisoner's Dilemma Task

Wilson C. Tucker

Appalachian State University

Abstract

The objective of this study was to investigate the effects of working memory, strategy availability, experience, and emotionality on a Prisoner's Dilemma game. Participants consisted of 126 undergraduates from Appalachian State University's psychology research pool. A 3 (High Working Memory, Middle Working Memory, Low Working Memory) x 2 (Strategy, No Strategy) x Trial Blocks design was employed. The primary dependent measure was the frequency of cooperative decisions. Students' working memory spans were assessed using an automatic operational working memory span task. Participants in the strategy condition were given information about the typical outcomes of Prisoner's Dilemma games. There was an unexpected finding: competition was positively correlated with overall winnings. This outcome resulted in the revision of some hypotheses that were based on the expectation that cooperative responses would lead to higher overall winnings. After this revision, some of the main hypotheses were that: (a) players would become more competitive over time, (b) players in the strategy manipulation would be more cooperative than those in the control condition, (c) high working memory participants would be more competitive than those with middle and low working memory, and (d) working memory would buffer against the effects of emotionality in the game. It was found that players became more competitive as the game progressed. Participants in the strategy condition were more cooperative than those in the control condition. The hypotheses that working memory would influence decisions and buffer against emotionality were not supported. These new findings were examined in relation to reciprocity literature.

Influence of Working Memory, Strategy, Experience, and Emotionality on a Prisoner's Dilemma Task

Prisoner's Dilemma (PD) is a commonly used task for investigating cooperation and competition. The traditional PD typically involves two men arrested for a crime (Poundstone, 1992). The police do not have enough evidence to obtain a conviction. Therefore, they decide to separately question each man in hopes of getting one criminal to testify against the other. The men are told that they will be rewarded for the information that they give. If only one betrays the other, the betrayer receives no punishment while the betrayed individual receives a year in prison. If they both keep their silence, they will each receive one month in prison on a misdemeanor charge. Finally, if each betrays the other, then they both will receive three months in prison. As the men are separated, they cannot know what the other will do. Essentially, it is in each man's best interest to betray the other, but the best outcome for the group occurs when each man keeps his silence.

The dilemma becomes more interesting in its iterated form. Although the best decision in a single trial situation is to compete, when matched with the same partner in multiple rounds, cooperation typically leads to a better overall outcome (Axelrod, 1984; Kassinove, Roth, Owens, & Fuller, 2002). As the game is played several times, each individual has the opportunity to reward or punish the other for previous decisions.

Axelrod (1984) identified four qualities of the most successful strategy in the PD. The qualities were labeled nice, retaliating, forgiving, and non-envious. Nice describes not competing until the other player has competed. Strategies that punish competition with competition are referred to as retaliating. People employing a forgiving strategy sometimes

cooperate even after a competitive decision by the other person. Finally, non-envious players are those that are unconcerned with having a better outcome than the other individual.

The traditional PD game has been used in analyzing political situations (Clark & Lee, 2005), economics (Arce, 2010), and climate change (Brennan, 2010). Although cooperative strategies have been shown to lead to better overall outcomes, competitive strategies are often used in these situations (e.g., Clark & Lee, 2005). An investigation of factors that result in competition in social dilemmas can offer some insight to why cooperative strategies are not invariably used.

Factors Influencing Cooperation Versus Competition

In an extensive review, Kopelman, Weber, and Messick (2002) identified nine factors that influence social dilemmas. These factors are social motives (e.g., Kelley & Stahelski, 1970), gender (e.g., van Lange, de Bruin, Otten, & Joireman, 1997), payoff structure (e.g., Bell, Petersen, & Hautaluoma, 1989), uncertainty (e.g., Budescu, Rapoport, & Suleiman, 1990), power and status (e.g., Massey, Zelditch, & Freeman, 1997), group size (e.g., Kerr, 1989), communication (e.g., Bohnet & Frey, 1999), causes (e.g., Hoffman & Spitzer, 1985) and frames (e.g., Kahneman & Tversky, 1979). This investigation will examine the influence of two other factors that could affect the resolution of social dilemmas, emotionality and working memory (WM).

Threat and emotionality. A study by Deutsch and Krauss (1960) investigated the impact of threat on competition. Researchers manipulated the amount of threat that was available to two participants in a social dilemma game. Two players controlled different hypothetical companies; each was trying to make as much money as possible. Winnings were directly related to the speed with which the trucks were delivered to their destinations. There

were two possible paths, a direct route with a stretch of one lane road and an alternate, but longer route, that was always clear. If the trucks met on the one lane section of the shorter road, neither could proceed until the lane had been cleared by the other truck.

Deutsch and Krauss (1960) varied the number of players who had the ability to threaten the other. Neither player in the no-threat condition could threaten the other. In the unilateral threat manipulation, one participant could threaten the other. Both individuals in the bilateral threat condition could threaten the other. These threats were delivered via gates on the shorter road. Closing the gate blocked the other player's truck from continuing. The game was structured so that cooperative responses yielded faster delivery times, resulting in greater overall payoffs.

Deutsch and Krauss (1960) found that when neither player could threaten the other, they often worked together through turn taking. Due to this, players in the no-threat condition experienced the highest individual and overall payoffs of the three conditions. Unilateral threat augmented competition, reducing the payoff for both participants. In the bilateral threat manipulation, players competed more than in the unilateral threat condition; their monetary winnings were the lowest of the three groups. These results suggest that as the availability of threat increases, cooperation is attenuated.

One interpretation of Deutsch and Krauss's (1960) experiment is that threat induces anger which in turn augments competition. Kassinove et al. (2002) provided a test of this hypothesis. They had participants respond to the State-Trait Anger Expression Inventory (Spielberger, 1988) both before and after a PD task. As predicted, players with higher levels of reported anger were also significantly more likely to compete in the task. Other investigators (e.g., van Kleef, van Dijk, Steinel, Harinck, & van Beest, 2008) have reported

similar results; anger was associated with higher levels of competition when confronted with social dilemmas.

If anger increases competition, then it is reasonable to propose that positive emotions might heighten cooperation. If we may generalize from the prosocial literature, then a number of studies provide support for this proposition. Algoe and Haidt (2009) found that viewing prosocial behaviors by others can lead to a state of "elevation" or a general improvement in mood and disposition due to gratitude or admiration. Additional research by Schnall, Roper, and Fessler (2010) revealed that helping behavior increases when participants experienced a state of elevation. This prosocial behavior is also not necessarily directed at the individual who performed the cooperative act, signifying a general increase in helping behaviors. The literature leaves little doubt that emotionality is associated with cooperative and competitive decisions and prosocial behaviors.

WM. WM, or an individual's information processing capacity, can be viewed as a hierarchical system, with one central executive system controlling three lower systems. The three subordinate systems are the visuo-spatial sketchpad, the phonological loop, and the episodic buffer (Baddeley, 2000). Due to the central role of WM, it has been implemented in a wide range of tasks including risky decision making (Cokely & Kelley, 2009), attention regulation (Engle, 2002), and emotional regulation (Schmeichel, Volokhov, & Demaree, 2008).

In an experimental study, Milinski and Wedekind (1998) examined the impact of constraining WM on decisions made during a PD game. Two commonly used strategies in a traditional PD game were Memory-1, also known as tit for tat (TFT), and Memory-2, which

is also called Pavlovian (Milinski & Wedekind, 1998). These strategies vary in both their complexity and effectiveness.

In a basic TFT strategy, the player always copies the other player's previous decision. Because of this, a TFT strategy only takes into account the other player's decision in the prior round (Nowak & Sigmund, 1993). A more common variant of the TFT is the generous tit for tat (GTFT) strategy (Milinski & Wedekind, 1998). When using a GTFT strategy, the player typically copies the other player's previous decision, but occasionally chooses to cooperate after the other participant has competed. Presumably, players engage in GTFT in an attempt to generate cooperation.

A Pavlovian strategy is more complex, taking into account both players' decisions in the previous round. Participants using this Memory-2 strategy follow a win-stay, lose-shift paradigm (Nowak & Sigmund, 1993). A player using this Pavlovian strategy will always cooperate following dual cooperation. The player will never cooperate following a trial in which the player cooperated and the other individual competed. If the player competed and the other player cooperated, then the player will compete again. Following dual competition, the player will usually cooperate. Through simulation, Memory-2 strategies were found to be more efficient in terms of winnings than Memory-1 strategies (Nowak & Sigmund, 1993).

Memory-1 and Memory-2 strategies are also differentiated by the amount of information that must be remembered. Using a TFT strategy, the only response to be recalled was the other player's decision in the previous round. The Pavlovian strategy requires both players' decisions from the previous round to be recalled. As a Memory-2 strategy requires twice as much information as a Memory-1 strategy, Milinski and Wedekind

(1998) hypothesized that constraining the players' WM would result in those participants using simpler strategies that require less information.

Student participants played the PD game in either constrained or unconstrained memory conditions. Students assigned to the unconstrained memory condition played a typical PD game, but participants in the constrained memory condition performed a distracting task between each round of the PD. Milinski and Wedekind (1998) found that as predicted, a Pavlovian strategy was used less in the constrained than the unconstrained condition.

The investigators hypothesized that the distracting task had four effects on WM. It limited the number of choices remembered by dissipating the recency effect, used WM capacity for the task information, prevented rehearsal of stored information, and increased the available time for information to decay. Support for this hypothesis was tested by asking students to recall both players' decisions from each round of play. Participants in the unconstrained memory condition were able to recall decisions with 75% accuracy for the final two rounds of play. Those in the constrained condition were only able to recall decisions with 75% accuracy for the final round of play.

The results of the Melinski and Wedekind's (1998) study suggest that a larger WM capacity will be beneficial in making efficient decisions in a traditional PD game. It is important to recognize that using the Pavlovian strategy maximized expected values. Players with higher WM capacity seem to have a greater ability to use complex strategies to elicit cooperation and punish competition as seen in their higher total winnings. The ability to remember more information is important as it allows the player to use reciprocal interactions to achieve maximum payoff.

Another area of interest is the relationship between WM and frames in decision making. Cokely and Kelley (2009) presented participants with a choice between two different possible winnings with different expected values. For example, participants could choose to either receive a 100% chance for five dollars or a 5% chance for 200 dollars, resulting in expected values of five dollars and ten dollars, respectively. There were also some situations where the riskier decision resulted in a lower expected value. For example, participants could choose between a 75% chance at 100 dollars and a 10% chance at 500 dollars. These options yield expected values of 75 and 50 dollars, respectively. Overall, high WM players were less affected by the framing of the task and more influenced by expected values than low WM individuals.

A related finding in WM research that is important for this study is the role of WM on delayed discounting. Delayed discounting is the general trend to value rewards that occur sooner over those that occur after a longer period of time (Green, Myerson, & McFadden, 1997). Hinson, Jameson, and Whitney (2003) found that as WM load increases, the rate of delayed discounting increases as well. Limits on WM function were associated with an impulsive decision-making style. This finding is relevant to the current study due to how it could affect decision making in the PD. In the traditional PD game, competition leads to gaining the most money in a short period of time, but cooperation can lead to larger overall gains over a longer period of time. This research also suggests that those individuals with larger WM capacity make decisions that are more consistent with expected value calculations.

Cokely and Kelley's (2009) and Hinson et al.'s (2003) results do not necessarily indicate that high WM people are insensitive to frames. A study by Corbin, McElroy, and

Black (2010) found that when the expected values of two choices are equal, high WM capacity participants were more strongly influenced by positive and negative frames than those with low WM capacity. When considered together, the findings of Cokley and Kelley (2009), Corbin et al. (2010), and Hinson et al. (2003), suggest that expected values and frames are considered by high WM participants when making choices, but that people with higher WM capacity are more strongly influenced by expected value than frames.

A theory of WM proposed by Engle (2002) offers a means of understanding the relationship of WM to expected values in social dilemmas. Engle (2002) proposes that WM capacity "represents a domain free limitation in ability to control attention" (p. 19). This proposition is supported by findings by Kane and Engle (2000) that constraining WM capacity increased proactive interference on a memory retrieval task. Similarly Kane, Bleckley, Conway, and Engle (2001) found that individuals with higher WM capacity were better able to regulate eye movements in an antisaccade task. Studies using a Stroop task (Kane & Engle, 2003) and a dichotic listening task (Conway, Cowen, & Bunting, 2001) also support the proposition that WM capacity enhances the ability to focus attention. If WM capacity does represent the ability to control attention, as Engle contends, then any distracting information should be less influential on individuals with higher WM capacity than those with lower WM capacity.

Interaction of emotionality and WM. If emotionality is viewed as a non-central part of a PD game, then we should expect that emotions and WM should combine to determine player's responses. Specifically, high WM should serve as a buffer against the influence of positive and negative emotions. A study by Schmeichel et al. (2008) investigated how WM capacity influenced participants' outward expressions and inward

experiences of emotion. In this multiple part study, the researchers attempted to elicit emotional responses using film clips. For example, in the first study participants were shown a two minute clip of animal mutilation and slaughter. This clip had previously been shown to increase negative emotionality, particularly disgust. In the second part of the study, to elicit happiness, participants were shown a two minute comedy clip from a late night talk show. In other parts of the study, additional methods of generating emotionality were used. As they watched the film clips, participants were instructed to keep their faces neutral and not show outward reaction to the clips.

Schmeichel et al. (2008) found that those persons with higher WM capacity suppressed expressions of negative and positive emotion by not moving their faces better than those with lower WM capacity. Furthermore, people with higher WM capacity thought about emotional stimuli in a more analytical and unemotional way than individuals with lower WM capacity.

A subsequent study by Schmeichel and Demaree (2010) found that participants with higher WM capacity experienced less unpleasant emotional response to false negative feedback about an emotional intelligence test. In addition, higher WM persons were better able to make constructive use of negative feedback than lower WM counterparts. In general, these findings indicate that individuals with higher WM capacity are more likely to self-regulate their automatic emotional reactions than those with lower WM capacity. Again, people with higher WM capacity were more task oriented and less influenced by distracting information than people with lower WM capacity.

Other studies have shown similar relationships between negative emotions and WM capacity. Klein and Boals (2001) found that participants with more life event stress received

lower scores on measures of WM. A related study by Schmader and Johns (2003) revealed that remembering negative self-relevant stereotypes reduced WM capacity. Schmader and Johns (2003) also found that the reduction in WM capacity was a mediating factor in the influence of stereotype threat on participants' math performance. So not only does research show that individuals with lower WM capacity are more susceptible to emotionality (Schmeichel & Demaree, 2010; Schmeichel et al., 2008), but emotionality can attenuate peoples' WM capacity (Klein & Boals, 2001; Schmader & Johns, 2003).

Purpose of Present Study

The objective of this investigation is to further examine the effects of WM, knowledge of effective game strategy, and experience on a PD task. A 3 (High WM, Middle WM, Low WM) x 2 (Strategy, No Strategy) x Trial Blocks design will be used. The WM and strategy variables are between factors, and the trials variable is within factors. The dependent variable is the players' responses (cooperative or competitive) on a PD task. The preceding literature suggests that cooperative choices generally lead to the highest overall payoffs. Therefore, there should be a statistically significant positive correlation between the number of cooperative choices a player makes and that player's overall payoff.

WM should yield a statistically significant main effect. The literature shows that the choices of persons with high WM are particularly influenced by expected value. Given that cooperative responses produce better payoffs, players with high WM are predicted to make more cooperative decisions than low WM participants.

A main effect for the trials variable is also predicted. As the students gain experience over multiple trials, they should identify which strategies and choices are most effective. If

cooperation is the most effective choice in terms of payoffs, then over trials the participants should become more cooperative.

In this study, players in the strategy manipulation will be told that cooperation usually leads to the greatest overall payoffs. Players in the no strategy condition will not be given this information. Thus, a main effect for strategy is hypothesized; participants in the strategy manipulation will be more cooperative than those in the no strategy manipulation.

A WM x Trials ordinal interaction is hypothesized. Because the decisions of players with high WM are governed by expected value, they should be more cooperative on earlier trials than players with low WM. However, after a large number of trials have passed, all of the individuals will learn from experience and are hypothesized to reach similar levels of cooperation. The result should be a statistically significant ordinal interaction.

A similar logic applies to the Strategy x Trials interaction. Players in the strategy group will be told that cooperation generally maximizes long term payoffs. During early trials, players in the strategy group should be more cooperative sooner than those in the no-strategy group. Given sufficient trials, all participants will likely reach high levels of cooperation. Thus, an interaction is predicted between strategy and trials.

It is not clear whether there will be a statistically significant WM x Strategy interaction. Both high WM and strategy should enhance cooperation. Currently, there is insufficient evidence to judge whether these variables combine in an additive or multiplicative manner. Also, there is no hypothesis regarding a three way WM x Strategy x Trials interaction.

Previous research has found that cooperative actions are associated with positive emotions, and competitive actions are associated with negative emotions (e.g., Algoe &

Haidt, 2009; Kassinove et al., 2002). Therefore, it is predicted that following a cooperative decision by the other player in the proceeding round, the participant is more likely to be cooperative than competitive. Following the same logic, after a competitive response by the other player in the previous round, the individual is predicted to be more likely to respond competitively than cooperatively. Most importantly to this investigation, it is hypothesized that WM should buffer the effects of emotionality. As research has revealed that higher WM reduces emotionality (Schmeichel et al., 2008), the probability that participants' responses are emotionally affected by their opponents' responses is expected to be lower for high WM players than those with low WM.

As this is an unusual method for looking at the effects of emotionality, an example is useful to demonstrate how this measure functions. There are two participants who are responding in a PD game. The first is strongly affected by emotionality. Because of this, after the other player cooperates, the emotional player cooperates 90% of the time. After the other player competes, the emotional player only cooperates 20% of the time. The difference between these numbers results in a score of 70%. The second player is not strongly affected by emotionality. After the other player cooperates, the nonemotional player only cooperates 70% of the time. After the other player competes, the nonemotional player cooperates 30% of the time. His score would be 40%. As intended, the higher score on the difference between the two percentages reveals a stronger effect of emotionality on decision making.

Method

Participants

One hundred and twenty-six undergraduates (83 females and 43 males) from Appalachian State University's psychology research pool participated in exchange for course

credit. The average age of participants was 19.94 years (*SD* = 2.18; range = 17 – 29). Treatment of participants was in accordance with the American Psychological Association Ethics Code (2002). Approval was also obtained from the Appalachian State Institutional Review Board on April 27, 2011 (see Appendix A).

Materials

Operational Span (OSPAN) task. Memory capacity was assessed by an automated computer version of the OSPAN task (Unsworth, Heitz, Schrock, & Engle, 2005). Each trial began with a math operation. The first screen of each trial displayed a math problem, for example, (2 * 3) – 2. Once the student thought he or she knew the answer, the student clicked a mouse button. The next screen displayed a number that was or was not the correct answer. The student then used the mouse to indicate if the answer on the screen was correct.

Next, a letter was shown for 800 ms. Each round consisted of three to seven trials. At the end of each round, the participants were asked to recall the letters in the order they were presented. A screen displayed 12 letters, including all letters presented in the previous round. Students used the mouse to select what they believed to be the correct letter sequence. When the participant felt that all letters had been identified, she or he selected the "exit" button. After every round, the screen showed the participant's average math score and the number of letters correctly recalled.

PD task. Levels of cooperation and competition were measured by a PD game hosted on a server at the University of Virginia Economics Department (http://veconlab.econ.virginia.edu/games.php). This task allowed the participants to play against each other without knowing who was matched with whom for individual rounds. Therefore, every round of the game was similar to a one-shot trial. If both participants

cooperated, they each received eighty points. When one cooperated and the other competed, the cooperator received nothing and the competitor received one hundred points. If each participant chose to compete, they each received thirty points. Participants played twenty rounds; on each round they knew that they were randomly matched to a new partner.

Procedure

Participants were tested in groups ranging from four to twelve in size. Once all participants arrived, they were presented with an informed consent form that summarized the procedure (see Appendix B). The experimenter then told the participants that they would first complete a measure of WM. Instructions for the OSPAN task were delivered via computer. Participants were told that they would be evaluated on their math score and on recalling the correct letters in the proper order. A recall error was recorded if the participant recorded an incorrect letter or reported letters in the incorrect sequence.

Each of fifteen rounds consisted of three to seven trials, determined in a random order. This made for a total of 75 letters and 75 math problems. The typical time to complete the OSPAN task was between twenty and twenty-five minutes. After all students finished the OSPAN task, the experimenter instructed them to begin the PD.

Players were in the same room with visual contact, but could not see one another's choices. Students were given the goal of gaining as many points as possible. In order to evaluate the effects of knowledge strategy use in the PD, half of the participants were randomly assigned to a control condition and half to a strategy condition. Participants in the control condition were told the rules for the PD game and what decisions resulted in what outcomes, but they were given no strategies or advice. In addition to these basic instructions, participants in the strategy condition were told by the experimenter:

To give you some background on how the Prisoner's Dilemma game works and an idea for your choices in this game, I will review some general game play findings. While it may feel that your decision may not matter one way or the other in this game, there are a few strategies. Most often people initially feel that choosing to compete is the best option. If you choose to compete, you will be better rewarded than if you choose to cooperate for each individual round. You always gain more competing than you do cooperating on a round to round basis.

However, over time it is typically beneficial to cooperate in this dilemma. If everyone was to compete in every round, then the winnings would be less than half than if everyone was to choose to cooperate in every round. Typically, those groups that cooperate show higher winnings over a period of time. However, as you will be matched with a random person in every round, you cannot build a pattern with a single partner. Ultimately, the choice is yours every round, and how you choose to gain as many points as possible is up to you.

Twenty PD trials were performed. The entire session, OSPAN and PD tasks, typically lasted forty-five minutes. Participants were not given any financial compensation; all received the same amount of course credit for serving. Students were then thanked, debriefed, and encouraged to ask questions.

Results

The current study defined OSPAN score as the sum of all perfectly recalled sets (Unsworth et al., 2005). For example, "if an individual correctly recalled 3 letters in a set size of 3, 4 letters in a set size of 4, and 3 letters in a set size of 5, his or her OSPAN score would be 7" (Unsworth et al., 2005, p. 501). The sample was divided into thirds based on

their OSPAN scores (high, *M* = 58.05, *SD* = 6.66; middle, *M* = 41.14, *SD* = 4.44; and low, *M* = 22.12, *SD* = 8.23). For the purpose of analyses, the twenty PD trials were divided into five four-trial blocks. For all analyses, an alpha of .05 was used.

First, a correlation was run in order to determine the relationship between decisions made and overall winnings in the PD task. The prediction that there would be a positive correlation between the number of cooperative decisions and total payoffs was not supported. Instead the correlation was statistically significant and negative, $r = -.34$, $p < .001$.

Next, a 3 (High WM, Middle WM, Low WM) x 2 (Strategy, No Strategy) x 5 (Trial Blocks 1-4, Trial Blocks 5-8, Trial Blocks 9-12, Trial Blocks 13-16, Trial Blocks 17-20) ANOVA was conducted. WM and strategy were between-subjects variables, and trial blocks was a within-subjects variable. The dependent measure was the number of cooperative responses. The main effect of WM was not statistically significant, $F(2, 119) = 1.06$, $p = .35$, $\eta_{p^2} = .018$. Participants in the strategy condition (*M* = 8.88, *SD* = 4.87) were significantly more likely to cooperate, $F(1, 119) = 14.70$, $p < .001$, $\eta_{p^2} = .11$, than participants in the no strategy condition (*M* = 5.84, *SD* = 4.01).

A statistically significant main effect for trial blocks was also found, $F(4, 476) = 16.34$, $p < .001$, $\eta_{p^2} = .12$. Subsequent pairwise comparisons using least significant difference testing evaluated differences between trial blocks. Participants were significantly more cooperative in Trial Block 1 (*M* = 1.93, *SD* = 1.25), than in Block 2 (*M* = 1.62, *SD* = 1.15), Block 3 (*M* = 1.30, *SD* = 1.13), Block 4 (*M* = 1.36, *SD* = 1.22), or Block 5 (*M* = 1.17, *SD* = 1.17). They were also significantly more cooperative during Trial Block 2 than during Block 3, Block 4, or Block 5. No statistically significant differences in levels of cooperation between Blocks 3, 4, and 5 were found, all *p*s > .05.

There was no significant interaction between WM and trial blocks, $F(8, 476) = 1.29$, $p = .25$, $\eta_{p^2} = .02$. Neither was the strategy by trial blocks interaction statistically significant, $F(4, 476) = 0.21$, $p = .93$, $\eta_{p^2} = .002$. Finally, the WM by strategy interaction yielded no statistically significant interaction, $F(2, 119) = 2.60$, $p = .079$, $\eta_{p^2} = .042$. The three-way interaction between WM, strategy, and trial blocks was statistically significant, $F(8, 476) = 2.03$, $p = .041$, $\eta_{p^2} = .033$.

A final analysis was performed to investigate the hypothesis that WM buffered the effects of emotionality. If this supposition is correct, then the difference between the percentage of cooperative decisions following cooperative responses by the other player and the percentage of cooperative decisions following competitive responses by the other player should be less for high WM than low WM participants. The measure was labeled "emotional difference" and served as the dependent measure in the following analysis. The three levels of WM served as the independent variables. The resulting one-way ANOVA was not statistically significant, $F(2, 122) = 0.40$, $p = .67$, $\eta_{p^2} = .007$.

Discussion

This experiment investigated the impact of multiple factors on the choices individuals made in a PD game. The first hypothesis was that individuals who made more cooperative decisions would have higher payoffs. The results did not support this hypothesis, and instead revealed an inverse relationship between the number of cooperative choices that participants made and their overall winnings. It is likely that this unexpected finding is due to the structure of the experiment and the importance of reciprocity in social dilemmas; I will revisit reciprocity later in this discussion.

Hypothesis Two was that participants with higher WM capacity would be more cooperative. This prediction was made because individuals with higher WM capacity make decisions that are consistent with higher expected value calculations, and cooperative responses were expected to be economically superior to competitive responses. The finding that cooperative responses were inversely related to higher payoffs logically reverses the predictions for Hypothesis Two. In light of this, it should be hypothesized that participants with higher WM capacity will make more competitive decisions relative to lower WM capacity individuals. The results did not support this hypothesis as there was no statistically significant difference in choices between higher and lower WM capacity participants.

Hypothesis Three was that participants in the strategy condition would be more likely to cooperate than those in the no strategy condition, and the findings from this study supported the hypothesis. This prediction was not altered by the finding that competition was related to higher overall payoffs. The logic behind this hypothesis was that when participants were told that cooperative decisions usually led to higher payoffs, they would be more likely to be cooperative. Therefore, this manipulation functioned as expected.

Hypothesis Four was that, over time, the participants would become more cooperative. This was based on the expectation that cooperative decisions would lead to higher payoffs, and as people gained experience, they would alter their responses toward the higher payoff of cooperation. However, the unexpected finding that cooperation was inversely related to higher payoffs logically reversed what would have been predicted, making competition the best choice for higher payoffs. Therefore, it seems prudent to revise this approach and revisit Hypothesis Four. In doing so, the prediction that participants will migrate toward the strategy with the higher payoff is still valid, but the best strategy in this

situation involves competition rather than cooperation. Therefore, in light of this, people should become more competitive over time. The results supported this revised hypothesis.

Hypothesis Five was that WM would buffer against the effects of emotionality. The results of this research did not support this prediction. There are several possible reasons that a significant effect was not found for this hypothesis. As the primary focus of the participants was to achieve their highest possible score, the main focus of their decision making process was to generate the best economic outcome, not to fulfill emotional desires. Because of this, the effect size for the emotional influence on decision making was expected to be relatively small. Also, the structure of the experiment indirectly led to limited variability in participant responses, producing a vast majority of competitive responses (approximately 70%). Because of this competitive environment, there were very few opportunities for participants to experience positive emotionality from the other player's cooperation. Therefore, although WM may actually work to buffer emotional decision making, the small effect size and lack of variability in the current design makes it difficult to observe this effect.

Two interactions were also hypothesized. First, a WM x Trials interaction was predicted, but the results did not support the hypothesis. A Strategy x Trials interaction was predicted as well, but the results did not support this hypothesis. Finally, an unpredicted three-way interaction between WM, strategy, and trial blocks was found to be statistically significant. However, this interaction was not predicted and had an extremely small effect size, indicating limited theoretical value for this interaction.

The finding that WM did not have a main effect on the number of cooperative decisions seems, at first, surprising. Recall that the study by Milinski and Wedekind (1998)

demonstrated that players with larger WM capacity used more complex and effective strategies which led them to become cooperative. With this in mind, the expectation was that WM would have a similar influence on decisions in the current investigation. However, the findings from the current study were inconsistent with those reported by Milinski and Wedekind. I will next discuss possible reasons for this discrepancy.

One reason for this discrepancy may be that the Milinski and Wedekind (1998) study utilized a more traditional type of PD game. Specifically, the participants believed that they were playing against the same person for the entire duration of the game. In actuality they were playing against a confederate to balance opponent responses, but they were not aware of this. Because participants in the Milinski and Wedekind study believed that they were playing against the same opponent, they were able to develop and use strategies from the interactions between themselves and their opponent across many previous rounds. Importantly, both the TFT and the Pavlovian strategies require knowledge of the other player's response from the preceding round.

Unlike the Milinski and Wedekind (1998) study, participants in the current investigation were matched with new partners in every round. This removed the ability of the player to reward or punish the other player for previous responses. Therefore, participants were no longer able to use either the TFT or the Pavlovian strategies. In the current investigation the most effective response was competition within every round. As this strategy is not complex and does not require players to remember previous responses, WM did not have an effect on players' decisions. Therefore, this may explain why WM capacity was an important factor in effective decision making in the Milinski and Wedekind study, but it did not have a significant impact on decision making in the current study.

The differences in the type of PD game used in the Milinski and Wedekind (1998) investigation and the current experiment highlight the importance of reciprocity as a factor in social dilemma games. The possibility of reciprocity is an element inherent in most social dilemma situations. It is also likely that reciprocity will influence the kind of strategy that decision makers will use in social situations (Nowak, 2006). For example, if there is a limited amount of a desired resource, then the goal of the individual is to obtain as much of the resource as possible. As a result, in situations where reciprocity is possible, then the cooperation of others benefits everyone because all are able to obtain more of the resource with the cooperative helpfulness of others. However, when there is no possibility of reciprocity, then the best strategy is to take as much of the resource as possible (Akcay, Reed, Campbell, Templeton, & Beecher, 2010; Taylor & Nowak, 2007).

Due to the structure of social dilemmas, those who compete are always better rewarded on a single trial than those who cooperate. Therefore, for cooperation to take place, certain situations must be present. Research has identified five mechanisms that lead to cooperation: kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection (Nowak, 2006; Taylor & Nowak, 2007). Due to the random structuring of groups in an experimental setting, kin selection, network reciprocity, and group selection are not possible avenues for cooperative behavior; however, reciprocity likely does occur. Direct reciprocity is based on repeated interactions between two individuals that lead to cooperation. Indirect reciprocity occurs when an individual's reputation is known, and due to this reputation others are more likely to cooperate with that person (Akcay et al., 2010). Because players in the current game were anonymous, direct reciprocity is the only one of the five mechanisms that could affect cooperation in this investigation.

Since direct reciprocity is the only means available for eliciting cooperation in the present study, it is important to understand the factors that allow for it. Nowak (2006) found that under direct reciprocity, cooperation only occurs if the probability of another encounter between the same two individuals exceeds the cost-to-benefit ratio of the cooperative act. In the current study, the cost-to-benefit ratio is equal to the likelihood of future interactions. As the probability of additional encounters did not exceed the cost-to-benefit ratio, cooperation was not elicited through direct reciprocity. Traditional PD games have a likelihood of future encounters that exceeds the cost-to-benefit ratio of cooperative acts. This allows participants in those tasks to cooperate through direct reciprocity. However, in games where there is little chance of future interaction, the cost of cooperation is too great.

Limitations

There were several shortcomings in this study that, if altered, may provide a more accurate means for testing the hypotheses in the future. One of the shortcomings was the oversight of the importance of reciprocity in social dilemmas. Had the study been conducted in a way that allowed for direct reciprocity to occur, there may have been greater variability in participant responses. Consequently, this would allow players to use multiple strategies to increase their gains as much as possible. Those individuals who were able to elicit cooperation from others would have been rewarded with higher payoffs themselves. However, players who relied on competition would have induced others players toward competition and this would have decreased their overall totals. Further, the overall increase in strategy variability should allow high WM participants to use more complex and efficient strategies that should produce a main effect for WM capacity.

Another potential limitation that could have hindered clarity of the results was the number of participants within the respective conditions. There were a total of six between subject blocks (High WM, Middle WM, Low WM x Strategy, No Strategy) and 126 participants; therefore, only around twenty individuals were in each block. Although this number of participants did reveal significant main effects, other effects may have been weaker and having thirty people in each block would give more power to the statistical analysis and potentially reveal smaller effects.

Another important limitation in this study was the absence of a validated measure of emotionality. Recall that emotionality was measured by analyzing the difference between the percentage of cooperative responses following cooperative responses by the other player and the percentage of cooperative responses following competitive responses by the other player. However, there is no way to guarantee that the difference in responses is due to emotionality. An example of how this measure could be inaccurate can be found by looking at responses in a TFT strategy. In a true TFT strategy, the percentage of cooperative responses following cooperation would be 100%, and the percentage of cooperative responses following a competitive response would be 0%, resulting in a score of one. The individual may have made the decision to use a TFT strategy and to ignore his or her emotional responses completely, but the score of one indicates a participant who is strongly affected by emotion. In hindsight, using a measure that has been validated to quantify emotionality is more desirable and could have provided strong evidence to support the contention that WM serves as a buffer against emotionality.

Future Research

Looking forward to future research, two main paths of inquiry seem most deserving for future investigation. One possible path is to modify the situation to allow for different methods of generating cooperation. Recall that Nowak (2006) identified five mechanisms that allowed for the evolution of cooperation. Using this as a basis, different experiments could be constructed to investigate cooperation through these different mechanisms.

For example, one type of PD game involves pairing participants on multiple consecutive trials which allows for direct reciprocity. When this method is incorporated, it creates a situation within which the probability of future interactions is larger than the cost-to-benefit ratio. Another interesting approach to this method would be to incorporate a way for individuals to develop and display their reputations of cooperation and competition in the PD game. Specifically, if a participant's likelihood of cooperation or competition is displayed to the other player before a round, then his or her level of reciprocity would be readily apparent.

Another factor that should continue to be investigated is the effect of WM on the PD game. The current investigation was relatively limited in that WM was measured, but it was not manipulated. The literature shows multiple examples of methods for manipulating participants WM capacity while performing the main task (e.g., Hinson et al., 2003, & Milinski & Wedekind, 1998). For example, these studies have used distraction tasks, such as remembering a short list of numbers, which act to utilize a portion of an individual's WM capacity, effectively decreasing the WM available for the task at hand. By utilizing a within subjects design, decision making could be investigated when WM is unconstrained and when

it is limited. Further, this method would allow for a within participants analysis and the effects of WM capacity could be more effectively investigated.

In conclusion, previous research has shown that WM influences decision making (e.g., Cokely & Kelley, 2009; Corbin et al., 2010; Hinson et al., 2003) including decisions made in social dilemmas (Milinski & Wedekind, 1998). Further, a good deal of research has shown that PD games are a good way of analyzing social dilemma situations. The current study highlights the importance of considering additional factors that may come to bare on social decisions, especially the need to consider both reciprocity and emotionality in these situations.

References

Akcay, C., Reed, V. A., Campbell, S., Templeton, C. N., & Beecher, M. D. (2010). Indirect reciprocity: Song sparrows distrust aggressive neighbours based on eavesdropping. *Animal Behaviour, 80,* 1041-1047. doi:10.1016/j.anbehav.2010.09.009

Algoe, S.B., & Haidt, J. (2009). Witnessing excellence in action: The 'other-praising' emotions of elevation, gratitude, and admiration. *Journal of Positive Psychology, 4,* 105–127.

American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist, 57,* 1060-1073.

Arce, D. G. (2010). Economics, ethics, and the dilemma in the Prisoner's Dilemmas. *American Economist, 55,* 49-57.

Axelrod, R. (1984). *The evolution of cooperation.* New York, NY: Basic Books.

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory?. *Trends in Cognitive Sciences, 4,* 417-423. doi: 10.1016/S1364-6613(00)01538-2

Bell, P. A., Petersen, T. R., & Hautaluoma, J. E. (1989). The effect of punishment probability on overconsumption and stealing in a simulated commons. *Journal of Applied Social Psychology, 19,* 1483-1495. doi:10.1111/j.1559-1816.1989.tb01460.x

Bohnet, I., & Frey, B. S. (1999). The sound of silence in prisoner's dilemma and dictator games. *Journal of Economic Behavior and Organization, 38,* 43-57.

Brennan, G. (2010). Climate hopes: Pious and otherwise. *The Australian Journal of Agricultural and Resource Economics, 54,* 5-7.

Budescu, D. V., Rapoport, A., & Suleiman, R. (1990). Resource dilemmas with environmental uncertainty and asymmetric players. *European Journal of Social Psychology, 20,* 475-487.

Clark, J. R., & Lee, D. R. (2005). Leadership, prisoner's dilemma, and politics. *CATO Journal, 25,* 379-397.

Cokely, E. T., & Kelley, C. M. (2009). Cognitive abilities and superior decision making under risk: A protocol analysis and process model evaluation. *Judgment and Decision Making, 4,* 20-33.

Conway, A. R. A., Cowan, N., & Bunting, M. F. (2001). The cocktail party phenomenon revisited: The importance of working memory capacity. *Psychonomic Bulletin and Review, 8,* 331-335.

Corbin, J., McElroy, T., & Black, C. (2010). Memory reflected in our decisions: Higher working memory capacity predicts greater bias in risky choice. *Judgment and Decision Making, 5,* 110-115.

Deutsch, M., & Krauss, R. M. (1960) The effect of threat upon interpersonal bargaining. *Journal of Abnormal and Social Psychology, 61,* 181-189.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11,* 19-23.

Green, L., Myerson, J., & McFadden, E. (1997). Rate of temporal discounting decreases with amount of reward. *Memory and Cognition, 25,* 715-723.

Hinson, J. M., Jameson, T. L., & Whitney, P. (2003). Impulsive decision making and working memory. *Journal of Experimental Psychology, Learning, Memory, and Cognition, 29,* 298-306. doi: 10.1037/0278-7393.29.2.298

Hoffman, E., & Spitzer, M. L. (1985). Entitlements, rights, and fairness: An experimental examination of subjects' concepts of distributive justice. *Journal of Legal Studies, 14,* 259-298.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47,* 263-291.

Kane, M. J., Bleckley, M., Conway, A. A., & Engle, R. W. (2001). A controlled-attention view of working-memory capacity. *Journal of Experimental Psychology: General, 130,* 169-183. doi:10.1037/0096-3445.130.2.169

Kane, M. J., & Engle, R. W. (2000). Working-memory capacity, proactive interference, and divided attention: Limits on long-term memory retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 336-358.

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General, 132,* 47-70.

Kassinove, H., Roth, D., Owens, S. G., & Fuller, J. R. (2002). Effects of trait anger and anger expression style on competitive attack responses in a wartime prisoner's dilemma game. *Aggressive Behavior, 28,* 117-125. doi: 10.1002/ab.90013

Kelley, H. H., & Stahelski, A. J. (1970). Social interaction basis of cooperators' and competitors' beliefs about others. *Journal of Personality and Social Psychology, 16,* 66-91. doi:10.1037/h0029849

Kerr, N. L. (1989). Illusions of efficacy: The effects of group size on perceived efficacy in social dilemmas. *Journal of Experimental Social Psychology, 25,* 287-313. doi:10.1016/0022-1031(89)90024-3

Klein, K., & Boals, A. (2001). The relationship of life event stress and working memory capacity. *Applied Cognitive Psychology, 15*, 565-579. doi:10.1002/acp.727

Kopelman, S., Weber, J., & Messick, D. M. (2002). Factors influencing cooperation in commons dilemmas: A review of experimental psychological research. In E. Ostrom, T. Dietz, N. Dolšak, P. C. Stern, S. Stonich, & E. U. Weber (Eds.), *The drama of the commons* (pp. 113-156). Washington, DC, US: National Academies Press.

Massey, K., Zelditch, M., & Freeman, S. (1997). Status, power, and accounts. *Social Psychology Quarterly*, *60*, 238-251.

Milinski, M., & Wedekind, C. (1998). Working memory constrains human cooperation in the prisoner's dilemma. *Proceedings of the National Academy of Sciences of the United States of America*, *95*, 13755-13758.

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, *314*, 1560-1563. doi:10.1126/science.1133755

Nowak, M., & Sigmund, K. (1993). A strategy of win-stay, lose-shift that outperforms tit-for-tat in the prisoner's dilemma game. *Nature*, *364*, 56-58.

Poundstone, W. (1992). *Prisoner's dilemma.* New York, NY: Doubleday.

Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology, 85*, 440-452. doi:10.1037/0022-3514.85.3.440

Schmiechel, B. J., & Demaree, H. A. (2010). Working memory capacity and spontaneous emotion regulation: High capacity predicts self-enhancement in response to negative feedback. *Emotion, 10*, 739-744. doi:10.1037/a0019355

Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology, 95,* 1526-1540. doi: 10.1037/a0013345

Schnall, S., Roper, J., & Fessler, D. T. (2010). Elevation leads to altruistic behavior. *Psychological Science, 21,* 315-320. doi:10.1177/0956797609359882

Spielberger, C.D. (1988). *Professional manual for the state-trait anger expression inventory*. Odessa, FL: Psychological Assessment Resources.

Taylor, C., & Nowak, M. A. (2007). Transforming the dilemma. *Evolution, 61*, 2281-2292. doi:10.1111/j.1558-5646.2007.00196.x

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods, 37,* 498-505.

Van Kleef, G. A., van Dijk, E., Steinel, W., Harinck, F., & van Beest, I. (2008). Anger in social conflict: Cross-situational comparisons and suggestions for the future. *Group Decision and Negotiation, 17,* 13-30. doi: 10.1007/s10726-007-9092-8

Van Lange, P. M., de Bruin, E. N., Otten, W., & Joireman, J. A. (1997). Development of prosocial, individualistic, and competitive orientations: Theory and preliminary evidence. *Journal of Personality and Social Psychology, 73*, 733-746.

Appendix A

To: Wilson Tucker
Psychology
CAMPUS MAIL

From: Dr. Timothy Ludwig, Institutional Review Board

Date: 4/27/2011

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)

Study #: 11-0282
Study Title: Working Memory Influence on Cooperation and Competition
Submission Type: Initial
Expedited Category: (7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.

Approval Date: 4/27/2011
Expiration Date of Approval: 4/25/2012

This submission has been approved by the Institutional Review Board for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Investigator's Responsibilities:

Before beginning your research please remove the directions from your letter of consent that begin "If this research is for extra credit..."

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented. Should any adverse event or unanticipated problem involving risks to subjects occur it must be reported immediately to the IRB. Best wishes with your research!
CC:
Gary McElroy, Psychology
David Dickinson, Economics
Hall Beck, Psychology

Appendix B

Consent to Participate in Research

Information to Consider About this Research

Opinions and activities

Principal Investigator: Wilson Tucker

Department: Psychology

Contact Information: Dr. Todd McElroy, Psychology Department, Appalachian State University, Boone NC. 28608. (828) 262-2720

What is the purpose of this research?

You are being invited to take part in a research study about individual differences in working memory and how that affects various constructs. If you take part in this study, you will be one of about 200 people to do so. By doing this study we hope to learn about how working memory influences a person's interaction with other people.

What will I be asked to do?

The research procedures will be conducted at the department of psychology in the Smith-Wright building. You will need to come here once during the study. When you come to your session you will complete the OSPAN, which is a measure of working memory. You will then participate in a decision making task. The total amount of time you will be asked to volunteer for this study is forty-five minutes.

What are possible harms or discomforts that I might experience during the research?

There is a risk of a breach of confidentiality as certain questions in the surveys ask sensitive questions that you may want to keep confidential. For this reason all surveys will not have your name, but rather a subject number. Only the researchers will have access to the identifiers that indicate each subject's identity. At the completion of the data gathering segment of the experiment, the information linking the subject to their subject number will be deleted.

What are the possible benefits of this research?

There may be no personal benefit from your participation but the information gained by doing this research may help others in the future.

This study should help us learn about how individual differences that people possess influence their behaviors.

Will I be paid for taking part in the research?

You will receive two ELC's for taking part in this research. No monetary awards will be given for participation in this study.

How will you keep my private information confidential?

Your information will be combined with information from other people taking part in the study there will be no identifiers to determine individual identities. When we write up the study to share it with other researchers, we will write about the combined information. You will not be identified in any published or presented materials.

We will make every effort to prevent anyone who is not on the research from knowing that you gave us information or what that information is. *However, there are some circumstances in which we may have to show your information to other people. We may be required to show information that identifies you to people who need to be sure that we have done the research correctly, such as Appalachian's Institutional Review Board.*

Who can I contact if I have questions?

The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator's faculty advisor at [(828)262-2720]. If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2130 (days), through email at irb@appstate.edu or at Appalachian State University, Office of Research and Sponsored Programs, IRB Administrator, Boone, NC 28608.

Do I have to participate? What else should I know?

Your participation in this research is completely voluntary. If you choose not to volunteer, there will be no penalty and you will not lose any benefits or rights you would normally have. If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. There will be no penalty and no loss of benefits or rights if you decide at any time to stop participating in the study.

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University This study was approved on 4/27/2011. This approval will expire on 4/25/2012 unless the IRB renews the approval of this research.

I have decided I want to take part in this research. What should I do now?

The person obtaining informed consent will ask you to read the following and if you agree, you should indicate your agreement:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I understand that I can stop taking part in this study at any time.
- I understand I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

By participating in this study you are giving your informed consent. Remember that you have the right to withdraw from the study at any time throughout the study.

VITA

Wilson Candler Tucker was born in Pensacola, FL. He received his Bachelor of Science degree in Behavioral Science and commission as an officer in the United States Air Force from the United States Air Force Academy in May 2010. In the fall of 2010, he accepted a position in the General Experimental Psychology program at Appalachian State University, and he began studying toward a Master of Arts degree. He graduated from Appalachian State University in August 2012. Lt. Tucker is now conducting research at Wright Patterson Air Force Base in Dayton, OH.