

AGE DIFFERENCES IN INTERPERSONAL PROBLEM SOLVING:  
EXAMINING INTERPERSONAL CONFLICT IN  
AN ITERATED PRISONER'S DILEMMA GAME

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Age Differences in Interpersonal Problem Solving:  
Examining Interpersonal Conflict in an Iterated Prisoner's Dilemma Game

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## TABLE OF CONTENTS

ACKNOWLEDGMENTS .....	iii
LIST OF FIGURES .....	vi
SUMMARY .....	vii
CHAPTER 1: INTRODUCTION .....	1
CHAPTER 2: LITERATURE REVIEW .....	3
2.1 Age Differences in Everyday Problem Solving .....	3
2.2 Problem Solving Effectiveness .....	4
2.3 Emotion Regulation Underlies Effective Interpersonal Problem Solving .....	7
2.4 The Limits of Assessing Effectiveness .....	9
2.5 Rationale for Studies .....	11
CHAPTER 3: EXPERIMENT 1 - INTERACTING WITH STRANGERS.....	21
3.1 Overview for Experiment 1 .....	21
3.2 Hypotheses for Experiment 1.....	23
3.3 Method for Experiment 1 .....	26
3.4 Results for Experiment 1 .....	34
CHAPTER 4: EXPERIMENT 2 - INTERACTING WITH FRIENDS.....	55
4.1 Overview for Experiment 2 .....	55
4.2 Hypotheses for Experiment 2 .....	57
4.3 Method for Experiment 2 .....	60
4.4 Results for Experiment 2 .....	65
4.5 Comparing Results Experiments 1 and 2 .....	83

## TABLE OF CONTENTS (continued)

CHAPTER 5: CONCLUSIONS .....	90
CHAPTER 6: ENDNOTES .....	110
APPENDIX A.....	118
APPENDIX B .....	124
APPENDIX C .....	129
APPENDIX D.....	134
REFERENCES .....	135

## LIST OF FIGURES

Figure 1	Game board used in Nickels coin game .....	15
Figure 2	Appearance of the game during the Alone Round .....	29
Figure 3	Appearance of the game during an Interactive Round .....	30
Figure 4	Percentage of cooperation in Alone Round of Experiment 1 for each of the eight 4-turn blocks .....	36
Figure 5	(a) Average percentage of cooperation for each round of Experiment 1, (b) Average percentage of cooperation for each round of Experiment 1 .....	38
Figure 6	Percentage of cooperation in the Interactive Rounds of Experiment 1 for each of the eight 4-turn blocks with each partner type .....	41
Figure 7	Histograms of total percentage of cooperation frequency counts for the Interactive Rounds of Experiment 1 .....	42
Figure 8	(a) Aggregate positive attribution scores for young and older adults in the Interactive Rounds of Experiment 1, (b) Cooperative and competitive attribution scores for young and older adults in the Interactive Rounds of Experiment 1 .....	47
Figure 9	Percentage of cooperation in the Alone Round of Experiment 2 for each of the eight 4-turn blocks .....	66
Figure 10	Average percentage of cooperation for each round of Experiment 2.....	69
Figure 11	Percentage of cooperation in the Interactive Round of Experiment 2 for each of the eight 4-turn blocks .....	70
Figure 12	Histograms of average total percentage of cooperation frequency counts for the Interactive Round of Experiment 2.....	72
Figure 13	Percentage of cooperation in the Interactive Round for each of the eight 4-turn blocks, displayed separately for young and older adults by partner type (Experiment 1 = Strangers; Experiment 2 = Friends).....	84

## SUMMARY

Studies of life span development in everyday problem solving suggest two trajectories of change in adulthood: individuals become less effective at solving well-defined instrumental problems but more effective at managing ill-defined interpersonal problems. Two experiments were conducted to examine the ability of young and older adults to effectively manage an interpersonal problem that has a well-defined measure of instrumental success. Participants played an iterated Prisoner's Dilemma game with same-age, computer-simulated strangers (Experiment 1) and friends (Experiment 2). Success was dependent upon one's ability to put aside self-interest and cooperate with a partner. Computer-simulated partners reciprocated the participants' decisions 100% of the time or behaved in a more self-interested manner. Young and older adults' tendencies to create conflict with the reciprocating partner and their defensive reactions to the selfish partner were examined. Although young adults outperformed older adults when playing the game on their own, they did not carry this performance advantage into the interactive rounds. In fact, despite their success when playing alone, young adults were no more successful than older adults when interacting with others. Young and older adults both cooperated more with friends than with strangers and more with the reciprocating partner than the selfish partner. However, when the participants' first interaction was with a selfish stranger, older adults were more cooperative than young adults and consequently accrued more reward. This is consistent with previous research demonstrating that older adults use more passive interpersonal problem solving strategies than young adults, and it also partially supports the prediction that advancing age leads to more effective strategy implementation when solving interpersonal problems.

# **CHAPTER 1**

## **INTRODUCTION**

Advancing age is associated with competing trajectories of gains and losses. Normative physical and cognitive declines co-occur in late life with gains in maturity and experience (Baltes & Baltes, 1990; Riediger, Li, & Lindenberger, 2006). Despite being outperformed by young adults on a number of tasks which broadly characterize adult cognition, older adults live independently and function autonomously in the community. In fact, some research suggests that a certain resiliency develops throughout adulthood which helps older adults to respond in more flexible ways than young adults when dealing with the demands of everyday life (Blanchard-Fields, 2007; Blanchard-Fields, Mienaltowski, & Seay, 2007). Sometimes referred to as the paradox of cognitive aging, this blending of competing trends is quite evident in the literature on everyday problem solving.

Traditionally, everyday problem solving has been examined through the lens of a person's ability to successfully accomplish instrumental activities of daily life. However, successful functioning also involves maintaining harmony in one's current relationships and in interactions that one may have with strangers and acquaintances when accomplishing personal goals. Generally speaking, older adults are characterized as being more effective than young adults at resolving interpersonal conflict (Blanchard-Fields, 2007). The belief is that advancing age is associated with the development of social expertise that allows older adults to more flexibly and effectively implement strategies when faced with interpersonal conflict. Of course, it is more difficult to examine effective



interpersonal problem solving than effective instrumental problem solving because interpersonal problems tend to involve socioemotional factors that are difficult to control, are less structured, and have multiple solutions. As a result, few studies have been able to capture age differences in social expertise. The pair of studies reported herein addresses this issue by examining the strategies that young and older adults used to manage conflict that emerged during the course of an interactive game with an objective definition of effective game performance. Overall, these two studies had four main objectives: (1) To characterize the strategies that young and older adults implemented during conflict that emerged in the context of the game; (2) To examine how effective young and older adults were at reaching the game's objective despite the presence of conflict; (3) To see if young and older adults would flexibly implement behavioral strategies when confronted by two different types of social partner (i.e., cooperative versus selfish); and (4) To investigate the role that interpersonal closeness (i.e., situations involving strangers versus those involving friends) played in strategy choice when young and older adults were faced with conflict.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Age Differences in Everyday Problem Solving**

Everyday problems include both well-defined instrumental problems (e.g., medication adherence) and ill-defined emotionally evocative interpersonal problems (e.g., conflicts with friends or family members) (Berg, Strough, Calderone, Sansone, & Weir, 1998). Instrumental problems emerge when one experiences an obstacle while trying to achieve a personally relevant competence-related goal that does not involve other people. Such problems are usually resolved by thinking about a solution or taking some direct action to eliminate the obstacle. Research on age differences in instrumental problem solving demonstrates that both young and older adults volunteer solutions that directly address the obstacle at hand, but that young adults generate more safe and effective solutions than do older adults (Berg, Meegan, & Klaczynski, 1999; Denney, 1990). Conversely, interpersonal problems occur when the harmony in a relationship between two people is disrupted by a conflict (Berg et al., 1998). Although direct action is sometimes used to resolve interpersonal problems, conflict in a relationship often creates negative emotions that also require mitigation. As with instrumental problems, both young and older adults prefer to use direct, purposeful action when resolving interpersonal problems (Blanchard-Fields, Chen, & Norris, 1997). However, older adults are more likely than young adults to tackle both the practical and the emotional concerns of the problem, and thus are considered to be more effective at solving interpersonal problems (Blanchard-Fields, Jahnke, & Camp, 1995; Blanchard-Fields et al., 2007;

Watson & Blanchard-Fields, 1998). Across problems, young adults may offer more possible solutions, but older adults are more likely to factor in strategies that also address the problems' emotional side-effects.

## **2.2 Problem Solving Effectiveness**

This difference in young and older adults' response tendencies raises an important question about the definition of problem solving effectiveness. What matters more when resolving problems- the number of solutions generated by the participant or the quality of the participant's preferred solutions? Also, does the definition of effectiveness (i.e., number of solutions or quality of the preferred solution) change when considering whether the problem is instrumental or interpersonal in nature? Research examining instrumental functioning across the adult life span has based efficacy on the number of solutions generated and how closely a participant-generated solution matches some ideal solution (for review, Thornton & Dumke, 2005; Heidrich & Denney, 1994). When instrumental problems are tightly constrained to a single best solution or to an ideal sequence of responses (e.g., Willis & Marsiske, 1993), young adults typically outperform older adults. This age difference is misleading because most older adults function independently without much difficulty. One suggestion is that older adults' performance in the lab only partially reflects their actual abilities (Marsiske & Margrett, 2006). This is supported on three levels. First, the tasks used to assess performance are tied to fluid cognitive abilities which typically decline with advancing age. Second, individual differences research on the latter half of life shows that everyday problem solving is multidimensional and not completely explained by traditional psychometric measures of

intelligence (Allaire & Marsiske, 2002; Marsiske & Willis, 1995). Finally, when faced with instrumental problems, older adults opt to use proactive strategies just as much as young adults do. Young adults may spontaneously describe several more ways to directly remove an obstacle to a goal than do older adults, but the solutions offered by older adults may be just as effective.

Another possible explanation for age-related decline in instrumental problem solving is that older adults approach problem solving from a qualitatively different perspective than young adults. With advancing age, physical and cognitive limitations motivate humans to carefully select where to invest their time and energy (Baltes, 1997; Jopp & Smith, 2006; Riediger & Freund, 2006). Although young adults might be willing to use resource-demanding strategies that match the requirements of a complex problem solving task, older adults may be motivated to conserve energy and use strategies that, although less effective than the ideal target strategy, are more familiar and have led to personal success in the past (Li, Lindenberger, Freund, & Baltes, 2001). Given these two possibilities, quantitative assessments of problem solving ability sometimes confound the breadth of an individual's strategy repertoire with efficacy of the most preferred strategy (e.g., heuristics, see Gigerenzer, Czerlinski, & Martignon, 2002).

Similarly, judging problem solving efficacy based on how quickly a person finds the ideal strategy for eliminating an obstacle can also be misleading. When the source of a problem cannot be directly and immediately addressed, the person facing the problem will have to bide their time until they can effectively address the obstacle with purposeful action. Obstacles to goals that fall outside of the control of the individual oftentimes create negative emotions (for review of secondary control, Morling & Evered, 2006). For

example, when dealing with a health emergency, we are often at the mercy of our health care providers. The flow of information is limited by the ability of health care professionals to consider the results of tests, make a definitive diagnosis, and prescribe treatment. Similarly, with interpersonal problems (i.e., when conflict develops with a friend or a family member), sometimes we have to wait for the other person to act before we can act. In both types of problems, there may be little that we can do to immediately fix the problem, so instead we must try to ameliorate the negative emotions that we are experiencing. In a way, success in each of these two incidents is defined by one's ability to be patient while they wait for someone else to act (i.e., passive dependence).

Successful or effective problem solving sometimes requires that we know when to act and when to focus on internal problem appraisal (Blanchard-Fields, 2007; Heckhausen & Schulz, 1995; Lang & Heckhausen, 2001). When faced with emotionally evocative problems, especially uncontrollable interpersonal problems, older adults are more likely than young adults to implement emotion regulation strategies (Blanchard-Fields et al., 1995; Blanchard-Fields et al., 2007). Specifically, young adults will try to use direct action to fix the problem, but older adults will step back and try to resolve their emotions before trying to fix the problem. Temporally speaking, this means that, when faced with an uncontrollable problem, one might first use emotion regulation and then later implement a more proactive instrumental strategy actually geared towards resolving the problem. A participant's response to the question "What strategy will you use?" will depend on where in the process his efforts are currently devoted. Because previous studies did not focus on the dynamic nature of problem solving, they might have

underestimated older adults' problem solving effectiveness by inadvertently missing the temporal sequence used to implement strategies.

One of the strengths of these two experiments, therefore, is that strategy implementation was examined as the problem unfolded over time within each round of the interactive game. Effective problem solving required the participant to recognize that they had to flexibly adapt their choices during the game based on the decisions made by their partners. In this way, effective problem solving emerged when a player consistently monitored the give-and-take of the game and accommodated their behavior relative to their partner's behavior in pursuit of the game's objective. When conflict emerged in the game, reaching a successful resolution required the participant to attend to their partner's concerns while also looking out for their own interests. Although emotion reactivity and regulation were not directly examined, how young and older adults balanced their own interests with those of their partner was examined in each experiment. Given past research on older adults' propensity towards emotion regulation, the studies examined whether or not older adults would be more willing than young adults to temporarily put their own interests aside in order to manage conflicts (i.e., via self-sacrificial cooperation) and successfully reach the game's objective. Moreover, the experiments examined how young and older adults adapt to distinctively competitive and cooperative personalities.

### **2.3 Emotion Regulation Underlies Effective Interpersonal Problem Solving**

Past problem solving research suggests that, when faced with conflict, older adults step back and appraise the situation before acting (Blanchard-Fields, 2007). Stepping back from a problem gives a person a chance to do two things (Gross, 2001).

First, one can try to control their emotional response to the conflict. Second, one can think of a strategy that might help to avoid future conflict and thus future negative emotions. Previous research demonstrates that advancing age is associated with an increased reluctance to express anger towards others in interpersonal conflicts (Coats & Blanchard-Fields, 2008). In the context of interpersonal problems, this may take the form of using passive and avoidant strategies to prevent a negative interpersonal situation from becoming even worse. Past research demonstrates that older adults use more passive and avoidant types of strategies when faced with interpersonal conflict, partially to cope with negative emotions (Blanchard-Fields, 2007) and partially to avoid the dissolution of social bonds (Birditt & Fingerman, 2005). With advancing age, an individual's drive to achieve competency-oriented goals is supplanted by a desire to be close to friends and family and a desire to pass a legacy on to future generations (Diehl, Owen, & Youngblade, 2004; McAdams, de St. Aubin, & Logan, 1993). As a result, older adults may give greater consideration than young adults to the enduring qualities of relationships (Carstensen, 2006). Their affiliative goals may motivate them to be sensitive to the needs of others and more tolerant of temporary setbacks in close relationships.

It is this drive to promote positive interactions with others that should underlie older adults' problem solving effectiveness in the face of interpersonal conflict. Due to their communal approach to relationships and their focus on interpersonal harmony, older adults may be more likely than young adults to use strategies that foster social bonds while avoiding strategies that act to communicate interpersonal displeasure (discussed in Blanchard-Fields, 2007). In these two experiments, successful social interaction required

that young and older adults cooperate with interactive partners who are sometimes selfish. It was expected that, in the face of conflict, older adults' preference for cooperative, affiliative strategies would help them to be more successful than young adults, who were predicted to rely more on self-interested motives. This is consistent with Blanchard-Fields's (2007) suggestion that, contrary to popular expectations, passivity is oftentimes adaptive in interpersonal problems, and that its use under the appropriate circumstances may play a large role in defining success for older adults' problem solving efforts. Key to this argument is the notion that the successful implementation of instrumental (i.e., action-oriented) strategies in interpersonal problems requires that both parties in a conflict agree to work together (or "it takes two to tango"). Older adults' preference for affiliative goals predisposes them to consider the needs of their partner in a conflict and was thus expected to benefit their performance in the two experiments.

## **2.4 The Limits on Assessing Effectiveness**

Up to this point, it should be clear that the literature portrays older adults' problem solving abilities in both a positive and negative light. Older adults typically demonstrate problem solving deficits when problems are well-defined and of an instrumental nature, but they demonstrate superior levels of effectiveness when problems are ill-defined and are interpersonal or emotionally-evocative in nature (Blanchard-Fields, 2007; Heidrich & Denney, 1994; Marsiske & Willis, 1995). This disparity in findings suggests that the current techniques for assessing the effective resolution of well-defined problems provide only a narrow perspective on the strategies that older adults use to cope with obstacles to instrumental goals. For instance, recent work by Finucane and



colleagues (2002, 2005) demonstrates that older adults display less decision making competence than young adults. The authors associated the cause of this deficit with older adults' declining information comprehension abilities and poor inferencing skills. The tasks used to assess decision making competence required participants to complete tax forms and health insurance applications. It is true that advancing age adversely affects reasoning and comprehension abilities, but, when faced with challenges while completing forms outside of the lab, older adults might compensate for their cognitive limitations by seeking assistance from others (e.g., loved ones or experts in the field).

If an older adult sought assistance from another person, the problem space would expand to include other people. For example, the older adult might find a trustworthy person who was capable of helping. She would then have to develop a strategy for interacting with this person to make sure that she could meet the relational demands associated with the interaction (e.g., have personal financial information readily available, offer time during the day to consult, etc.). The older adult would also have to monitor the success of the interaction in order to (a) maintain harmony if things were progressing successfully or (b) gradually place distance between herself and the other person if the other person was not helpful. Of course, seeking social support is just one example of how older adults might choose to cope with an instrumental problem that they could not personally solve. How older adults truly cope in this situation is an empirical question. However, it is important to keep in mind that, by expanding the breadth of the possible solutions that a participant might use to solve a problem, the conclusions that one draws about that individual's problem solving effectiveness might change.

Although research methods used to examine instrumental problems underestimate older adults' problem solving capacity by strictly defining optimal strategy selection, those methods used to investigate age differences in interpersonal problem solving seldom offer a clear definition of objective success (Thornton & Dumke, 2005). Moreover, even though interpersonal problems involve more than one person, successful interpersonal problem solving is typically gauged from the perspective of the individual who is being asked about the problem. From this person's point of view, strategies (1) that remove the source of contention, (2) that distance the individual from the problem, or (3) that ameliorate negative emotions created by the conflict, can all be considered effective. It is difficult to objectively define success when it comes to interpersonal problems because each participant might have a different goal for the relationship in which the conflict occurs. Essentially, to know which strategy truly leads to success, one would have to determine if the solutions provided by the participant were appropriate given the participant's personal goal for the relationship (Hoppmann, Coats, & Blanchard-Fields, in press).

Overall then, each approach to assessing problem solving has its own limitations and strengths. On one hand, research on well-defined instrumental problems describes the problem solving deficits displayed by older adults when compensatory strategies and emotion regulation are not considered viable alternatives (Allaire & Marsiske, 2002). Conversely, research on ill-defined interpersonal problems suggests that older adults may rely on personal goals to carefully choose those strategies that optimize success when no single strategy is optimal (Hoppmann et al., in press). The current study meshes these two approaches to problem solving together by examining the strategies that young and

older adults used to manage interpersonal conflict that developed in the context of an instrumental task situation.

## **2.5 Rationale for Studies**

During interpersonal conflict, relationship partners each bring their own individual goals to the problem space. From an experimental standpoint, such goals are difficult to control, so individual differences in goals might be examined as a predictor of the strategies that a person adopts to manage conflict. Ultimately, each partner wants the conflict to be resolved with as positive an outcome as possible. However, there is no guarantee that the partners will share the same view on what the most positive outcome is or on how to reach this outcome. To standardize the optimal goal state, participants were asked to try to reach a well-defined achievement-oriented objective. Each partner was individually told to work toward the same goal, and both partners had to work together to successfully achieve this objective.

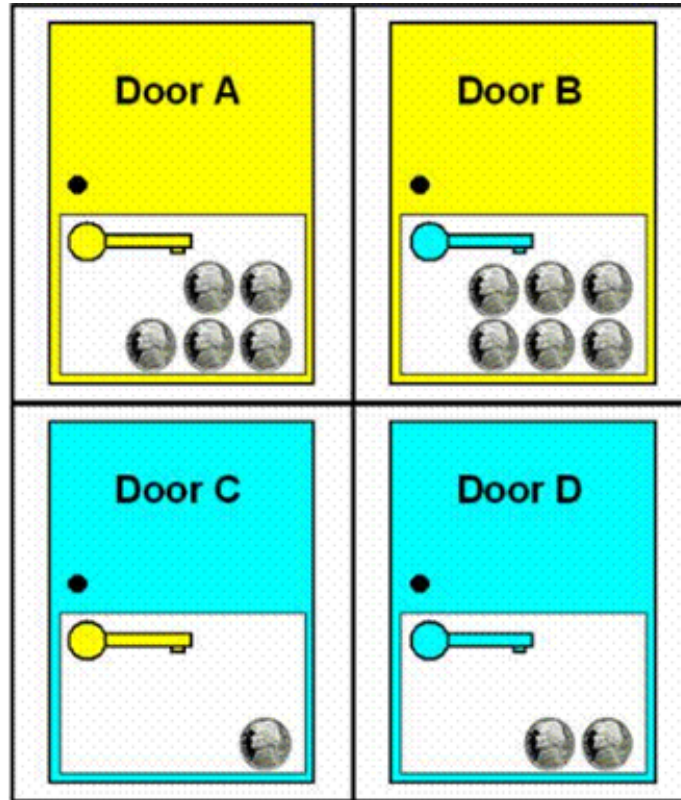
Conflict emerged in the interaction if at least one partner deviated from the path that led to the most optimal outcome. Once a conflict emerged, task success was dependent upon how quickly the partners resolved their differences. Moreover, both experiments examined the conditions that led to conflict in this controlled interpersonal interaction. Specifically, the interaction task was set up to examine (a) how likely each participant was to instigate conflict, and (b) what strategy participants used to manage conflict instigated by their interaction partner. Effective problem solving required participants to implement strategies that addressed the task-related achievement-oriented goal while at the same time fostering cooperation with the interaction partner. Past

research has focused on examining conflict that occurs in interactions with friends and family members (e.g., Akiyama, Antonucci, Takahashi, & Langfahl, 2003; Birditt & Fingerman, 2003, 2005; Blanchard-Fields, 2007; Krause & Rook, 2003), but interpersonal conflict can also involve individuals with whom we do not have enduring relationships (e.g., Artistic, Cervone, Pezzuti, 2003; Blanchard-Fields et al., 2007). For example, we frequently interact with strangers who provide services that help us to meet achievement-oriented goals. Conflict in such interactions can serve as obstacles to our goals and to the goals of the service providers. Each study examined age differences in interactive behavior in the context of a game (Luce & Raiffa, 1985). Experiment 1 focused on interactions with strangers, and Experiment 2 focused on interactions with friends. To control for between-pairing idiosyncrasies in behavior, participants did not actually play with one another. Deception was used to convince players that they were playing with human partners when they were actually interacting with computer players that were manipulated to simulate specific response strategies.

To interact with their partners during the game, players took turns making choices. Each choice was rewarded with a specific number of reinforcers. The choice made by a given player was dependent upon the previous choice of the other player. That is, one player's choice placed limits on the options that were available to the other player. During each turn, participants had to decide between acting cooperatively and acting out of self-interest (Axelrod, 1984). Both players were instructed to pursue the same objective (i.e., obtain as much of the reinforcer as possible). In the long run, both players would collect more of the reinforcer via consistent, mutual cooperation (Aumann, 1959). However, individuals could act out of self-interest in order to attempt to achieve a better

outcome than the other player (i.e., more of the reinforcer). Given this dynamic, individuals could keep a mental record of the past decisions made by the other player in order to predict that player's future decisions (for e.g., see Poundstone, 1992, pp. 106-121). If one player cooperated, then the other player could have chosen to reciprocate in order to establish a track record of cooperation. If one player decided to act out of self-interest, then the other player could have also chosen to act out of self-interest. The game used in both experiments was a form of an iterated Prisoner's Dilemma (PD) paradigm. In its original form, the PD was a thought-experiment proposed by Albert Tucker (Luce & Raiffa, 1985, pp. 94-95) to illustrate how self-interest could inhibit social cooperation and lead to negative outcomes when two individuals were faced with a single choice (i.e., cooperate or defect) but neither individual was certain of the motives of the other. In the iterated version of the PD, players choose one of two options (i.e., behave cooperatively or selfishly) in each of several turns such that previous turns influence future turns. This affords players a wide variety of strategic options for attempting to steer the game in a direction to produce individually and/or mutually favorable outcomes (Aumann, 1959).

The version of the iterated PD that was used in these experiments was adapted from Rachlin and colleagues' work (1999, 2000, 2001) exploring the relationship between self-control and cooperation. Participants were presented with a game board (see Figure 1) and were asked to take turns opening doors using keys. The primary goal of the game was to collect as many nickels as possible during each round. The game was presented to players in two formats. First, participants played the game by themselves (a.k.a., Alone Round). During this round, participants had a chance to explore the game and to think about how best to achieve the game's objective. Afterwards, participants



*Figure 1.* Game board used in Nickels coin game.

engaged in interactive play, during which each player's decisions limited the possible decisions that could be made by their partner. One might expect participants to use the same strategy that they learned in the Alone Round when playing with others in the Interactive Rounds. For Experiment 1, participants were told that they were playing with two different same-age strangers who were being tested in another location. For Experiment 2, pairs of friends were recruited and told that they would be playing the game with one another.

During the Alone Round, participants were presented with the game board and instructed that each choice that they made would be rewarded with a specific number of nickels and a color-coded key that would be used on the next turn. The reward (i.e., key

and nickels) found behind each door remained the same during each turn. For example, with a yellow key, the participant could open either door found on the top of the game board. If the player opened Door A, they received 5 nickels and a yellow key. By opening Door B, the player earned 6 nickels and a blue key. Each choice made by the player limited his or her options in the next choice to just two doors. If a player was focused on the objective of the game, or earning as many nickels as possible in each round, they could have first used a yellow key to open Door B to collect 6 nickels and a blue key. On the very next turn, however, they would have had to choose between Doors C and D. To maximize their total number of nickels, participants needed to focus on the long-run instead of focusing on larger immediate rewards. Doors on the right side of the game board represented larger immediate rewards, as opening these doors led to the highest possible number of nickels in any given turn (i.e., Door D's 2 nickels > Door C's 1 nickel; Door B's 6 nickels > Door A's 5 nickels). Choosing the doors on the right came at a cost. By choosing Door B over A, a player was forced to choose between the bottom two doors on their next turn, and would thus forgo at least 3 nickels (i.e., 5 nickels from Door A less 2 nickels from Door D). This meant that a player who opened Door B would be strongly motivated to open Door C on their next turn so as to collect a yellow key and once again be able to choose from the top two doors.

In previous work, players typically discovered that the optimal solution was to always choose Door A after a few turns in the Alone Round (Brown & Rachlin, 1999). A failure to rely on this strategy was associated with having low self-control, as the larger immediate reward (e.g., rewards behind Doors B and D > rewards behind Doors A and C, respectively) was too tempting to pass up (Rachlin, 2000). A failure to discover the

optimal solution was also related to one's inability to reason through the situation and understand how best to achieve the game's objective. Given this, the Alone Round format of the game resembled well-defined instrumental problems used in the past to study instrumental everyday problem solving. Specifically, to meet the game's objective, participant had to rely on their cognitive skills to figure out the optimal strategy (i.e., choosing doors on the left side of game board promote largest gain). Previous research on the PD has not focused on the performance of older adult samples, but advancing age has been associated with gains in self-control as indexed by a reduction of the discounting of delayed rewards (Green, Fry, & Myerson, 1994; Green, Myerson, & O'Donoghue, 1999). Assuming that older adults developed a proper understanding of the game's instructions in each experiment, they should be just as able as young adults to determine the optimal strategy for collecting nickels. However, age-related differences could still emerge in this game if more young adults use the optimal strategy than older adults. The critical test of game comprehension emerged in each experiment when examining change in performance between the Alone Round and the Interactive Rounds. At this juncture, participants were forced to consider how their choices influenced their partner's success.

During interactive play, each player's decision as to which door to open influenced the subsequent decision that was made by the other player. Specifically, when a player opened a door using a key, that player collected the nickels found behind that door but gave the key to the other player. Although participants determined that it was important to choose from the yellow doors to obtain the most nickels, whether or not they consistently chose Door A (and returned a yellow key to their partner) was dependent upon what the participant inferred the other player's intentions were. Ultimately, the best



possible outcome occurred when both players cooperated and exclusively chose Door A. However, the moment that one player acted purely out of self-interest, the other player became suspicious of that player's motives and lost confidence in that player's ability to cooperate. In both experiments, successful social interaction required that the participants kept their own interests in mind while also being mindful of those of their interaction partner. If one partner failed to reciprocate sensitivity to mutual interest, conflict erupted and each partner then struggled to control the situation.

There were two ways in which a person could immediately react to conflict created by their partner (i.e., partner chose Door B). First, some participants chose to retaliate by also making a selfish choice when it was their turn (i.e., Door D). By doing this, the participant communicated to the other player that selfish choices would be reciprocated with selfish choices. The second response that was displayed in the face of conflict was to continue to cooperate despite the fact that the selfish partner could very well choose to remain selfish (i.e., Door C). By doing this, the participant communicated to the selfish partner that they were not motivated to out perform him or her but instead wanted to get the best score that they could for themselves through cooperation. The first reaction was considered to be more confrontational in nature because the participant was proactive in punishing the selfish partner for deviant, selfish behavior. The second reaction was considered to be more passive because the participant was allowing the other player to determine how much success each of them would have.

In addition to these immediate reactions, participants also developed more long-term strategies for how to behave. For example, after being taken advantage of by their partner, some participants feigned a willingness to cooperate in order to make selfish

choices themselves the first chance that they got (i.e., Participant chose C, partner chose A, participant chose B; a.k.a. “getting even”). Other participants decided to cooperate even after their partner was uncooperative on more than two occasions. Once again, the former was considered to be a more confrontational strategy because it involved deliberately creating a situation to try to make one’s partner feel the same type of frustration experienced by the participant. However, the latter was considered more passive as the participant gives the selfish partner multiple chances to reconcile and cooperate. Ultimately, flexible strategy implementation occurred during the game when the participant adapted their strategy over time to match the cooperative tendencies of the interaction partners. In so doing, a person would maximize their earnings.

Interpersonal problems occur when an obstacle emerges in a relationship or interaction between two or more individuals. In these two experiments, obstacles were examined at two different levels of interpersonal closeness. In Experiment 1, conflict was induced between strangers by programming computer-simulated strangers to be selfish (i.e., act out of self-interest) on a fixed proportion of the trials. Likewise, in Experiment 2, conflict was induced between friends by programming a computer-simulated friend to be selfish on a fixed proportion of the trials. In both experiments, if the participant established a reciprocal pattern of cooperation with the computer-simulated player, conflict emerged when the computer player deviated from this pattern and prevented the participant from obtaining the game’s objective.

The main purpose of these two experiments was to provide an initial examination of the ways in which young and older adults reacted to conflict that emerged when cooperation broke down in interactions with strangers and friends. Because conflict in

relationships is typically bi-directional, the likelihood that participants would instigate conflict themselves when their partner did not first instigate it was also examined. Again, participants interacted with computer-simulated strangers (Experiment 1) and friends (Experiment 2), but, in this condition, these partners did not cause conflict. Differences in the likelihood of instigating conflicts with strangers as opposed to friends were examined for young and older adults using cross-study comparisons. Finally, in Experiment 1, participants played the game with two strangers: one who was programmed to break patterns of mutual cooperation and one who was programmed to always reciprocate the participant's choice (i.e., if the participant was selfish, then the computer was selfish; if the participant was cooperative, then the computer was cooperative). The order with which participants played each of the computer players was manipulated to examine possible reactivity effects across player.

## **CHAPTER 3**

### **EXPERIMENT 1 - INTERACTING WITH STRANGERS**

#### **3.1 Overview of Experiment 1**

Findings from life span developmental research on interpersonal problem solving suggest that advancing age is associated with a greater flexibility in problem solving strategy use (Blanchard-Fields, 2007; Blanchard-Fields et al., 2007). Older adults are more likely than young adults to include emotion regulation strategies in their reactions to interpersonal strife (Blanchard-Fields et al., 1995, 1997; Blanchard-Fields, Stein, & Watson, 2004). Moreover, the strategies that they select are better suited for meeting the affiliative goals that they have for their relationships (Blanchard-Fields, 2007; Hoppmann et al., in press). Specifically, the strategies adopted by older adults are more likely to diffuse interpersonal tension than those selected by young adults (Birditt & Fingerman, 2005). In interpersonal problems, confrontation and emotional venting may further ignite the emotions of the other person involved, and thus may be destructive to relationships (Birditt & Fingerman, 2005). When faced with an uncontrollable interpersonal problem, older adults are more likely to passively withdraw from the problem. By doing this, they can avoid escalating the conflict and focus instead on more instrumental solutions. Conversely, young adults will often invest more time and energy into managing the cause of the problem than into trying to resolve the negative emotions created by the conflict. When they do try to resolve their negative emotions, young adults are more likely to use confrontive strategies that might make achieving instrumental goals more difficult (Blanchard-Fields, 2007). When taken together, these findings suggest that older adults

are more attuned to maintaining harmony in relationships than are young adults, and that older adults may use more passive behaviors (e.g., withdrawal) to allow the tension that builds during a conflict to subside. As mentioned earlier, older adults' use of passive strategies may actually be effective because they are more appropriate for the context of the problem (Blanchard-Fields, 2007).

In Experiment 1, young and older adults played one round of an iterated PD game alone and then two rounds with two different computer-simulated strangers. Participants first played by themselves to become familiar with the game. In the Interactive Rounds, one of the strangers reciprocated the participant's behavior 100% of the time using a Tit-for-Tat (TFT) strategy (a.k.a., TFT Stranger). The other stranger reciprocated the participant's behavior in 75% of the trials, but, during the remaining 25%, this stranger made selfish, or the self-interested, choices (a.k.a., Selfish Stranger). In past experiments, young adults were able to predict the behavior of the TFT Stranger 100% of the time, but had more difficulty in predicting the behavior of the Selfish Stranger (Baker & Rachlin, 2001). These two programs were adopted in both experiments as a way to manipulate the cooperative intent of the computer-simulated players. Participants interacted with strangers by taking turns opening doors in the iterated PD game, and their level of cooperation was monitored as the main dependent variable. Cooperative responses involved choosing to open Door A or Door C because each of these choices required the player to forgo a larger immediate reward to obtain a larger average gain in the long run. At the end of each round, participants were asked to describe the goal that they had in mind for that round and to characterize the personal qualities of the other player.

Although interpersonal interactions between older adults and their friends and family members have been the focus of much research, how older adults spontaneously interact with strangers has yet to be examined. Friends and family members do represent important components of older adults' social support mechanism. Nevertheless, older adults come into contact with novel social partners (i.e., strangers) on a regular basis. For example, a stranger may provide a service that helps an older adult meet an instrumental goal. Given this possibility, it is important to consider how older adults go about interacting with strangers and how older adults might cope with conflicts when strangers fail to act in their interest. Because older adults develop distinct preferences for close social partners that provide emotionally meaningful interactions, their mechanism for selecting friendly partners, and even friendly strangers, may be more sensitive than that of young adults (Carstensen, Isaacowitz, & Charles, 1999). Experiment 1 was designed to provide some insight into this selection mechanism by characterizing how young and older adults reacted to one stranger who was selfish and one who was open to cooperation.

### **3.2 Hypotheses for Experiment 1**

The hypotheses for Experiment 1 are broken down into three groups: those where age should not matter (*age non-specific*), those where age should matter (*age specific*), and those that are more exploratory in nature (*exploratory*).

#### *3.2.1 Age Non-Specific Hypotheses*

Because the TFT Stranger was more consistently willing to consider the mutual interest of both players than the Selfish Stranger, all participants were expected to display a greater percentage of cooperative behavior for the TFT Stranger than for the Selfish Stranger (Hypothesis 1). Moreover, while playing the TFT Stranger, participants were expected to discover that this stranger was willing to cooperate, so cooperative behavior was predicted to increase over time (Hypothesis 2). Conversely, while playing the Selfish player, participants were expected to respond to the broken pattern of cooperation by being less cooperative (Hypothesis 3). The change in cooperation over time predicted in Hypotheses 2 and 3 were operationalized by tracking the percentage of time that each participant displayed cooperative behavior (i.e., chooses Doors A or C) in eight successive 4-turn blocks during the course of each 32-turn round. Finally, given that participants were expected to display more cooperative behavior toward the TFT Stranger than the Selfish Stranger, they were predicted to have more favorable impressions of the TFT Stranger (Hypothesis 4). To test this hypothesis, participants' trait ratings for the other player's personal characteristics were collected after each round and then comparisons were made between the TFT Stranger and Selfish Stranger.

### *3.2.2 Age Specific Hypotheses*

Because advancing age was associated with increased self-control and with an increased prioritization of relationship harmony in previous research, older adults were predicted to be less likely than young adults to instigate conflict (i.e., make self-interested choices) when playing with the TFT Stranger. In other words, older adults were expected to be more likely than young adults to cooperate (i.e., choose Doors A or C) with

strangers who do not initiate a deviation from the rules of reciprocal exchange (Hypothesis 5). Also, given their more passive approach to interpersonal conflict, on average older adults were predicted to use fewer turns to punish the Selfish Stranger after this player acted out of self-interest (Hypothesis 6). This hypothesis was tested by examining the frequency of selfish behavior (i.e., choosing Doors B or D) displayed by young and older adults immediately after the first time the Selfish Stranger behaved in a selfish way. It was expected that once a conflict emerged, young adults would focus on fixing the deviant behavior of the Selfish Stranger and thus punish the Selfish Stranger via reciprocal selfishness (i.e., choosing Doors B or D), whereas older adults were expected to punish the Selfish Stranger more sparingly (i.e., choose Doors B or D less often than young adults) so that they could capitalize on those turns that the Selfish Stranger actually did reciprocate (75%) to collect more nickels. In other words, older adults were predicted to focus on the Selfish Stranger's less-than-perfect willingness to cooperate, but young adults were expected to focus on the Selfish Stranger's willingness to behave selfishly. Additional confirmation for this was also sought by examining the goals that young and older adults reported they had in mind during each of the rounds of interactive play (Hypothesis 7).

Young adults' insensitivity to the Selfish Stranger's willingness to cooperate was predicted to lead to two possible side effects for their behavior during the game. First, when young adults interacted with the Selfish Stranger before the TFT Stranger, the earlier experience was expected to bias their choices toward selfishness (i.e., choosing Doors B or D) when later playing with the TFT Stranger (Hypothesis 8). To test this hypothesis, overall cooperation in each round was examined with order of play acting as



a between-subjects factor. Some participants played with the TFT Stranger first, others played play with the TFT Stranger after first playing the Selfish Stranger. Second, young adults were predicted to have a more negative impression of the TFT Stranger when playing the TFT Stranger after the Selfish Stranger rather than before (Hypothesis 9). Older adults were expected to be more sensitive than young adults to the differences in the behavioral tendencies of the TFT and Selfish Strangers. As a result, older adults were predicted to collect more nickels than young adults and thus more effectively resolve interpersonal conflict (Hypothesis 10).

### *3.2.3 Exploration of Individual Differences*

In addition to collecting data on the iterated PD task, participants were asked to complete questionnaires assessing individual differences in personality, competitiveness, locus of control, preference for antecedent- (i.e., reappraisal) and response- (i.e., suppression) focused emotion regulation, interpersonal flexibility, interpersonal trust, coping flexibility, future time perspective, generativity, agentic and communal values, and one's propensity to engage in life management strategies. In order to get a better understanding of the factors that predict effective interpersonal problem solving, scores on these measures were examined for possible relationships to the overall level of cooperative behavior. Also examined were relationships between cooperation in the game and the participants' gender and level of cognitive functioning.

## **3.3 Method for Experiment 1**

### *3.3.1 Overview*

Young and older adult participants played an iterated Prisoner's Dilemma game (PD) first alone and then with each of two distinct fictional strangers. One stranger was programmed to reciprocate the participant's choices 100% of the time (a.k.a. Tit-for-Tat, or TFT, stranger). The other stranger resembled the TFT stranger some of the time, but also displayed self-interested behavior (a.k.a. Selfish player). The order with which participants interacted with these two computer programs was counterbalanced. Of primary interest were (a) the degree to which participants would cooperate with the strangers during the game and (b) the accumulated reward (i.e., nickels that participants were able to accrue). Also examined were the participants' impressions of the strangers and their self-reported goals for the interactive round of the game.

#### Participants

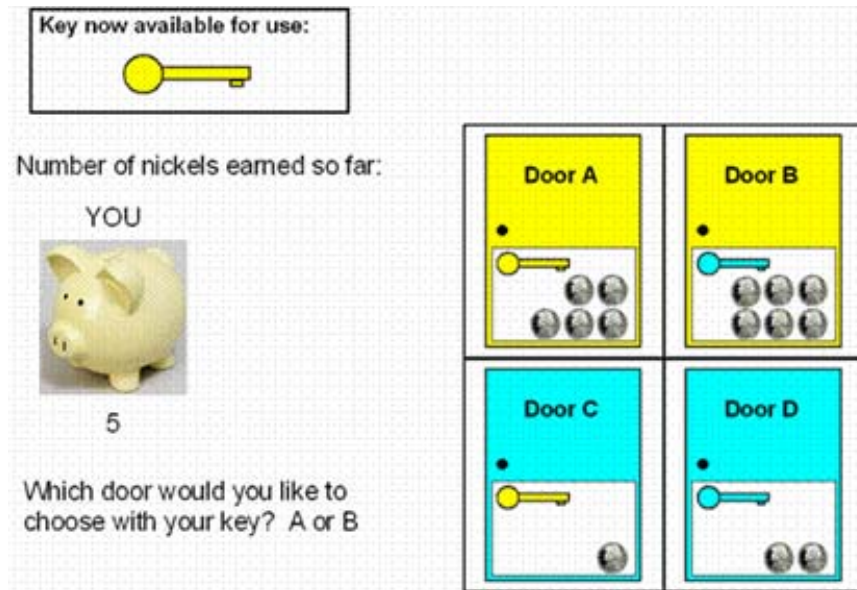
Eighty-one young (ages 18-28;  $M = 19.9$ ,  $SE = 0.2$ ; 44% women) and 72 older adults (ages 58-82;  $M = 70.1$ ,  $SE = 0.8$ ; 54% women) were recruited to participate in this experiment. Participants were predominantly Caucasian (71%; African American = 11%, Asian = 9%, Other = 10%). Relative to young adults, older adults reported being in worse overall health,  $t(148) = 2.83$ ,  $p < .001$ , and felt that their health problems were more likely to get in the way of their daily activities,  $t(147) = 3.40$ ,  $p < .01$  (Young overall health:  $M = 3.95$ ,  $SE = 0.09$ ; Old overall health:  $M = 3.57$ ,  $SE = 0.11$ ; Young health problems:  $M = 1.53$ ;  $SE = 0.09$ ; Old health problems:  $M = 2.00$ ,  $SE = 0.11$ ). Older adults ( $M = 21.9$ ,  $SE = 0.9$ ) obtained a higher vocabulary score than did young adults ( $M = 17.4$ ,  $SE = 0.5$ ),  $t(147) = 4.27$ ,  $p < .001$ , but young adults obtained higher scores in inductive reasoning (Letter Sets; Ekstrom, French, Harman, & Dermen, 1976) and processing speed (Digit-Symbols Matching; Salthouse, 1992) than did older adults,  $t(149) = 8.16$  ( $p$

$< .001$ ) and  $t(149) = 12.02$  ( $p < .001$ ), respectively (Young Letter Sets:  $M = 23.3$ ,  $SE = 0.4$ ; Old Letter Sets:  $M = 17.1$ ,  $SE = 0.7$ ; Young Speed:  $M = 65.5$ ,  $SE = 1.2$ ; Old Speed:  $M = 44.8$ ,  $SE = 1.2$ ). Young and older adults reported a similar level of education (i.e., “some college”).

### 3.3.2 Materials

*3.3.2.1 Iterated Prisoner’s Dilemma (PD) Game.* The iterated PD game adapted for this experiment (Brown & Rachlin, 1999) asked players to take turns opening doors in order to collect nickels. Doors were color-coded with the key that was needed to open them. Blue keys opened blue doors, and yellow keys opened yellow doors. See Figure 1 for a graphic depiction of the game board. The objective of the game was to collect as many nickels as possible in each round. Each round consisted of 32 turns; however, participants were unaware of this and were told that each round would end after some randomly-determined number of turns. Participants played the first round by themselves (Alone Round) and then played two rounds with strangers (Interactive Rounds). Participants started off each round with a yellow key and were asked to choose between opening Door A or Door B. When a participant opened a door in the Alone Round (see Figure 2 for a depiction of a trial in the Alone Round), they collected the key and the nickels found behind that door (i.e., shown in the window at the bottom of the door). After each turn, the game board was reset and the participant was free to open any door that matched the color of the key that they had just obtained in the previous turn. In the Interactive Rounds, when a player opened a door, that player kept the nickels found behind the door but gave the key that they uncovered to the other player. The other player

would then use this key to open a door during their turn (see Figure 3 for a depiction of a trial in the Interactive Rounds), collecting the nickels behind the door of their choice and passing the accompanying key to the other player. The optimal strategy for all rounds was to consistently choose Door A, yielding an average gain of five nickels per turn.



*Figure 2.* Appearance of the game during the Alone Round.

In conjunction with each round of the game, participants completed a few questionnaires. First, after each round, participants were asked to briefly describe the goal that they had in mind while playing the game in that round. Second, immediately prior to the first Interactive Round, participants were asked to describe the strategy that they felt would maximize the number of nickels that a person could collect in that round. These questions were posed to assess the participants' approach to and frame of mind during the Interactive Rounds. Responses were coded for the degree to which they reflected each

participant's competitive or cooperative intentions. Finally, after each Interactive Round, participants made trait attributions about the stranger with whom they had just interacted

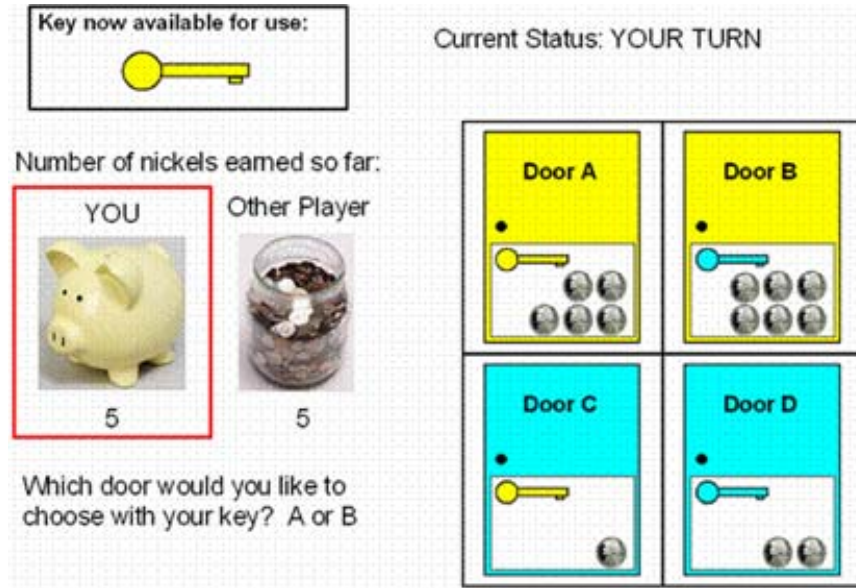


Figure 3. Appearance of the game during an Interactive Round.

by indicating the extent to which they agreed that the stranger displayed each of 25 personal characteristics (i.e., likeable, intelligent, kind, trustworthy, charitable, friendly, honest, competent, loyal, passive, selfish, stubborn, unfaithful, annoying, uncaring, lazy, inexperienced, hostile, independent, cooperative, competitive, impulsive, curious, masculine, and feminine; rating: 1 = *strongly disagree* to 7 = *strongly agree*).

All rounds of the iterated PD game were played on computers using E-prime software (Psychology Software Tools, Pittsburgh, USA) that had been programmed to create the feel of a turn-based game setting. During the Interactive Rounds, the participants received feedback from the computer-programmed strangers in such a way to make it appear that a real human was taking time to make a response. The computer's

response time randomly varied between 2 to 6 seconds for young adults and 2 to 10 seconds for older adults. The program for the TFT Stranger reciprocated the behavior of the participant on every turn (i.e., if receive a yellow key, then pass a yellow key). However, the program for the Selfish Stranger reciprocated the participant's choices on only 75% of the turns. During the Selfish Stranger's first two turns, the computer reciprocated the participant's choices to create the illusion of being willing to cooperate and also to allow for the possibility that the participant would defect before the Selfish Stranger did. However, during eight of the 30 remaining turns, the Selfish Stranger would pass a blue key regardless of the participant's pattern of choices (i.e., choose Door B if Selfish Stranger has a yellow key or choose Door D if Selfish Stranger has a blue key). These defections were randomly distributed, and each participant's responses were examined to determine the number of times that the participant noticed the Selfish Stranger's defections.

*3.3.2.2 Individual Difference Measures.* Prior to the experimental session, participants were asked to complete a packet of surveys and questionnaires. These global measures assessed each participant's social and personal goals and tendencies. This battery of measures was included to explore how such intra- and interpersonal characteristics would relate to performance in the iterated PD game. Included in the packet were measures of interpersonal flexibility, coping flexibility, emotion suppression, emotion reappraisal, future time perspective, generativity, locus of control, agentic and communal values, interpersonal trust, interpersonal control strivings, personality dimensions (i.e., conscientiousness, agreeableness, neuroticism, extraversion, and openness), and competitiveness. For a description of each measure, see Appendix A.

### *3.3.3 Procedure*

Participants were recruited from the student population at the Georgia Institute of Technology and from the Atlanta metropolitan community to take part in a study examining how people interact with others while playing a computer game. Participants completed a packet of individual difference questionnaires (described above and in Appendix A) prior to the laboratory session. Sessions were conducted with one or two participants per session. Participants were told that they would play multiple rounds of a computer game called “Nickels”, and that two additional same-age participants (i.e., anonymous strangers) were simultaneously taking part in this experiment in another testing location with another experimenter. No information (e.g., gender) was given to the participants about the strangers. Participants were told that the experimenters who were conducting the session at each testing location would coordinate the game by communicating with one another using a Voice-Over-IP program (e.g., Skype). When sessions included two participants, the participants were reassured that they would only be playing with strangers during the interactive rounds and that they would never play the game with one another. Participants were then instructed as to how to play the computer game.

Participants were first instructed as to the rules of the Alone Round (see Appendix B for the instructions that were read to the participants before playing the Alone Round). Briefly, participants were informed (a) that they would be collecting nickels by making sequential decisions to open doors using keys (i.e., blue keys open blue doors, and yellow keys open yellow doors), (b) that the decision to open a door in one turn impacted the

next turn by giving you a new key that limited your next choice, and (c) that their objective was to obtain as many nickels as possible during the round. After completing a short practice round, participants were left alone to complete the Alone Round of the game. At the end of the round, participants were asked to indicate which strategy a person would use if they wanted to maximize the number of nickels that they earned in that round.

Next, participants were instructed on the game format for the Interactive Rounds (see Appendix B for the instructions that were read to the participants before playing the Interactive Rounds). Participants were told (a) that they had the same objective as in the Alone Round, to earn as many nickels as possible, (b) that their choices (as well as those of the strangers with whom they were playing) would be limited by the color of the key that they were passed when the strangers made their choices, and (c) that they should let the experimenter know immediately if there was a connectivity problem between their computer and that of the stranger with whom they were playing. No allusions to cooperating (e.g., “partner”) or competing (i.e., “opponent”) were made in the instructions. If participants asked questions about the intentions of the strangers with whom they were playing, the experimenter responded with an ambiguous, non-evaluative response (e.g., “Each person has to use their own judgment when making choices. It is up to each of you.”). Just prior to starting the first Interactive Round, participants were once again asked to indicate which strategy a person might use to maximize the number of nickels that they earned in the round. Participants were then left alone to complete each Interactive Round. After each round, participants were asked to indicate what their objective was while playing. They were also asked to provide their impression of each



stranger by rating the stranger on 25 personal traits. Once the rounds of the iterated PD game were completed, cognitive abilities tests were administered, and participants were probed for their suspicion about the deception used during the game. Afterwards, participants were debriefed as to the purpose of the experiment, and all deception involved was disclosed. Participants were also asked to verify that it was acceptable to use their data given the deceptive method used to obtain them.

### **3.4 Results for Experiment 1**

#### *3.4.1 Overview*

This study used a 2 (Age Group: young and older adults) by 2 (Stranger Type: Tit-for-Tat and Selfish program) by 2 (Player Order: Tit-for-Tat first and Tit-for-Tat second) by 8 (Time: turns 1-4, 5-8, 9-12, 13-16, 17-20, 21-24, 25-28, and 29-32) mixed-model design. Age Group and Player Order were between-subjects factors, whereas Stranger Type and Time were within-subjects factors. The main dependent variables were (a) the extent to which participants made cooperative choices (i.e., choose doors that pass yellow keys; Doors A and C) during the iterated PD game, (b) the trait ratings that the participants provided for each of the two strangers after playing with them, (c) the number of nickels that the participants earned during each interactive round of the game, and (d) the participants' self-reported goals for the interactive rounds of the game. Unless otherwise noted, an  $\alpha = .05$  level was used for all of the statistical tests reported below.<sup>1</sup>

#### *3.4.2 Do Young and Older Adults Learn the Main Point of the Game in the Alone Round?*

Given that the best possible strategy for this experiment's iterated PD game involves choosing a yellow door and obtaining yellow keys on every turn, optimal performance was gauged by the percentage of time that the participant chose either Door A or Door C. When playing with a partner, this reflected a percentage of cooperation with the partner. When playing alone, this proportion reflected a form of self-cooperation, or self-control, where the participant was willing to forgo a large reward in one turn for more consistent long-term gains. To be able to compare young and older adult behavior in the interactive round, it was essential that members of both age groups could learn to perform well on the task.

Proportion of cooperation (i.e., the percentage of times that Doors A or C were chosen) were calculated for each participant for each round as (1) a round total including all 32 turns and (2) eight 4-turn blocks. A 2 (Age Group) x 2 (Player Order) x 8 (Time) mixed model ANOVA conducted on the participants' percentage of cooperation in the Alone Round revealed that main effects of Time,  $F(7,924) = 5.80$ ,  $\eta^2 = .04$ , and Age Group  $F(1,132) = 20.73$ ,  $\eta^2 = .14$  were qualified by a significant Time x Age Group interaction  $F(7,924) = 3.21$ ,  $\eta^2 = .02$ . As depicted in Figure 4, the interaction was driven by older adults' significant improvement in the game over time. For example, the contrast between older adults' first and last 4-turn blocks revealed a significant difference in performance,  $t(64) = 2.28$  ( $M_{diff} = 0.12$ ,  $SE = 0.04$ ). Young adults remained stable in their performance and outperformed older adults at every time point during the Alone Round. Both age groups demonstrated average performance that fell between 66.7% and 100% cooperation, suggesting that both groups (a) chose Doors A and C more frequently than

Doors B and D, and (b) chose Door A multiple times in a row (e.g., A-A-B-C), and thus were likely to experience noticeable defections with the Selfish Stranger.<sup>2</sup>

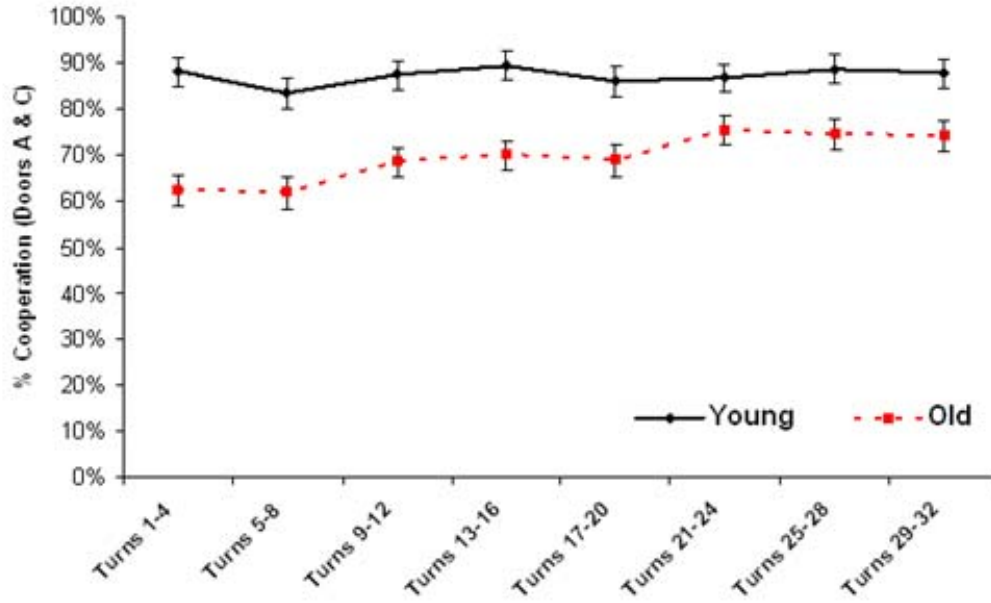


Figure 4. Percentage of cooperation in the Alone Round of Experiment 1 for each of the eight 4-turn blocks, displayed separately for young and older adults.

### 3.4.3 Average Cooperation Declines between the Alone Round and Interactive Rounds for Both Age Groups

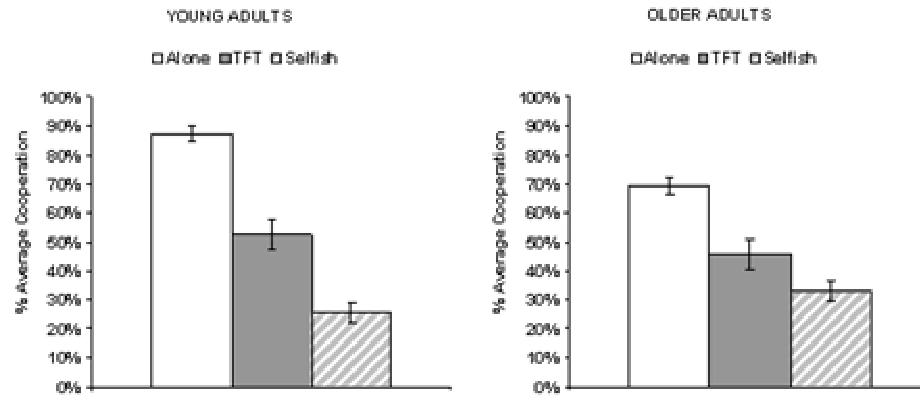
Although young adults outperformed older adults in the Alone Round, both age groups experienced decline in performance when shifting from the Alone Round to the Interactive Rounds. A 2 (Age Group) x 3 (Round: Alone, TFT, and Selfish) x 2 (Player Order) mixed model ANOVA conducted on the total percentage of cooperation across all 32 turns in each round yielded a main effect of Round,  $F(2,264) = 98.60$ ,  $\eta^2 = .43$ , a Round x Age Group interaction,  $F(2,264) = 6.33$ ,  $\eta^2 = .04$ , and a marginal Round x Player Order x Age Group interaction,  $F(2,264) = 2.66$ ,  $\eta^2 = .02$ ,  $p < .08$ . The results of

within-subjects contrasts comparing performance between rounds suggested that both young and older adults displayed less cooperation in each of the two Interactive Rounds than in the Alone Round: Alone ( $M = 0.78$ ,  $SE = 0.02$ ) versus TFT ( $M = 0.49$ ,  $SE = 0.04$ ),  $F(1,132) = 54.39$ ,  $\eta^2 = .29$ ; Alone versus Selfish ( $M = 0.29$ ,  $SE = 0.02$ ),  $F(1,132) = 300.43$ ,  $\eta^2 = .70$ . Moreover, as depicted in Figure 5a, a within-subjects Round x Age Group interaction contrast also revealed that young adults displayed a steeper decline in cooperation between the Alone Round and the Selfish Interactive Round than did older adults,  $F(1,132) = 19.46$ ,  $\eta^2 = .13$ .<sup>3</sup> Finally, the marginal Round x Player Order x Age Group interaction emerged because older adults displayed a higher level of cooperation when they interacted with the Selfish Stranger first (i.e., immediately after the Alone Round) in the Interactive Round ( $M = 0.40$ ,  $SE = 0.05$ ) rather than second (i.e., immediately after the TFT Stranger;  $M = 0.26$ ,  $SE = 0.04$ ),  $t(63) = 2.11$ . Figure 5b displays the mean performance of young and older adults in each round of play separately by Player Order. Consistent with the age non-specific hypotheses (Hypothesis 1), all participants cooperated more with the TFT Stranger than the Selfish Stranger. However, inconsistent with the age specific hypotheses, older and young adults displayed equivalent average cooperation when interacting with the TFT Stranger. Older adults were predicted to be more cooperative than young adults with the TFT Stranger (Hypothesis 5).

#### 3.4.4 *Cooperation Remains Stable with TFT Stranger but Declines with Selfish Stranger*

When playing the iterated PD game with each of the two strangers, young and older adults unexpectedly displayed quite similar behavior throughout the course of each

(a)



(b)

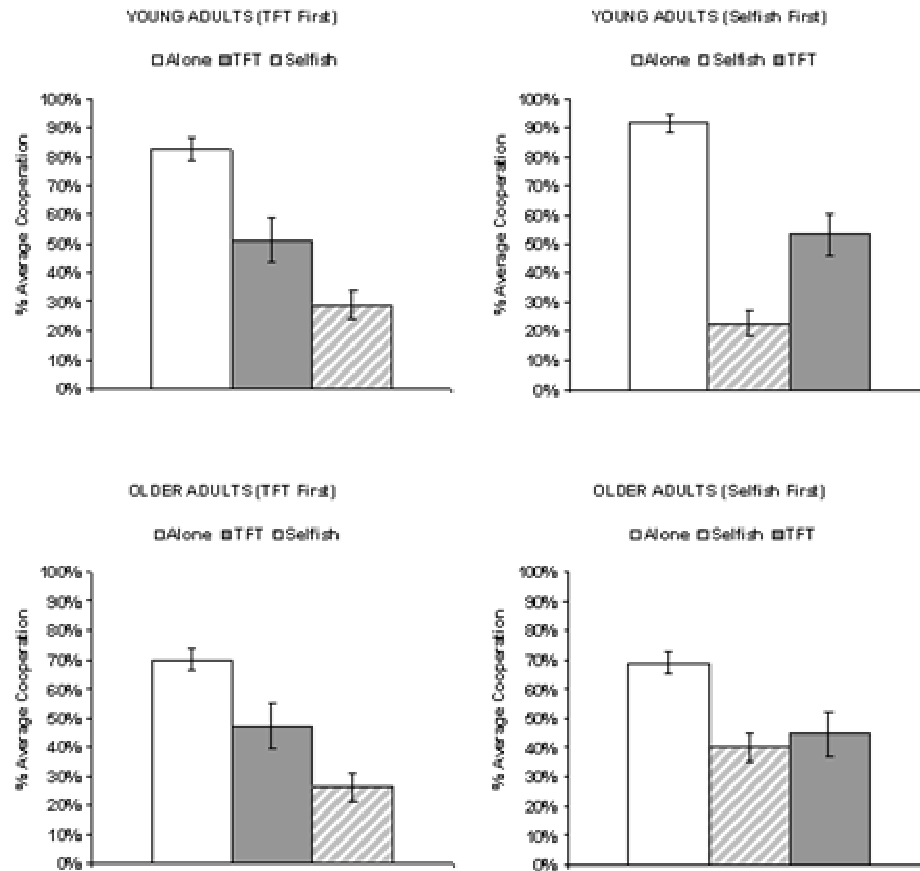


Figure 5. (a) Average total percentage of cooperation for each round of Experiment 1, displayed separately for young and older adults. (b) Average total percentage of cooperation for each round of Experiment 1, displayed separately by player order for young and older adults.

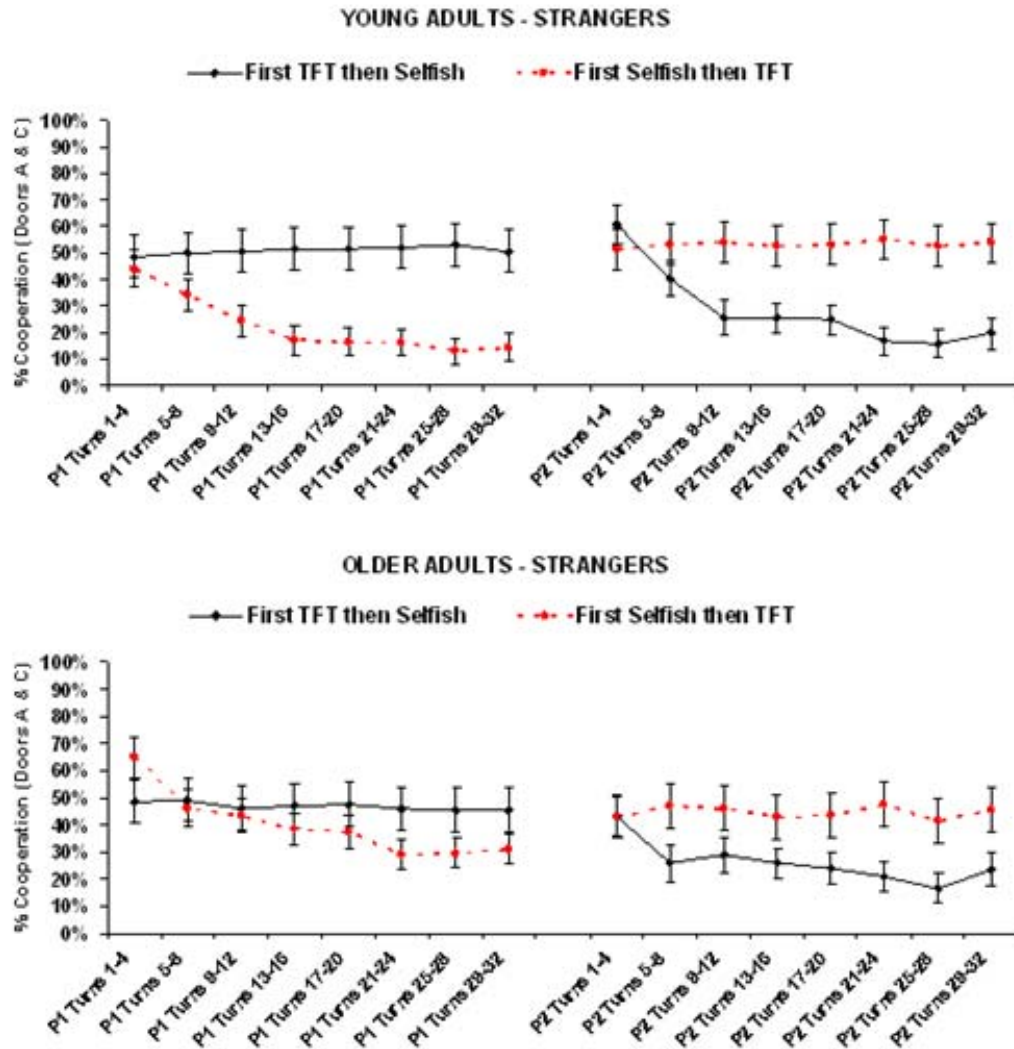
round. A 2 (Age Group) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVA conducted on mean level of cooperation across all 32 turns in each round revealed that a main effect of Stranger Type,  $F(1,132) = 29.38$ ,  $\eta^2 = .18$ , was qualified by a marginal Stranger Type x Age Group interaction,  $F(1,132) = 3.65$ ,  $\eta^2 = .03$ ,  $p < .06$ , and a marginal Stranger Type x Player Order x Age Group interaction,  $F(1,132) = 2.90$ ,  $\eta^2 = .02$ ,  $p < .10$ . Consistent with age non-specific predictions (Hypothesis 1) and already mentioned above, the main effect of Stranger Type demonstrated that young and older adults cooperated more with the TFT Stranger ( $M = 0.49$ ,  $SE = 0.04$ ) than with the Selfish Stranger ( $M = 0.29$ ,  $SE = 0.02$ ). The marginal Stranger Type x Age Group and Stranger Type x Player Order x Age Group interactions emerged because, older adults cooperated more with the Selfish Stranger when that stranger was played in the first of the two Interactive Rounds than in the second. This difference boosted the older adults' mean overall level of cooperation with the Selfish player ( $M = 0.33$ ,  $SE = 0.03$ ) to be marginally greater than that of the young adults ( $M = 0.26$ ,  $SE = 0.03$ ),  $t(134) = 1.64$  ( $p < .11$ ), hence the marginal interaction reported in the above section.<sup>4</sup>

In addition to examining participants' overall performance in the Interactive Rounds, separate 2 (Age Group) x 2 (Player Order) x 8 (Time) mixed model ANOVAs were conducted on the participants' eight consecutive 4-turn blocks to determine if (a) cooperation with the TFT Stranger improved over time (i.e., assuming that the participant became increasingly aware of the reciprocating nature of the TFT Stranger) and (b) cooperation with the Selfish Stranger decreased over time (i.e., assuming that the participant would become less cooperative as the Stranger takes advantage of them). The ANOVA on cooperation with the TFT Stranger did not reveal any significant main

effects or interactions, and thus failed to support the age non-specific prediction (Hypothesis 2) that all participants would become more cooperative with the TFT Stranger over time. The ANOVA on cooperation with the Selfish Stranger revealed a main effect of Time,  $F(7,924) = 30.30$ ,  $\eta^2 = .19$ , and an Age Group x Player Order interaction,  $F(1,132) = 4.83$ ,  $\eta^2 = .04$ . Consistent with age non-specific predictions (Hypothesis 3), the main effect of Time was driven by a decrease in cooperation with the Selfish Stranger over time. Within-subjects contrasts comparing mean performance between each 4-turn block showed that cooperation dropped between block 1 and block 2,  $F(1,132) = 30.52$ ,  $\eta^2 = .19$ , between block 2 and block 3,  $F(1,132) = 4.79$ ,  $\eta^2 = .04$ , marginally between block 3 and block 4,  $F(1,132) = 2.62$ ,  $\eta^2 = .02$ ,  $p < .08$ , and then significantly again between block 5 and block 6,  $F(1,132) = 8.27$ ,  $\eta^2 = .06$ . As discussed above, the Age Group x Player Order interaction emerged because older adults cooperated more with the Selfish Stranger computer program when they interacted with it before the TFT Stranger program. Mean levels of cooperation at each time point for each of the Interactive Rounds are displayed in Figure 6.<sup>5</sup>

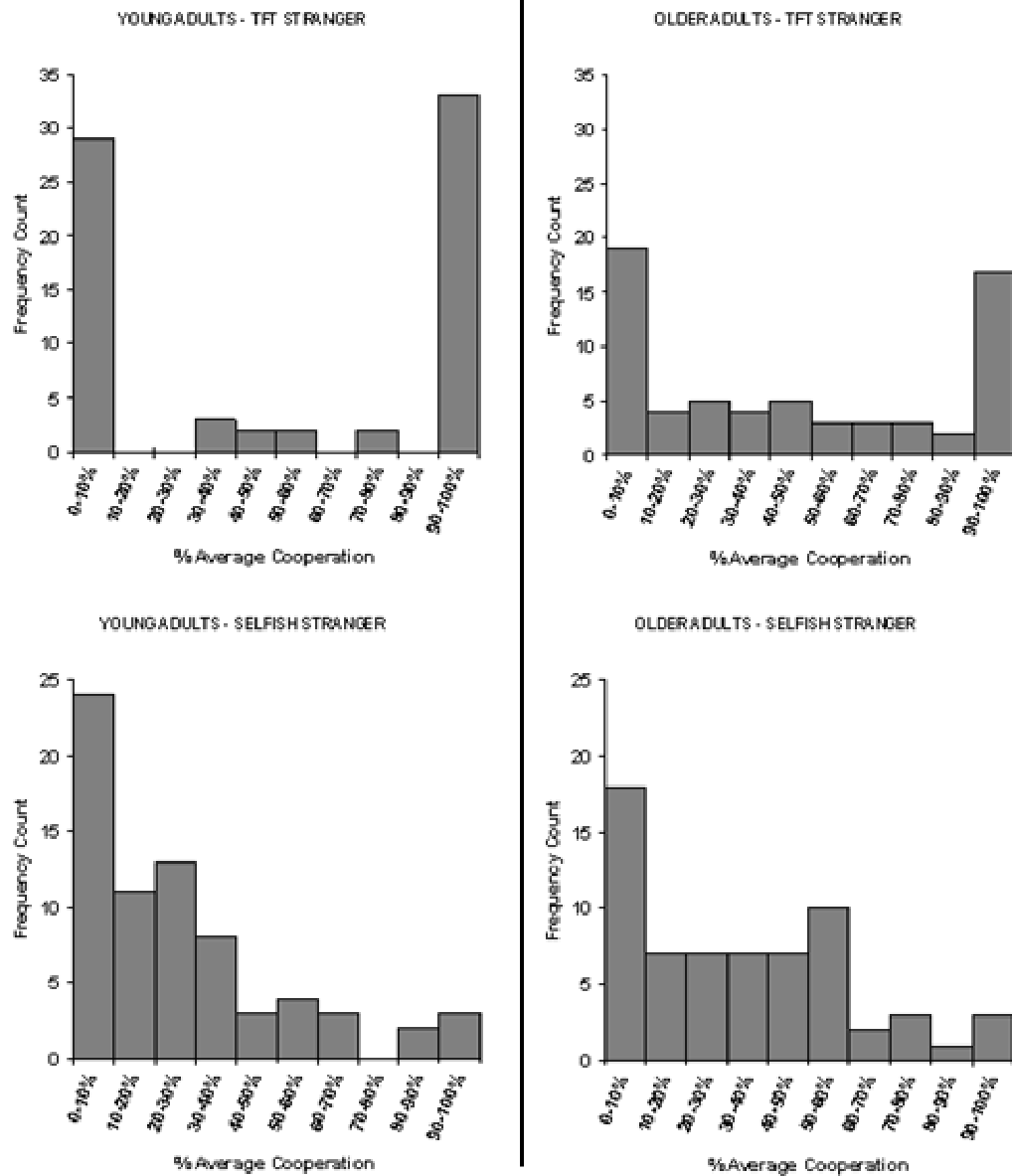
#### *3.4.5 Examination of Distributions Revealed More Cooperation with TFT Stranger than with Selfish Stranger*

Although the results thus far suggest that the mean level of cooperation was higher when participants interacted with the TFT Stranger than with the Selfish Stranger, it is worth noting that the mean levels of performance can be deceiving. Figure 7 displays histograms for young and older adults' overall cooperation during each of the Interactive Rounds. With respect to the distributions for cooperation with the TFT Stranger, it



*Figure 6.* Percentage of cooperation in the Interactive Rounds of Experiment 1 for each of the eight 4-turn blocks with each partner type, displayed separately by player order for young and older adults.





*Figure 7.* Histograms of average total percentage of cooperation frequency counts for the Interactive Rounds of Experiment 1, displayed separately by stranger type for young and older adults.

appears that about 73% of the young adults and 43% of the older adults chose either to cooperate or to defect 100% of the time. When interacting with the Selfish Stranger, this tendency to stick with the same response for every turn was attenuated (Young = 32%; Old = 21%). For both Stranger Types, young and older adults' mean levels of cooperation tended not to be normally distributed. To further examine possible differences in young and older adults' behavior when interacting with strangers (e.g., are young adults more likely than older adults to choose to pass the blue key for every of the round), mean cooperation for each individual was categorized as 100% Cooperation, 100% Defection, or "Somewhere in between" for each Stranger Type. Wilcoxon Signed Ranks Tests were conducted for each age group to determine if membership in these categories differed by Stranger Type, a paired samples variable. For both young adults and older adults, there were significantly more individuals who displayed more cooperative behavior when interacting with the TFT Stranger than when interacting with the Selfish Stranger (Young:  $Z_{\text{Selfish-TFT}} = -2.59, p < .01$ ; Old:  $Z_{\text{Selfish-TFT}} = -2.34, p < .05$ ).<sup>6</sup> Given that young and older adults displayed consistent cooperative behavior more often when interacting with the TFT Stranger than with the Selfish Stranger, chi-square tests were conducted separately by Stranger Type to determine if young and older adults differed at all in their distributions of cooperative behavior. For the TFT Stranger, young and older adults significantly differed in their behavior,  $\chi^2(2) = 13.11, n = 136, p < .01$ , such that young adults were more likely to act at either extreme while older adults less frequently chose to cooperate or defect 100% of the time (Young: 100% Cooperation = 39%, "Somewhere in between" = 27%, and 100% Defection = 34%; Old: 100% Cooperation = 20%, "Somewhere in between" = 57%, and 100% Defection = 23%). For the Selfish Stranger,

young and older adults did not differ in their behavior patterns using this cooperation categorization scheme,  $\chi^2(2) = 2.84$ ,  $n = 136$ ,  $p > .24$  (Young: 100% Cooperation = 1%, “Somewhere in between” = 68%, and 100% Defection = 31%; Old: 100% Cooperation = 2%, “Somewhere in between” = 80%, and 100% Defection = 19%). Consistent with age non-specific hypotheses (Hypothesis 1), these findings suggest that young adults and older adults were both more cooperative with the TFT Stranger than the Selfish Stranger but that older adults less frequently relied on maintaining a consistent pattern of decisions.

#### *3.4.6 Age-Related Differences in Turn-by-Turn Behavior during Interactive PD Rounds*

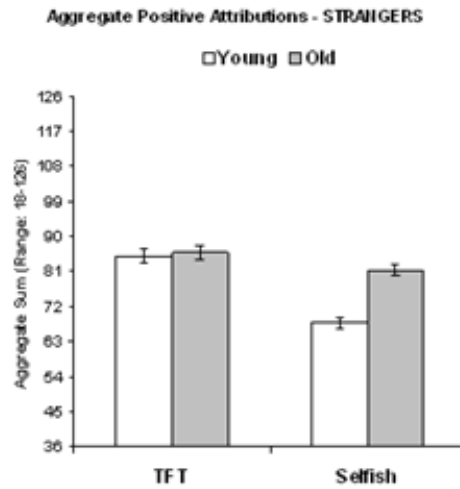
In order to determine if older adults were less confrontational than young adults after being taken advantage of by the Selfish Stranger, each participant’s responses were examined to determine (a) the overall number of times that the Selfish Stranger chose to pass a blue key after the participant had passed this stranger a yellow key (a.k.a., noticeable defections), (b) the number of consecutive times that the participant passed the Selfish Stranger a blue key after this stranger’s first noticeable defection (a.k.a., punishing), and (c) the likelihood that that the participant decided to choose Door B after forgiving the Selfish Stranger’s first noticeable defection (a.k.a. getting even). A 2 (Age Group) x 2 (Player Order) between-subjects ANOVA on the number of noticeable defections experienced during the Interactive Round with the Selfish Stranger revealed that a main effect of Age Group,  $F(1,132) = 4.31$ ,  $\eta^2 = .03$ , was qualified by an Age Group x Player Order interaction,  $F(1,132) = 3.97$ ,  $\eta^2 = .03$ . Although young ( $M = 2.15$ ,  $SE = 0.37$ ) and older adults ( $M = 2.18$ ,  $SE = 0.37$ ) experienced the same number of

noticeable defections when they played the Selfish Stranger second in the Interactive Rounds,  $t(64) = 0.06$ , *ns*, older adults ( $M = 3.19$ ,  $SE = 0.38$ ) experienced more noticeable defections from the Selfish Stranger program than did young adults ( $M = 1.68$ ,  $SE = 0.35$ ) when they played this program first,  $t(68) = 2.79$ . Also, older adults experienced marginally more noticeable defections from the Selfish Stranger when playing this program first as compared with second,  $t(63) = 1.79$ ,  $p < .08$ , whereas the order of play did not impact the number of noticeable defections experienced by young adults  $t(69) = 0.96$ , *ns*. A 2 (Age Group) x 2 (Player Order) between-subjects ANOVA on the number of times that the participant punished the Selfish Stranger after the first noticeable defection (i.e., chooses Door D) revealed a marginal main effect of Age Group,  $F(1,92) = 2.58$ ,  $\eta^2 = .03$ ,  $p < .12$ . Consistent with initial predictions (Hypothesis 6), older adults ( $M = 3.47$ ,  $SE = 1.15$ ) punished the Selfish Stranger on fewer consecutive turns than did young adults ( $M = 6.08$ ,  $SE = 1.17$ ) after the first noticeable defection. Finally, a chi-square test revealed that equal proportions of young (53%) and older adults (44%) chose to get even with the Selfish Stranger (i.e., choose Door B) after having chosen Door C following this stranger's first noticeable defection,  $\chi^2(1) = 0.56$ ,  $n = 66$ ,  $p > .45$ . These findings suggest that older adults experienced slightly more noticeable defections than did young adults (especially when interacting with the Selfish Stranger first in the Interactive Rounds). Also, consistent with age specific predictions (Hypothesis 6), older adults chose to punish the Selfish Stranger for fewer turns after this stranger's first transgression.

#### *3.4.7 Trait Impressions for TFT Stranger Were More Favorable than for Selfish Stranger*

The trait attributions that participants made for each stranger were aggregated into an overall composite sum of positive trait attributions for each stranger. These overall attributions indicated the participants' impressions of the individuals with whom they believed they were interacting, and they included scores for 18 of the 25 trait attributions made immediately after each Interactive Round: likeable, intelligent, kind, trustworthy, charitable, friendly, honest, competent, loyal, passive, selfish, stubborn, unfaithful, annoying, uncaring, lazy, inexperienced, and hostile. Responses for negative attributes were reverse scored to produce an overall positive-going rating that ranged from 18 to 126 ( $\alpha$ 's = 0.86-0.92). This aggregate positive attribution score represents how the participant viewed each partner after they interacted with them in the game. To some degree, participants' responses reflected the type of experience (i.e., positive or negative) that they had during the interaction. Positive interactions were expected to yield higher scores, whereas negative interactions during the game were expected to yield lower scores. A 2 (Age Group) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVA conducted on these aggregate positive attribution scores revealed that main effects of Age Group,  $F(1,128) = 19.40$ ,  $\eta^2 = .13$ , and Stranger Type,  $F(1,128) = 45.68$ ,  $\eta^2 = .26$ , were qualified by a Stranger Type x Age Group interaction,  $F(1,128) = 15.39$ ,  $\eta^2 = .11$ . Aggregate positive attribution scores are displayed in Figure 8a by Age Group and Stranger Type. Although both young and older adults rated the Selfish Stranger less favorably than the TFT Stranger, the difference in mean attributions between Stranger Type was larger for young adults than for older adults. Also, although young and older adults offered similarly favorable ratings for the TFT Stranger,  $t(132) = 0.31$ , *ns*, older adults offered more favorable attributions about the Selfish Stranger than did young

(a)



(b)

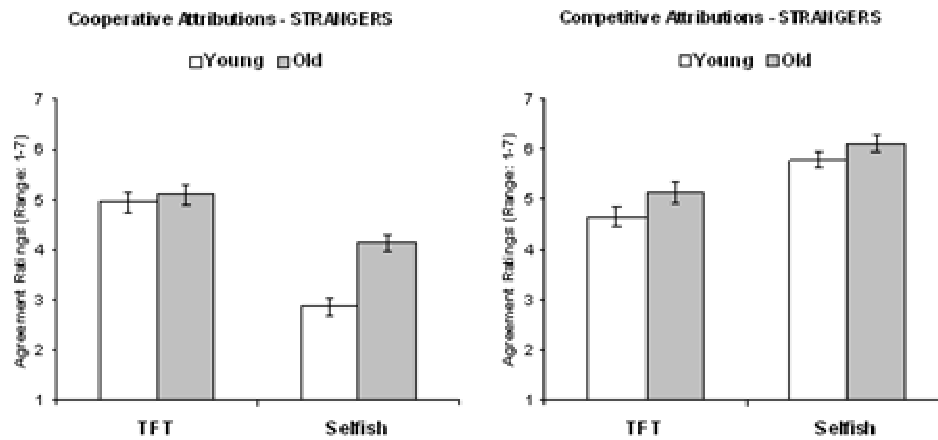


Figure 8. (a) Aggregate positive attribution scores for young and older adults in the Interactive Rounds of Experiment 1, displayed separately for each stranger type. (b) Cooperative and competitive attribution scores for young and older adults in the Interactive Rounds of Experiment 1, displayed separately for each stranger type.

adults,  $t(131) = 6.63$ . Overall, these findings support the age non-specific prediction that all participants would view the TFT Stranger more favorably than the Selfish Stranger (Hypothesis 4). Unexpectedly, older adults were more favorable than young adults in their attributions toward the Selfish Stranger.<sup>7</sup>

Separate 2 (Age Group) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVAs were also conducted on the cooperative and competitive attributions that participants made for each stranger. For cooperative attributions, main effects of Age Group,  $F(1,127) = 14.60$ ,  $\eta^2 = .10$ , and Stranger Type,  $F(1,127) = 59.18$ ,  $\eta^2 = .32$ , were qualified by an Age Group x Stranger Type interaction,  $F(1,127) = 7.88$ ,  $\eta^2 = .06$ . Young and older adults offered equivalent cooperative attributions for the TFT Stranger,  $t(131) = 0.38$ , *ns*, whereas older adults offered more cooperative attributions for the Selfish Stranger than did young adults,  $t(131) = 5.27$ . For competitive attributions, there were main effects of Age Group,  $F(1,128) = 4.41$ ,  $\eta^2 = .03$ , and Stranger Type,  $F(1,128) = 38.01$ ,  $\eta^2 = .23$ . On average, older adults rated each stranger as more competitive than did young adults, and both age groups rated the Selfish Stranger as more competitive than the TFT Stranger. Cooperative and Competitive attribution ratings are displayed in Figure 8b by Age Group and Stranger Type. Consistent with the findings from the positive aggregate attribution scores, older adults viewed the Selfish Stranger as being more cooperative than did young adults.

#### *3.4.8 Young and Older Adults Are Similar in Their Competitive Focus Towards Strangers*

Just prior to the first Interactive Round, participants were asked to describe the strategy that a person would use if they wanted to maximize the number of nickels that

they collected while interacting with others. Also, immediately after each Interactive Round, participants were asked to describe any goals that they had in mind during the interaction. Each participant's three responses were coded by two raters as falling into one of three categories: *cooperative*, *competitive*, and *neither cooperative nor competitive* (*a.k.a. ambivalent*). Inter-rater reliability for this categorization scheme was 96% for the responses provided *before* the Interactive Rounds and 89% for the responses provided *after* the Interactive Rounds.<sup>8</sup> Chi-square tests on the participants' responses prior to the Interactive Rounds suggest that young and older adults offered a different pattern of responses,  $\chi^2(2) = 17.51$  ( $n = 136$ ). Young adults offered the same number of competitive (39%) and cooperative (39%) responses, but fewer ambivalent responses (21%). On the other hand, older adults offered more ambivalent responses (55%) than cooperative (19%) or competitive (26%) responses. Similar patterns emerged when examining the goals that participants reported having in mind while playing the Interactive Rounds (i.e., responses collected after each round). When playing with the TFT Stranger, young adults reported slightly more competitive responses (47%) than cooperative (23%) or ambivalent (31%) responses, whereas older adults reported more ambivalent responses (52%) than competitive (34%) or cooperative (13%) responses,  $\chi^2(2) = 6.48$  ( $n = 136$ ). Finally, when playing with the Selfish Stranger, young adults reported slightly more competitive responses (45%) than cooperative (25%) or ambivalent (30%) responses, whereas older adults reported more ambivalent responses (52%) than competitive (37%) or cooperative (11%) responses,  $\chi^2(2) = 6.48$  ( $n = 136$ ). Overall, young and older adults displayed similar cooperative and competitive tendencies both before and after the Interactive Rounds. Young and older adults consistently offered more competitive



responses than cooperative responses when interacting with strangers. It is worth noting that older adults did offer ambivalent responses more frequently than cooperative or competitive responses. However, given that the coding scheme was limited to assessing the competitive or cooperative tone of each response, it is not entirely clear what is being captured by this trend toward ambivalent responding. Contrary to expectations (Hypothesis 7), young and older adults were very similar in their competitive focus when interacting with Strangers. Moreover, the response patterns of older adults did not suggest that they were any less competitive than young adults when interacting with either stranger.

#### *3.4.9 More Nickels Accrued during Interaction with TFT Stranger than with Selfish Stranger*

A 2 (Age Group) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVA conducted on the number of nickels that participants earned in each Interactive Round revealed only a main effect of Stranger Type,  $F(1,128) = 67.27$ ,  $\eta^2 = .34$ . Participants earned more nickels when interacting with the TFT Stranger ( $M = 113$ ,  $SE = 3.5$ ) than with the Selfish Stranger ( $M = 86$ ,  $SE = 1.5$ ). When examining mean cooperation levels for each of the Interactive Rounds, Player Order interacted with Age Group and Stranger Type because older adults cooperated more than young adults with the Selfish Stranger when interacting with this stranger first in the Interactive Rounds. Additionally, older adults who interacted with the Selfish Stranger *after* interacting with the TFT Stranger did not cooperate as much as those older adults who interacted with the Selfish Stranger *before* interacting with the TFT Stranger. Given this, contrasts were conducted (a) to

compare the number of nickels that young and older adults earned when playing the Selfish Stranger first in the Interactive Rounds, and (b) to compare the number of nickels that older adults earned when interacting with the Selfish Stranger in the first versus the second Interactive Rounds. The first contrast yielded a significant difference in the nickel totals of young ( $M = 83$ ,  $SE = 2.8$ ) and older ( $M = 93$ ,  $SE = 3.1$ ) adults when participants interacted with the Selfish Stranger first,  $t(68) = 2.36$ . The second contrast yielded a significant difference in the nickel totals of older adults who interacted with the Selfish Stranger first ( $M = 93$ ,  $SE = 3.1$ ) in the Interactive Rounds as opposed to second ( $M = 83$ ,  $SE = 2.7$ ),  $t(63) = 2.15$ . The above findings only provide partial support for the age specific prediction (Hypothesis 10) that older adults would earn more nickels than young adults in the Interactive Rounds. The only time when this was true was when older adults' first person-to-person interaction was with the Selfish Stranger. In all other conditions, young and older adults accrued similar nickel totals and were thus equally effective at managing the interactions with strangers.

#### *3.4.10 Exploration of Gender, Cognitive Abilities, and Individual Difference Measures*

Theoretical accounts of age-related changes in personality suggest that advancing age is accompanied by a shift toward androgyny (McCabe, 1989; however, see Thompson, 2006). As a result, men become more passive and women may become more assertive as they age (Gutmann, 1994). In terms of the iterated PD game, one might expect older women to be less likely to cooperate than older men. To examine this possibility, a 2 (Age Group) x 2 (Gender) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVA was performed on the participants' average level of cooperation in each

Interactive Round. The results yielded a main effect of Stranger Type,  $F(1,127) = 33.65$ ,  $\eta^2 = .21$ , a Player Order x Gender interaction,  $F(1,127) = 4.66$ ,  $\eta^2 = .04$ , a Stranger Type x Age Group x Gender interaction,  $F(1,127) = 8.19$ ,  $\eta^2 = .06$ , and a Stranger Type x Player Order x Gender interaction,  $F(1,127) = 4.31$ ,  $\eta^2 = .03$ . The first three-way interaction emerged because younger women cooperated more with the TFT Stranger and less with the Selfish Stranger than did older women,  $t(63) = 2.03$  and  $t(63) = 2.04$ , respectively (Young TFT:  $M = 0.58$ ,  $SE = 0.09$ ; Old TFT:  $M = 0.38$ ,  $SE = 0.06$ ; Young Selfish:  $M = 0.22$ ,  $SE = 0.04$ ; Old Selfish:  $M = 0.34$ ,  $SE = 0.04$ ). The second three-way interaction emerged because women ( $M = 0.38$ ,  $SE = 0.07$ ) cooperated less than men ( $M = 0.59$ ,  $SE = 0.07$ ) with the TFT Stranger after they first played the Selfish Stranger,  $t(68) = 2.07$ . Finally, older women ( $M = 0.38$ ,  $SE = 0.06$ ) were marginally less likely to cooperate with the TFT Stranger than older men ( $M = 0.56$ ,  $SE = 0.08$ ),  $t(62) = 1.89$ ,  $p < .07$ . When considered together, these findings suggest that older women were less likely than older men to cooperate with the TFT Stranger, especially when the TFT Stranger followed the Selfish Stranger. Overall, this is consistent with the notion that older women can be more assertive than older men.

Because there were age differences in each of the cognitive ability measures, correlations between these measures and performance during each round of the iterated PD game were calculated separately for each age group. For young adults, percentage of cooperation in the Alone Round (i.e., choosing Doors A or C) was positively related to the number of correct items on the measure of processing speed,  $r(69) = .25$ . For older adults, percentage of cooperation in the Alone Round was positively related to inductive reasoning ability,  $r(64) = .31$ , to verbal ability,  $r(64) = .30$ , and to education level,  $r(60) =$

.37. Cognitive performance was not significantly related to young or older adults' percentage of cooperation in either of the Interactive Rounds. Given the shape of the distributions for mean percentage of cooperation in the Interactive Rounds, each age group was divided into tertiles within each Interactive Round so that t-tests could be conducted to compare (a) performance on each cognitive ability test and (b) responses in each social individual difference measure for members of the top and bottom tertiles.<sup>9</sup>

When interacting with the TFT Stranger, relative to young adults in the bottom cooperation tertile, those young adults in the top tertile had marginally better processing speed scores (Top:  $M = 69.4$ ,  $SE = 2.7$ ; Bottom:  $M = 63.9$ ,  $SE = 1.8$ ) and reported marginally less difficulty when it came to disengaging from a goal that was being blocked by someone else (Top:  $M = 1.9$ ,  $SE = 0.2$ ; Bottom:  $M = 2.3$ ,  $SE = 0.2$ ),  $t(49) = 1.74$  ( $p < .09$ ) and  $t(50) = 1.73$  ( $p < .09$ ), respectively. When interacting with the Selfish Stranger, young adults in the bottom cooperation tertile were marginally more extraverted than those in the top tertile (Top:  $M = 6.0$ ,  $SE = 0.3$ ; Bottom:  $M = 7.0$ ,  $SE = 0.4$ ),  $t(51) = 1.82$ ,  $p < .08$ . When interacting with the TFT Stranger, older adults in the top tertile had higher emotional suppression scores,  $t(41) = 2.15$  (Top:  $M = 3.6$ ,  $SE = 0.2$ ; Bottom:  $M = 2.9$ ,  $SE = 0.2$ ), reported a marginally more expansive future time perspective,  $t(41) = 1.76$ ,  $p < .09$  (Top:  $M = 44.5$ ,  $SE = 3.3$ ; Bottom:  $M = 37.5$ ,  $SE = 2.3$ ), and were marginally more conscientious,  $t(41) = 1.95$ ,  $p < .06$  (Top:  $M = 9.3$ ,  $SE = 0.3$ ; Bottom:  $M = 8.5$ ,  $SE = 0.3$ ), than older adults in the bottom tertile. When interacting with the Selfish Stranger, older adults in the top cooperation tertile had marginally more communal values than those in the bottom tertile (Top:  $M = 4.31$ ,  $SE = 0.10$ ; Bottom:  $M = 3.99$ ,  $SE = 0.13$ ),  $t(43) = 1.98$ ,  $p < .06$ .<sup>10</sup>

#### *3.4.11 Summary of Results from Experiment 1*

In Experiment 1, participants believed that they were interacting with strangers via choices that they made in the context of a game. Although young adults outperformed older adults when they played the game on their own (i.e., the Alone Round), young and older adults displayed very similar performance when interacting with others. Contrary to predictions, older adults did not cooperate more than young adults, on average. Moreover, young and older adults were roughly equivalent in their propensity to act out of their own self-interest during the game. The one exception to this occurred when older adults interacted with the Selfish Stranger and they had yet to interact with the Tit-for-Tat Stranger. When older adults interacted with the Selfish Stranger first in the Interactive Rounds, they displayed a propensity towards higher average levels of cooperation. Of course, as the round progressed, older adults became less cooperative. Older adults' initial efforts at trying to maintain cooperation with the Selfish Stranger helped them to earn significantly more nickels than young adults. When comparing those older adults at the high and low ends of the cooperation spectrum during the Interactive Round with the Selfish Stranger, older adults who displayed higher levels of cooperation held marginally more communal values than older adults who displayed lower levels of cooperation. Overall, however, older adults did not express having more of a cooperative approach to interacting with the Selfish Stranger than young adults when asked to describe their goal for that particular Interactive Round.

## **CHAPTER 4**

### **EXPERIMENT 2 - INTERACTING WITH FRIENDS**

#### **4.1 Overview of Experiment 2**

In Experiment 2, young and older adults were asked to come to the lab with a same-age, same-gender friend to play a computer game. Participants played two rounds of an iterated PD game, first by themselves and then with their friend. As in Experiment 1, participants were not really playing with their human counterparts. Instead, each was randomly assigned to play one of two computer-simulated friends. Half of the participants from each age group interacted with a simulated friend who reciprocated the participant's behavior 100% of the time using a Tit-for-Tat (TFT) strategy (a.k.a., TFT friend). The other half from each age group played with a friend who reciprocated the participant's behavior in 75% of the trials, but, during the remaining 25%, this player made selfish, or the self-interested, choices (a.k.a., Selfish friend). Previous research has demonstrated that individuals are more likely to spontaneously cooperate with another player in an iterated PD game if that other player is a friend and not a stranger (Majolo et al., 2006). The mutual benefit reflects harmony in the relationship. When one player does not cooperate, it is implied that, at least temporarily, accumulating more reward is more important than the friendship. Once competition flares up in a game between friends, it might be easier for the friends to return to cooperative habits if each values the relationship more than the desire to "out do" the other player. The personal value invested in the relationship should be salient to each friend. When playing strangers, this relational value should be small, if it exists at all.

Life span changes in interpersonal goals are believed to create age differences in how people react to conflict with close others. Early on in adulthood, individuals compete to gain resources. A high value is placed on acquiring information and seeking new experiences (Carstensen, 2006). As a result, young adults may be more confrontational during conflict as a way to test boundaries and establish rank in a hierarchy. In one's later years, the focus shifts from aggregating resources to maintaining them (Riediger & Freund, 2006; Schindler, Staudinger, & Nesselrode, 2006). Older adults tend to be more focused than young on maintaining close relationships that offer meaning to their lives (Carstensen et al., 1999; McAdams et al., 1993). As a result, when conflict emerges in interpersonal relationships, older adults are more acquiescent and choose to devote effort into maintaining relationship harmony (Blanchard-Fields, 1997; Blanchard-Fields et al., 2004; Hoppmann et al., in press). One result of this may be that older adults are less driven to punish or retaliate against friends who occasionally betray the mutual interests associated with their relationships. It may be easier for older adults to overlook an occasional indiscretion or disagreement than it is to find a new group of friends. Support for this notion has been found in studies that show that older adults sometimes maintain relationships with close others who are the source of negative experiences because they merely value having close interpersonal associations (Akiyama et al., 2003; Krause & Rook, 2003). The purpose of this experiment was to examine how young and older adults reacted to conflicts that emerged with their friends in an iterated PD game. Participants in both age groups were expected to demonstrate higher levels of cooperation when playing with friends than with strangers, but older adults were thought to be more likely than young adults to be more submissive and lenient when friends acted out of self-interest.

Moreover, comparisons were made between the participants in each experiment to examine if young and older adults reacted to conflict with strangers and friends differently. Given that participants have a longer track record of reciprocation with friends than with strangers, both young and older adults were expected to be more passive (i.e., cooperative in the face of conflict) when interacting with friends as compared with strangers. Older adults were expected to consistently implement strategies that focused on maximizing positive outcomes, so, as was the case when interacting with strangers, older adults were expected to be more cooperative than young adults when faced with conflict by friends.

## **4.2 Hypotheses for Experiment 2**

Hypotheses for Experiment 2 are broken down into three groups: those where age should not matter (*age non-specific*), those where age should matter (*age specific*), and those that are more exploratory in nature (*exploratory*).

### *4.2.1 Age Non-Specific Hypotheses*

Again, some trends in the participants' responses were not expected to vary by age. For example, when playing with friends, participants were predicted to display a greater percentage of cooperative behavior (i.e., choosing Doors A or C) for the TFT Friend than the Selfish Friend because the TFT Friend was more consistently willing to consider the mutual interest of both players (Hypothesis 1). Along similar lines, participants were expected to rate the TFT Friend as being more cooperative and less competitive than the Selfish Friend. However, overall impression favorability was not



predicted to differ between TFT and Selfish Friends (Hypothesis 2). Also, participants were expected to have more favorable impressions of friends than of strangers, especially when comparing the impressions of the Selfish Stranger and the Selfish Friend (Hypothesis 3).

Because friendships are characterized by a track-record of past shared experiences that provide mutual benefit, participants were expected to infer that the TFT Friend's intentions were to cooperate to meet the game's objective and thus they were predicted to display cooperative behavior from the start of the game (Hypothesis 4). This prediction stands in stark contrast to that made for play with the TFT Stranger in Experiment 1, where cooperative behavior was expected to build over time (Hypothesis 5). Change in level of cooperation over time was compared across experiments to see if differences existed between participants' responses to TFT Strangers and their responses to TFT Friends. Also, because the strength of one's friendship might impact the initial level of cooperation, a positive correlation was predicted to exist between friendship quality (i.e., Experiment 2 only) and the participant's level of cooperation early in the game (Hypothesis 6).

#### *4.2.2 Age Specific Hypotheses*

As outlined in the overview for Experiment 2, young and older adults differ in the strategies that they use when faced with interpersonal conflict. Young adults may be more confrontational or reactionary, whereas older adults may be more acquiescent. In terms of the iterated PD game, this difference in reactive style was expected to possibly lead to a difference in how young and older adults responded to a Selfish Friend. Over

time, young adults were expected to become less cooperative with a Selfish Friend. Older adults, however, were not expected to display as substantial of a decline in cooperation as the round with the Selfish Friend progressed (Hypothesis 7). Age differences in change in cooperative responding over time were examined. As predicted in Experiment 1 as well, older adults were expected to react to conflict that developed with a Selfish Friend using more passivity, whereas young adults were expected to be more confrontational (Hypothesis 8). To test this hypothesis, participants' choices (i.e., act cooperatively or selfishly) immediately after the first indiscretion were examined. Young adults were expected to use a higher frequency of selfish retaliatory behavior than older adults. Similarly, young adults were predicted to have more of a competitive focus and less of a cooperative focus than older adults when playing with a Selfish Friend (Hypothesis 9). Analyses were also conducted across experiments to determine if young adults were less retaliatory toward Selfish Friends than Selfish Strangers.

Because they were expected to be less retaliatory when playing with Selfish individuals, older adults were predicted to be more effective at maintaining higher levels of cooperation than young adults. In fact, older adults were expected to consistently accrue more earnings than young adults in every condition (Hypothesis 10). This prediction was tested by comparing young and older adults' earnings across Experiments 1 and 2.

#### *4.2.3 Exploration of Individual Differences*

As in Experiment 1, participants were asked to complete questionnaires that assessed individual differences in personality, competitiveness, locus of control,

interpersonal flexibility, interpersonal trust, propensity to use antecedent- and response-focused emotion regulation, coping flexibility, future time perspective, generativity, agentic and communal values, and one's propensity to engage in life management strategies. Again, relationships between scores on these individual difference measures and overall level of cooperative behavior in the game were examined. Also examined were possible relationships between performance in the PD task and the participants' gender and level of cognitive functioning.

## **4.3 Method for Experiment 2**

### *4.3.1 Overview*

As in Experiment 1, young and older adults played an iterated Prisoner's Dilemma (PD) game in Experiment 2. Each participant first played the game alone and then with a friend who accompanied them to the session. Although individuals were told that they were playing with their friend, in actuality, each person played with one of two computer programs. One program reciprocated the participant's choices 100% of the time (a.k.a. Tit-for-Tat, or TFT, friend). However, the other friend resembled the TFT stranger some of the time, but, as in Experiment 1, displayed self-interested behavior 25% of the time (a.k.a. Selfish player). Each participant only interacted with their friend once, so, unlike Experiment 1, the type of partner played was a between-subjects factor. Of primary interest were the degree to which participants would cooperate with their friends during the game and the nickels that participants were able to accumulate. Also examined were the participants' impressions of their friends' behavior and their self-reported goals for the Interactive Round of the game.

#### 4.3.2 Participants

Seventy-six young (ages 18-23;  $M = 19.7$ ,  $SE = 0.2$ ; 43% women) and 71 older adults (ages 56-81;  $M = 69.0$ ,  $SE = 0.6$ ; 59% women) were recruited to participate in this experiment. Participants were predominantly Caucasian (65%; African American = 9%, Asian = 13%, Other = 13%). Young and older adults reported equivalent levels of overall health and were equally affected by health problems. Older adults ( $M = 22.4$ ,  $SE = 0.9$ ) obtained a higher vocabulary score than did young adults ( $M = 15.9$ ,  $SE = 0.6$ ),  $t(145) = 6.34$ ,  $p < .001$ , but young adults obtained higher scores in inductive reasoning (Letter Sets; Ekstrom, French, Harman, & Dermen, 1976) and processing speed (Digit-Symbols Matching; Salthouse, 1992) than did older adults,  $t(145) = 9.98$  ( $p < .001$ ) and  $t(145) = 14.23$  ( $p < .001$ ), respectively (Young Letter Sets:  $M = 23.8$ ,  $SE = 0.3$ ; Old Letter Sets:  $M = 17.1$ ,  $SE = 0.6$ ; Young Speed:  $M = 68.5$ ,  $SE = 1.2$ ; Old Speed:  $M = 46.2$ ,  $SE = 0.9$ ). On average, young and older adults both reported a similar level of education (i.e., “some college”). Age-related differences also emerged in some of the measures of relationship quality and closeness. Young adults ( $M = 5.26$  or “almost every other day”,  $SE = 0.14$ ) reported more frequent visits with their friend than did older adults ( $M = 2.74$  or “once per week”,  $SE = 0.16$ ),  $t(139) = 11.93$ ,  $p < .001$ . Older adults ( $M = 13.5$  years,  $SE = 1.6$  years) had been in longer relationships with their friend than young adults ( $M = 2.4$  years,  $SE = 0.3$  years),  $t(137) = 6.92$ ,  $p < .001$ . Finally, young adults ( $M = 3.44$  or “moderately” to “very” close,  $SE = 0.07$ ) reported that they were closer to their friend than did older adults ( $M = 3.06$  or “moderately” close,  $SE = 0.10$ ),  $t(139) = 3.11$ ,  $p < .01$ .<sup>11</sup>

#### 4.3.3 Materials

*4.3.3.1 Iterated Prisoner's Dilemma (PD) Game.* The iterated PD game adapted for this experiment was exactly the same one used in Experiment 1 (Brown & Rachlin, 1999). Once again, the objective of the game was to collect as many nickels as possible in each round. Each round consisted of 32 turns; however, participants were unaware of this and were told that each round would end after some randomly-determined number of turns. Participants played the first round by themselves (Alone Round) and then played one round with their friend (Interactive Round). Participants started off each round with a yellow key and were asked to choose between opening Door A or Door B. For the Interactive Round, when a participant opened a door they kept the nickels found behind the door but gave the key that they uncovered to their friend. Their friend would then use this key to open a door during their turn. The optimal strategy for all rounds was to consistently choose Door A, yielding an average gain of five nickels per turn.

As in Experiment 1, participants completed a few questionnaires in conjunction with each round of the game. First, after each round, participants were asked to briefly describe the goal that they had in mind while playing the game in that round. Second, immediately prior to the Interactive Round, participants were asked to describe the strategy that they felt would maximize the number of nickels that a person could collect in that round. These questions were posed to assess the participants' approach to and frame of mind during the Interactive Round. Responses were coded for the degree to which they reflected each participant's competitive or cooperative intentions. Finally, after the Interactive Round, participants made trait attributions about their friend by indicating the extent to which they agreed that the friend displayed each of 25 personal characteristics during the round (i.e., likeable, intelligent, kind, trustworthy, charitable,

friendly, honest, competent, loyal, passive, selfish, stubborn, unfaithful, annoying, uncaring, lazy, inexperienced, hostile, independent, cooperative, competitive, impulsive, curious, masculine, and feminine; rating: 1 = *strongly disagree* to 7 = *strongly agree*).

Both rounds of the iterated PD game were played on computers using E-prime software (Psychology Software Tools, Pittsburgh, USA) that had been programmed to create the feel of a turn-based game setting. During the Interactive Round, the participants received feedback from the computer programmed friend in such a way to make it appear that a real human was taking time to make a response. The computer response time randomly varied between 2 to 6 seconds for young adults and 2 to 10 seconds for older adults. The programs for the TFT Friend and the Selfish Friend were identical to that of the TFT Stranger and Selfish Stranger from Experiment 1.

*4.3.3.2 Individual Difference Measures.* Prior to the experimental session, participants were asked to complete the same packet of surveys and questionnaires that were completed in Experiment 1. For a description of each measure, see Appendix A. Participants were also asked to complete a questionnaire designed to assess the quality of their relationship with the friend who accompanied them to the session. This questionnaire can be found in Appendix D.

#### *4.3.4 Procedure*

Pairs of same-gender friends were recruited from the student population at the Georgia Institute of Technology and from the Atlanta metropolitan community to take part in a study examining how people interact with one another while playing a computer game. Participants completed a packet of individual difference questionnaires (described

in Appendix A) prior to the laboratory session. During the session in the lab, participants first completed a short battery of cognitive tests and then were instructed as to the rules of the Alone Round (see Appendix C) for the instructions that were read to the participants before playing the Alone Round). As in Experiment 1, participants were informed (a) that they would be collecting nickels by making sequential decisions to open doors using keys (i.e., blue keys open blue doors, and yellow keys open yellow doors), (b) that the decision to open a door in one turn impacted the next turn by giving you a new key that limited your next choice, and (c) that their objective was to obtain as many nickels as possible during the round. After completing a short practice round, participants were left alone to complete the Alone Round of the game. At the end of the round, participants were asked to indicate which strategy a person would use if they wanted to maximize the number of nickels that they earned in that round.

Next, participants were instructed on the game format for the Interactive Round (see Appendix C for the instructions that were read to the participants before playing the Interactive Rounds. Participants were told (a) that they had the same objective as in the Alone Round, to earn as many nickels as possible, (b) that their choices (as well as those of their friend) would be limited by the color of the key that they were passed when the strangers made their choices, and (c) that they should let the experimenter know immediately if there was a connectivity problem between their computer and that of their friend. No allusions to cooperating (e.g., “partner”) or competing (i.e., “opponent”) were made in the instructions. If participants asked questions about the intentions of their friend, the experimenter responded with an ambiguous, non-evaluative response (e.g., “Each person has to use their own judgment when making choices. It is up to each of

you.”). Just prior to starting the Interactive Round, participants were once again asked to indicate which strategy a person might use to maximize the number of nickels that they earned in the round. Participants were then left alone to complete the Interactive Round. After this round, participants were asked to indicate what their objective was while playing. They were also asked to provide their impression of their friend by rating the friend on 25 personal traits. Once the rounds of the iterated PD game were completed, participants were probed for their suspicion about the deception used during the game. Afterwards, participants were debriefed as to the purpose of the experiment, and all deception involved was disclosed. Participants were also asked to verify that it was acceptable to use their data given the deceptive method used to obtain them.

## **4.4 Results for Experiment 2**

### *4.4.1 Overview*

This study used a 2 (Age Group: young and older adults) by 2 (Partner Type: Tit-for-Tat and Selfish program) by 8 (Time: turns 1-4, 5-8, 9-12, 13-16, 17-20, 21-24, 25-28, and 29-32) mixed-model design. Age Group and Stranger Type were between-subjects factors, whereas Time was a within-subjects factor. Comparisons between Experiments 1 and 2 only involve between-subjects factors.<sup>12</sup> The main dependent variables were (a) the extent to which participants made cooperative choices (i.e., choose doors that pass yellow keys; Doors A and C) during the iterated PD game, (b) the trait ratings that the participants provided for their friend, (c) the number of nickels that the participants earned during the interactive round of the game, and (d) the participants’



self-reported goals for the interactive round of the game. Unless otherwise noted, an  $\alpha = .05$  level was used for all of the statistical tests reported below.

#### 4.4.2 Do Young and Older Adults Learn the Main Point of the Game in the Alone Round?

Proportion of cooperation (i.e., the percentage of times that Doors A or C were chosen) were calculated for each participant for each round as (1) a round total including all 32 turns and (2) eight 4-turn blocks. A 2 (Age Group) x 2 (Partner Type) x 8 (Time) mixed model ANOVA conducted on the participants' percentage of cooperation in the Alone Round revealed that main effects of Time,  $F(7,1001) = 6.41$ ,  $\eta^2 = .04$ , and Age Group  $F(1,143) = 37.42$ ,  $\eta^2 = .21$ , were qualified by a significant Time x Age Group interaction  $F(7,1001) = 7.16$ ,  $\eta^2 = .05$ . As depicted in Figure 9, the interaction was driven

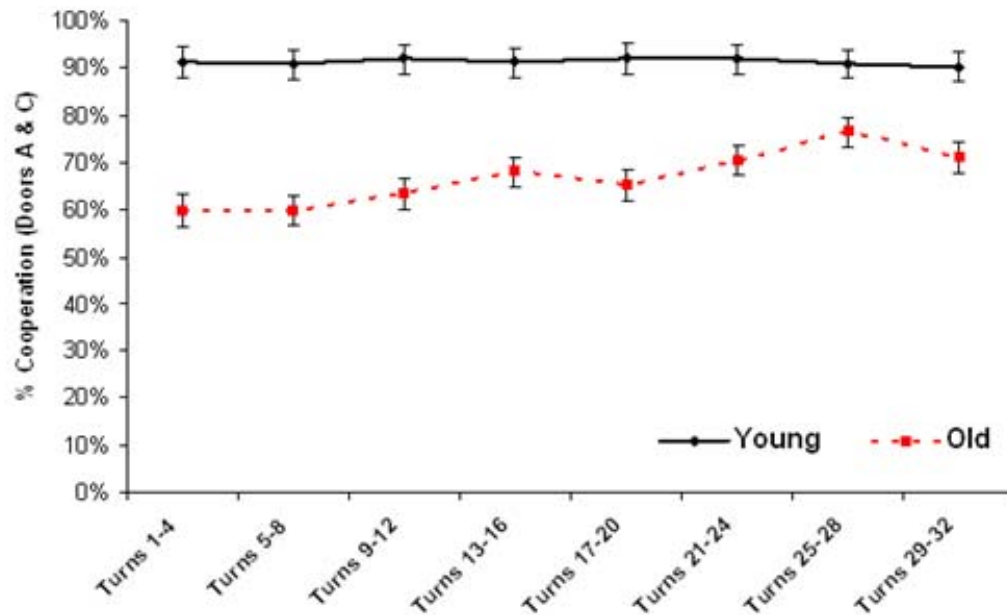


Figure 9. Percentage of cooperation in the Alone Round of Experiment 2 for each of the eight 4-turn blocks, displayed separately for young and older adults.

by older adults' significant improvement in the game over time. For example, the contrast between older adults' first and last 4-turn blocks revealed a significant difference in performance,  $t(71) = 3.32$  ( $M_{diff} = 0.11$ ,  $SE = 0.03$ ). Young adults remained stable in their performance and outperformed older adults at every time point during the Alone Round. Moreover, results were consistent across Experiments 1 and 2.<sup>13</sup> Similar learning trends in each experiment made it possible to compare results across experiments.

#### *4.4.3 Average Cooperation Declines between the Alone Round and Interactive Round for Both Age Groups*

Although young adults outperformed older adults in the Alone Round, both age groups experienced decline in performance when shifting from the Alone Round to the Interactive Rounds.<sup>14</sup> A 2 (Age Group) x 2 (Round: Alone and Interactive) x 2 (Partner Type) mixed model ANOVA was conducted on the total percentage of cooperation across all 32 turns in each round. For this analysis, Round was a within-subjects factor representing participants' performance in the Alone Round and the Interactive Round. Differences in how participants treated each type of Friend were captured by the between-subjects Partner Type factor. This analysis yielded main effects of Round,  $F(1,140) = 66.67$ ,  $\eta^2 = .32$ , Age Group,  $F(1,140) = 8.43$ ,  $\eta^2 = .06$ , and Partner Type,  $F(1,140) = 8.54$ ,  $\eta^2 = .06$ . These main effects were qualified by a Round x Age Group interaction,  $F(1,140) = 16.02$ ,  $\eta^2 = .10$ , and a Round x Partner Type interaction,  $F(1,140) = 34.70$ ,  $\eta^2 = .20$ . For each Age Group, mean cooperation levels for the Alone and Interactive Rounds are displayed separately by Partner Type in Figure 10. Overall, both young and older adults displayed less cooperation in the Interactive Round than in the

Alone Round: Alone ( $M = 0.78$ ,  $SE = 0.04$ ) versus Interactive ( $M = 0.52$ ,  $SE = 0.03$ ). The Round x Age Group Interaction was driven by the young adults' superior performance ( $M = 0.91$ ,  $SE = 0.02$ ) in the Alone Round relative to that of older adults ( $M = 0.66$ ,  $SE = 0.04$ ),  $t(145) = 6.02$ . Young and older adults did not differ in their overall performance in the Interactive Round (Young:  $M = 0.52$ ,  $SE = 0.05$ ; Old:  $M = 0.53$ ,  $SE = 0.04$ ),  $t(141) = 0.12$ , *ns*. The Round x Partner interaction stems from the tendency for those participants who interacted with the Selfish Friend ( $M = 0.37$ ,  $SE = 0.04$ ) to cooperate less than those who interacted with the TFT Friend ( $M = 0.67$ ,  $SE = 0.04$ ). This difference led to a larger drop in cooperation between the Alone Round and the Interactive Round for those participants who interacted with the Selfish Friend program,  $t(69) = 9.15$  ( $M_{diff} = 0.45$ ,  $SE = 0.05$ ) as opposed to the TFT Friend program,  $t(73) = 1.67$ ,  $p < .10$  ( $M_{diff} = 0.08$ ,  $SE = 0.05$ ). Consistent with age non-specific predictions (Hypothesis 1), participants cooperated more with the TFT Friend than the Selfish Friend.<sup>15</sup>

#### *4.4.4 Cooperation Remains Stable with the TFT Friend but Declines with the Selfish Friend*

A 2 (Age Group) x 2 (Partner Type) between-subjects ANOVA conducted on mean cooperation in the Interactive Round yielded only a main effect of Partner Type,  $F(1,140) = 26.72$ ,  $\eta^2 = .16$ . Young and older adults who interacted with the TFT Friend (Young:  $M = 0.69$ ,  $SE = 0.06$ ; Old:  $M = 0.66$ ,  $SE = 0.06$ ) displayed higher levels of cooperation in the Interactive Round than those young and older adults who interacted with the Selfish Friend (Young:  $M = 0.34$ ,  $SE = 0.06$ ; Old:  $M = 0.39$ ,  $SE = 0.06$ ).

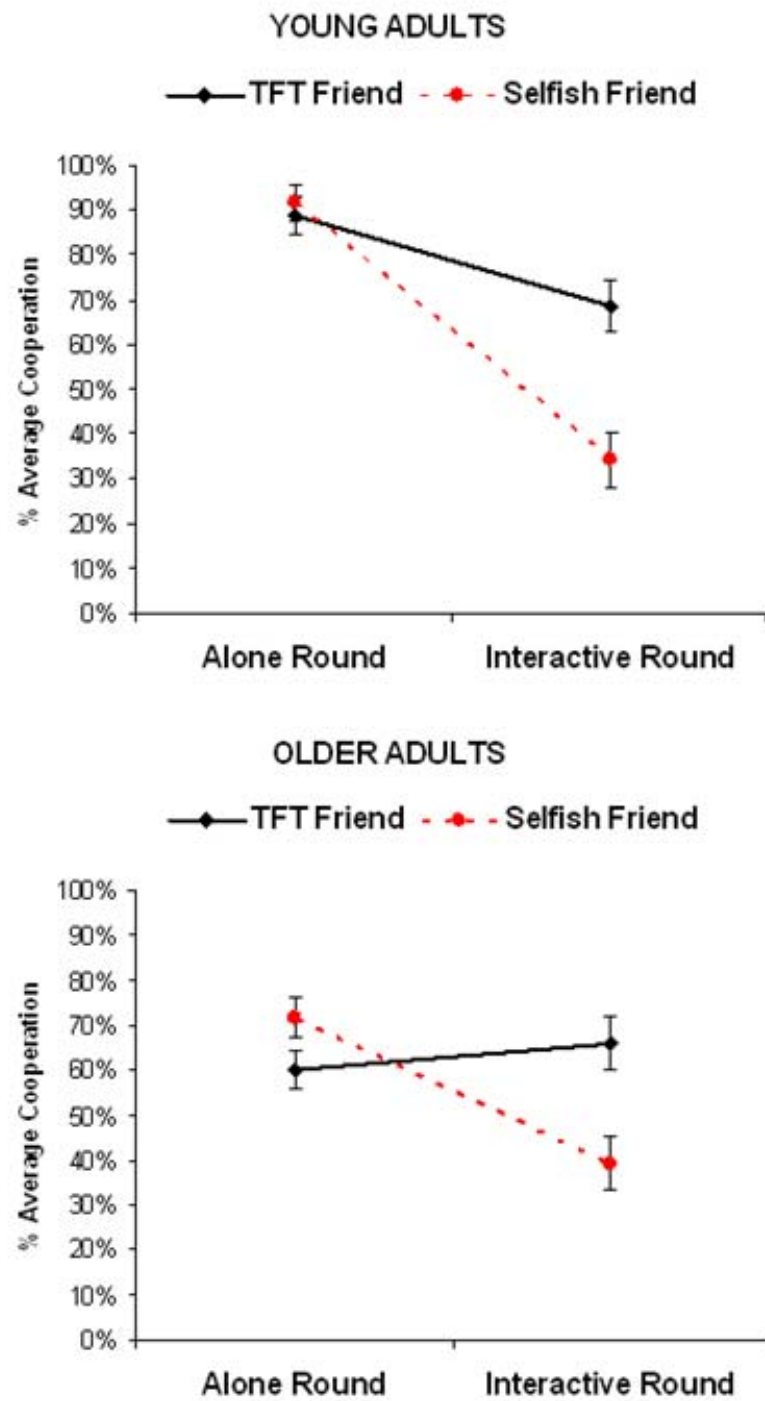
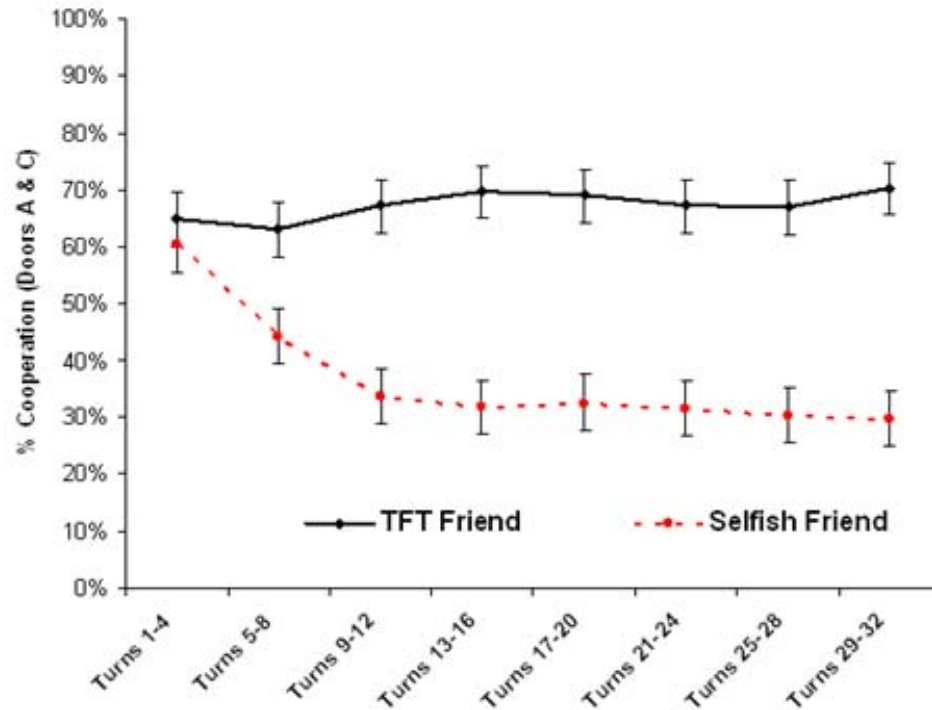


Figure 10. Average total percentage of cooperation for each round of Experiment 2, displayed separately for young and older adults.

In addition to examining participants' overall performance in the interactive rounds, separate 2 (Age Group) x 8 (Time) mixed model ANOVAs were conducted for each Partner Type to describe any changes in cooperation that took place over time in the Interactive Round. No significant effects emerged when participants interacted with the TFT Friend. For the interaction with the Selfish Friend, the mixed model ANOVA revealed a main effect of Time,  $F(7,476) = 13.25$ ,  $\eta^2 = .16$ . Within-subjects contrasts comparing mean performance between each 4-turn block showed that cooperation dropped between the block 1 and block 2,  $F(1,68) = 13.32$ ,  $\eta^2 = .16$ , and again between block 2 and block 3,  $F(1,68) = 9.39$ ,  $\eta^2 = .12$ . Mean levels of cooperation at each time point in the Interactive Round are displayed separately by Partner Type in Figure 11.



*Figure 11.* Percentage of cooperation in the Interactive Round of Experiment 2 for each of the eight 4-turn blocks, displayed separately by friend type.

Consistent with age non-specific predictions (Hypothesis 1), all participants cooperated more with the TFT Friend than the Selfish Friend. However, contrary to age specific predictions (Hypothesis 7), young and older adults displayed the same decline in cooperation over time when interacting with the Selfish Friend. Older adults were expected to be more cooperative with the Selfish Friend than were young adults. Additionally, young and older adults displayed equivalent levels of cooperation when interacting with the TFT Friend.<sup>16</sup>

#### *4.4.5 Examination of Distributions Revealed More Cooperation with TFT Friend than with Selfish Friend*

Up to this point, the above findings suggest that young and older adults were equally likely to start a conflict with a friend and were also equally likely to use retaliatory behavior (i.e., Choose Door D or fail to cooperate) in response to a conflict created by a friend. However, it is difficult to get a clear sense for such specific types of behaviors merely by examining the participants' mean performance within the Interactive Round. To remedy this, the distributions of the participants' average responses were characterized for each type of friend program (as was done for Experiment 1) and then possible Age Group differences in specific turn-by-turn behaviors were explored.

Figure 12 displays the histograms for young and older adults' overall cooperation with each Partner Type during the Interactive Round. When interacting with the TFT Friend, 58% of young adults and 44% of older adults chose to cooperate or to defect 100% of the time. When interacting with the Selfish Friend, this tendency to stick with the same response for every turn was not as substantial (Young = 20%; Old = 23%). In

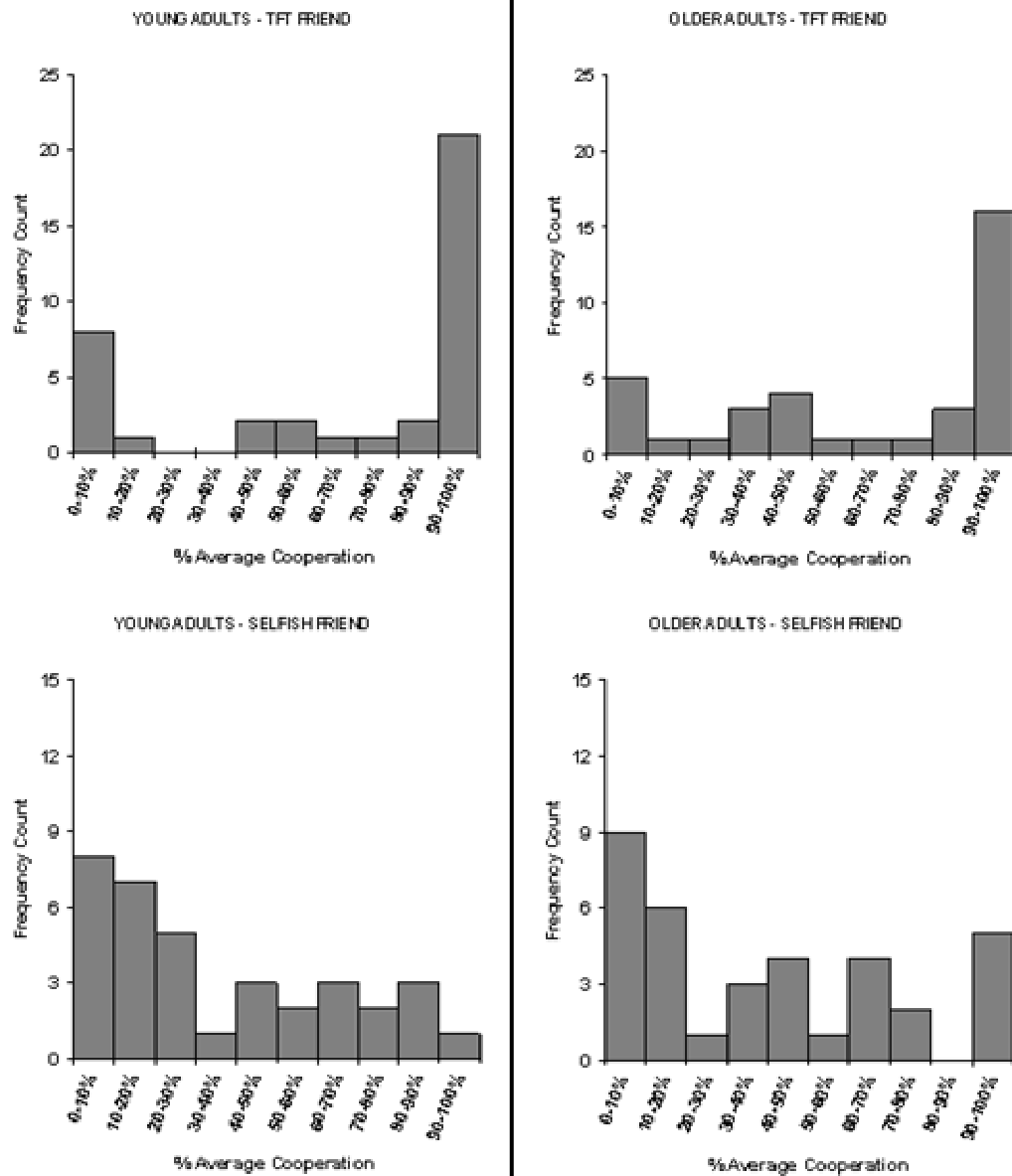


Figure 12. Histograms of average total percentage of cooperation frequency counts for the Interactive Round of Experiment 2, displayed separately by friend type for young and older adults.

both conditions, young and older adults' mean levels of cooperation were not normally distributed. To further examine possible differences in young and older adults' behavior when they interacted with their friend (e.g., are young adults more likely than older adults to choose to pass a blue key for every turn), mean cooperation for each individual was categorized as 100% Cooperation, 100% Defection, or "Somewhere in between". A chi-square test was conducted for each age group to determine if membership in each of these categories differed by the type of Friend program with which the participant interacted. For young adults, significantly more individuals chose to cooperate 100% of the time when interacting with the TFT Friend (100% Cooperation = 45%, "Somewhere in between" = 42%, and 100% Defection = 13%) than with the Selfish friend (100% Cooperation = 0%, "Somewhere in between" = 80%, and 100% Defection = 20%),  $\chi^2(2) = 20.52, n = 73, p < .001$ . Likewise, significantly more older adults chose to cooperate 100% of the time when interacting with the TFT Friend (100% Cooperation = 39%, "Somewhere in between" = 56%, and 100% Defection = 6%) than the Selfish Friend (100% Cooperation = 9%, "Somewhere in between" = 77%, and 100% Defection = 14%),  $\chi^2(2) = 9.43, n = 71, p < .01$ . Although both young and older adults displayed consistent cooperative behavior more often when interacting with the TFT Friend than the Selfish friend, the question remains: were young and older adults similar in their propensities to consistently cooperate? A chi-square test was conducted for each Friend program to determine if membership in the cooperation categories differed by age group. For the TFT Friend, young and older adults were equally likely to stick with consistent cooperation,  $\chi^2(2) = 1.97, n = 74, p > .37$  (Young: 100% Cooperation = 45%, "Somewhere in between" = 42%, and 100% Defection = 13%; Old: 100% Cooperation =



39%, “Somewhere in between” = 56%, and 100% Defection = 6%). For the Selfish Friend, young and older adults were equally unlikely to stick with consistent cooperation and equally likely to stick with consistent defection,  $\chi^2(2) = 3.35, n = 70, p > .19$  (Young: 100% Cooperation = 0%, “Somewhere in between” = 80%, and 100% Defection = 20%; Old: 100% Cooperation = 9%, “Somewhere in between” = 77%, and 100% Defection = 14%). Consistent with age non-specific predictions (Hypothesis 1), young and older adults were both more likely to stick with consistent cooperation when interacting with the TFT Friend than when interacting with the Selfish Friend.

#### *4.4.6 Examination of Turn-by-Turn Behavior during Interactive PD Rounds Confirms Lack of Age-Related Differences*

In addition to looking at age-related differences in the distributions of participants, an examination of turn-by-turn decisions could be useful for identifying possible differences in the ways that young and older adults interacted with their friends or for detecting additional evidence to verify the lack of age-related differences seen thus far. For example, consistent with the finding that young and older adults displayed equivalent levels of cooperation with the TFT Friend,  $t(72) = 0.28, ns$ , young and older adults were equally likely to choose to choose Door B (i.e., pass a blue key) in order to acquire more nickels (i.e., win the round) when interacting with TFT Friend,  $\chi^2(1) = 0.17, n = 74, p > .68$  (Young = 29%; Old = 33%). As was performed on the data for the Selfish Stranger in Experiment 1, each participant’s responses when interacting with the Selfish Friend were examined to determine (a) the overall number of times that the Selfish Stranger chose to pass a blue key after the participant had passed this stranger a yellow

key (a.k.a., noticeable defections), (b) the number of consecutive times that the participant passed the Selfish Stranger a blue key after this stranger's first noticeable defection (a.k.a., punishing), and (c) the likelihood that that the participant would decide to choose B after forgiving the Selfish Stranger's first noticeable defection (a.k.a. getting even). Young ( $M = 2.7$ ,  $SE = 0.4$ ) and older ( $M = 3.1$ ,  $SE = 0.4$ ) adults experienced an equivalent number of noticeable defections when interacting with the Selfish Friend,  $t(68) = 0.61$ , *ns*. Moreover, after the Selfish Friend's first noticeable defection, young ( $M = 5.7$ ,  $SE = 1.7$ ) and older adults ( $M = 7.1$ ,  $SE = 1.8$ ) passed the same number of consecutive blue keys to their friend,  $t(68) = 0.61$ , *ns*. Finally, an equal proportion of young and older adults chose to get even with the Selfish Friend by choosing Door B after first breaking a sequence of defections,  $\chi^2(1) = 0.39$ ,  $n = 31$ ,  $p > .41$  (Young = 23%; Old = 33%). Overall, analyses of the participants' turn-by-turn behaviors support the findings reported earlier and age non-specific predictions (Hypothesis 1); both young and older adults were more cooperative with the TFT Friend than with the Selfish friend, and there were no distinct differences between the choices made by young and older adults. This was inconsistent with the age-specific prediction that young adults would be more confrontational and older adults would be more acquiescent after being taken advantage of by a friend (Hypothesis 8).

#### *4.4.7 Trait Impressions for the TFT Friend Were More Favorable than for the Selfish Friend*

For each Partner Type, the trait attributions that participants made after completing the Interactive Round were aggregated into an overall composite sum of

positive trait attributions. As in Experiment 1, the aggregate included scores from 18 possible traits, which displayed a high level of internal consistency (TFT Friend:  $\alpha = 0.90$ ; Selfish Friend:  $\alpha = 0.92$ ). This aggregate positive attribution score represents how the participant viewed their partner after they interacted with them in the game. To some degree, participants' responses reflected the type of experience (i.e., positive or negative) that they had during this interaction. A 2 (Age Group) x 2 (Partner Type) between-subjects ANOVA on the aggregate positive attribution scores revealed main effects of Age Group,  $F(1,142) = 15.93$ ,  $\eta^2 = .10$ , and Partner Type,  $F(1,142) = 41.31$ ,  $\eta^2 = .26$ . On average, older adults rated their partners more favorably than did young adults, and the TFT Friend was rated more favorably by participants than was the Selfish Friend (Young TFT:  $M = 99.1$ ,  $SE = 2.8$ ; Old TFT:  $M = 107.1$ ,  $SE = 2.9$ ; Young Selfish:  $M = 77.2$ ,  $SE = 2.8$ , Old Selfish:  $M = 92.1$ ,  $SE = 2.9$ ). Overall, these findings fail to support the initial age non-specific prediction that participants' impressions of the TFT and Selfish Friend would not differ from one another (Hypothesis 2). Despite having a track record of past interactions, participants viewed their friends less favorably when they created an obstacle to their success in the game.

In addition to examining the aggregate positive attribution scores, separate 2 (Age Group) x 2 (Partner Type) between-subjects ANOVAs were also conducted on the competitive and cooperative attributions that participants made after the Interactive Round. For cooperative attributions, there was a main effect of Partner Type,  $F(1,142) = 40.76$ ,  $\eta^2 = .22$ , and a marginal main effect of Age Group,  $F(1,142) = 3.57$ ,  $p < .07$ ,  $\eta^2 = .03$ . Consistent with predictions (Hypothesis 2), the TFT Friend was rated as more cooperative than the Selfish Friend. The marginal main effect of Partner Type emerged

because older adults gave the Selfish Friend higher cooperative ratings than did young adults,  $t(71) = 2.07$  (Young TFT:  $M = 5.9$ ,  $SE = 0.3$ ; Old TFT:  $M = 6.1$ ,  $SE = 0.3$ ; Young Selfish:  $M = 3.7$ ,  $SE = 0.3$ , Old Selfish:  $M = 4.7$ ,  $SE = 0.3$ ). For competitive attributions, there a main effect of Age Group,  $F(1,141) = 7.68$ ,  $\eta^2 = .22$ , was qualified by an Age Group x Player Type interaction,  $F(1,142) = 11.40$ ,  $\eta^2 = .08$ . Although young and older adults provided similar competitive ratings for the Selfish Friend (Young Selfish:  $M = 6.0$ ,  $SE = 0.2$ , Old Selfish:  $M = 5.9$ ,  $SE = 0.2$ ), young adults provided lower competitiveness ratings than older adults for the TFT Friend (Young TFT:  $M = 4.8$ ,  $SE = 0.2$ , Old TFT:  $M = 6.3$ ,  $SE = 0.2$ ). Overall, young adults were able to distinguish between the cooperative and competitive tendencies of the two types of friends, but older adults were only able to distinguish the two types of friends based on their differing levels of cooperativeness.

#### *4.4.8 Young and Older Adults Were Similar in the Extent to which They Held a Competitive or a Cooperative Focus when Interacting with Friends*

As in Experiment 1, participants were asked to describe the strategy that a person would use if they wanted to maximize the number of nickels that they collected while interacting with others just prior to the Interactive Round. Also, immediately after the Interactive Round, participants were asked to describe any goals that they had in mind during the interaction. Two raters coded each response as falling into one of three categories: *cooperative*, *competitive*, or *neither cooperative nor competitive (a.k.a. ambivalent)*. Inter-rater reliability for this categorization scheme was 89% for the responses provided *before* the Interactive Round and 90% for the responses provided

after the Interactive Round. As with Experiment 1, the coding scheme was limited to characterizing the cooperative and competitive tone, so responses coded as ambivalent varied in content (e.g., from non-codeable to instrumentally-oriented responses). Moreover, comparisons were not made between different question types given temporal differences in content (e.g., “wait-and-see” or contingent strategies offered before versus reactive goals offered afterwards). Chi-square tests conducted on the participants’ responses prior to the Interactive Round demonstrated that young and older adults offered a similar pattern of responses,  $\chi^2(2) = 4.55, p > .10$  ( $n = 147$ ). Young adults offered slightly more cooperative responses (47%) than competitive (30%) or ambivalent (22%) responses, and older adults responses were more cooperative (41%) and ambivalent (38%) than competitive (21%). Similar patterns emerged when examining the goals that participants reported having in mind during the Interactive Round (i.e., responses collected after each round). Overall, young adults reported having similar goals while interacting with the TFT and Selfish Friends (TFT Friend: Cooperative = 45%, Competitive = 21%, and Ambivalent = 34%; Selfish Friend: Cooperative = 32%, Competitive = 37%, and Ambivalent = 32%),  $\chi^2(2) = 2.54, p > .28$  ( $n = 76$ ). Older adults also reported having similar goals while interacting with the TFT and Selfish Friends (TFT Friend: Cooperative = 25%, Competitive = 25%, and Ambivalent = 50%; Selfish Friend: Cooperative = 37%, Competitive = 25%, and Ambivalent = 37%),  $\chi^2(2) = 1.52, p > .46$  ( $n = 71$ ). Chi-square tests conducted on the participants’ responses separately by Partner Type also failed to yield any significant differences in the patterns of responses offered by young and older adults,  $\chi_{\text{TFT}}^2(2) = 3.28, p > .19$  ( $n = 74$ ) and  $\chi_{\text{Selfish}}^2(2) = 1.05, p > .59$  ( $n = 73$ ). Contrary to age specific predictions (Hypothesis 9), young adults did not

report having more of a competitive focus than older adults while interacting with the Selfish friend. Overall, the distributions of individuals who held a cooperative or a competitive focus during the round were not different between age groups.

#### *4.4.9 More Nickels Accrued during Interaction with TFT Friend than with Selfish Friend*

A 2 (Age Group) x 2 (Partner Type) between-subjects ANOVA conducted on the number of nickels that the participants earned in the Interactive Round revealed only a main effect of Partner Type,  $F(1,140) = 64.41, \eta^2 = .32$ . Young and older adults both earned more nickels when interacting with the TFT Friend (Young:  $M = 131, SE = 4.7$ ; Old:  $M = 129, SE = 4.9$ ) than when interacting with the Selfish Friend (Young:  $M = 89, SE = 4.9$ ; Old:  $M = 92, SE = 4.9$ ). Contrary to age specific predictions (Hypothesis 10), older adults did not outperform young adults by earning more nickels when interacting with their friends.

#### *4.4.10 Exploration of Gender, Cognitive Abilities, and Individual Difference Measures*

As mentioned in the Results section of Experiment 1, theoretical accounts of age-related changes in personality suggest that advancing age is accompanied by a shift toward androgyny such that men become more passive and women become more assertive (Gutmann, 1994). A 2 (Age Group) x 2 (Gender) x 2 (Partner Type) between-subjects ANOVA was performed separately for the participants' average level of cooperation in the Interactive Round and their aggregate positive attributions to investigate this possibility. With respect to mean level of cooperation in the Interactive Round, gender had no significant effects. However, for the aggregate positive

attributions, there was a main effect for Gender,  $F(1,138) = 8.36$ ,  $\eta^2 = .06$ , and also a marginal Age Group x Gender interaction,  $F(1,138) = 3.46$ ,  $\eta^2 = .02$ . The marginal interaction emerged because young men ( $M = 82.3$ ,  $SE = 2.6$ ) offered less favorable attributions than young women ( $M = 95.6$ ,  $SE = 2.9$ ), older men ( $M = 97.9$ ,  $SE = 3.1$ ), and older women ( $M = 100.8$ ;  $SE = 2.6$ ). The above findings do not support the prediction that advancing age is associated with more assertive behavior on the part of women and more passive behavior on the part of men. Because there were age differences in each of the cognitive ability measures, correlations between these measures and performance during each round of the iterated PD game were calculated separately for each age group. For the Alone Round, percentage of cooperation was not significantly related to any of the cognitive measures for either age group. For the Interactive Round, mean level cooperation was positively related to inductive reasoning,  $r(38) = .38$ , processing speed,  $r(38) = .33$ , and verbal ability,  $r(38) = .41$ , for those young adults who interacted with the Selfish Friend. Given the shape of the distributions for mean percentage of cooperation in the Interactive Rounds, each age group was divided into tertiles within each Interactive Round so that t-tests could be conducted to compare (a) performance on each cognitive ability test and (b) responses in each social individual difference measure for members of the top and bottom tertiles.<sup>17</sup>

When interacting with the TFT Friend, relative to young adults in the bottom tertile of mean cooperation, those young adults in the top tertile had higher scores on measures of inductive reasoning,  $t(28) = 2.22$  (Top:  $M = 25.4$ ,  $SE = 0.6$ ; Bottom:  $M = 23.1$ ,  $SE = 0.8$ ), processing speed,  $t(28) = 2.33$  (Top:  $M = 74.7$ ,  $SE = 2.9$ ; Bottom:  $M = 64.5$ ,  $SE = 3.3$ ), and verbal ability,  $t(28) = 2.63$  (Top:  $M = 17.5$ ,  $SE = 1.4$ ; Bottom:  $M =$

12.4,  $SE = 1.3$ ). They also had higher generativity scores,  $t(28) = 2.21$  (Top:  $M = 61.9$ ,  $SE = 2.1$ ; Bottom:  $M = 53.9$ ,  $SE = 3.1$ ), and marginally higher emotion suppression scores,  $t(28) = 2.02$ ,  $p < .06$  (Top:  $M = 4.3$ ,  $SE = 0.3$ ; Bottom:  $M = 3.5$ ,  $SE = 0.3$ ). Young adults in the top tertile also were less likely to endorse the use of Self-protective social comparisons when a problem developed in their relationships,  $t(28) = 2.57$  (Top:  $M = 1.7$ ,  $SE = 0.2$ ; Bottom:  $M = 2.7$ ,  $SE = 0.3$ ). When interacting with the Selfish Friend, young adults in the top tertile of cooperation had higher emotional reappraisal,  $t(22) = 2.79$  (Top:  $M = 5.6$ ,  $SE = 0.2$ ; Bottom:  $M = 4.7$ ,  $SE = 0.2$ ) and generativity scores,  $t(22) = 2.13$  (Top:  $M = 60.2$ ,  $SE = 2.9$ ; Bottom:  $M = 52.3$ ,  $SE = 2.2$ ) than those in the bottom tertile. Young adults in the top tertile were also less neurotic,  $t(22) = 2.88$  (Top:  $M = 3.9$ ,  $SE = 0.3$ ; Bottom:  $M = 5.4$ ,  $SE = 0.4$ ), reported better overall health,  $t(22) = 2.29$  (Top:  $M = 4.4$ ,  $SE = 0.2$ ; Bottom:  $M = 3.8$ ,  $SE = 0.2$ ) and that health problems were less likely to get in the way of their daily activities,  $t(22) = 2.84$  (Top:  $M = 1.1$ ,  $SE = 0.1$ ; Bottom:  $M = 1.7$ ,  $SE = 0.2$ ), and were more likely to endorse the use of self-protective intraindividual comparison when an obstacle emerged in a relationship,  $t(22) = 2.73$  (Top:  $M = 2.7$ ,  $SE = 0.2$ ; Bottom:  $M = 1.8$ ,  $SE = 0.2$ ).

When interacting with the TFT Friend, relative to older adults in the bottom tertile of mean cooperation, those older adults in the top tertile were more agreeable,  $t(24) = 2.15$  (Top:  $M = 8.3$ ,  $SE = 0.4$ ; Bottom:  $M = 6.8$ ,  $SE = 0.6$ ), had marginally more interpersonal trust,  $t(24) = 1.77$ ,  $p < .10$  (Top:  $M = 3.4$ ,  $SE = 0.2$ ; Bottom:  $M = 3.0$ ,  $SE = 0.2$ ), and reported being marginally less capable of expressing emotions (both positive and negative) in difficult interpersonal situations,  $t(24) = 1.76$ ,  $p < .10$  (Top:  $M = 75.3$ ,  $SE = 3.4$ ; Bottom:  $M = 82.8$ ,  $SE = 2.3$ ). Those older adults in the top tertile also were



marginally more likely to endorse the use of compensatory primary control,  $t(24) = 1.65$ ,  $p < .12$  (Top:  $M = 3.0$ ,  $SE = 0.2$ ; Bottom:  $M = 2.5$ ,  $SE = 0.2$ ) and self-protective intraindividual comparison when an obstacle emerged in a relationship,  $t(24) = 1.84$ ,  $p < .08$  (Top:  $M = 3.3$ ,  $SE = 0.1$ ; Bottom:  $M = 2.8$ ,  $SE = 0.3$ ). When interacting with the Selfish Friend, older adults in the top tertile of mean cooperation were marginally less likely to disengage from a goal when a relationship obstacle stood in the way of obtaining it,  $t(22) = 1.69$ ,  $p < .11$  (Top:  $M = 2.5$ ,  $SE = 0.3$ ; Bottom:  $M = 1.8$ ,  $SE = 0.2$ ).<sup>18</sup>

#### *4.4.11 Summary of Results from Experiment 2*

As in Experiment 1, young adults outperformed older adults during the Alone Round, cooperating more and thus earning more nickels. However, during the Interactive Round, young and older adults did not differ in their overall levels of cooperation. Both young and older adults were more cooperative when interacting with the TFT Friend than when interacting with the Selfish Friend. Additionally, all participants formed more favorable impressions of the TFT Friend than of the Selfish Friend. Overall, however, older adults were more positive than young adults in the attributions that they made toward their friends. Neither age group reported having more of a competitive or cooperative focus than the other. In fact, young and older adults displayed similar behavioral tendencies when interacting with each partner. The average level of cooperation generally remained stable over time when participants interacted with the TFT Friend. When interacting with the Selfish Friend, cooperation decreased over time for both young and older adults.

## 4.5 Comparing Results of Experiment 1 and Experiment 2

### 4.5.1 Overview

Across experiments, each sample of participants interacted with exactly the same two computer programs (i.e., the Tit-for-Tat program and the Selfish program). The only aspect of the methodology that changed between the experiments was the identity of the person with whom the participants were interacting. Given this, analyses were conducted to determine if young and older adults each displayed similar levels of cooperative behavior when interacting with strangers and friends.

### 4.5.2 Participants Cooperated More with Friends than with Strangers and More with TFT Partners than with Selfish Partners

A 2(Age Group) x 2 (Partner Relation: Stranger and Friend) x 2 (Partner Type: TFT and Selfish) x 8 (Time: consecutive 4-turn blocks) mixed model ANOVA conducted on participants' mean level of cooperation over each of eight consecutive 4-turn blocks yielded main effects of Partner Relation,  $F(1,272) = 7.82$ ,  $\eta^2 = .03$ , Partner Type,  $F(1,272) = 32.42$ ,  $\eta^2 = .11$ , and Time,  $F(1,138) = 3.46$ ,  $\eta^2 = .02$ . These main effects were qualified by a significant Time x Partner Type interaction,  $F(7,1904) = 22.12$ ,  $\eta^2 = .08$ , and a marginal Age Group x Partner Type interaction,  $F(1,272) = 2.97$ ,  $\eta^2 = .01$ .<sup>19</sup> Mean levels of cooperation at each time point for each Partner Type and Partner Relation are displayed separately for each age group in Figure 13. The Time x Partner Type interaction emerged because young and older adults both displayed decreasing levels of cooperation for the Selfish partner relative to the TFT partner. Although young and older adults were more cooperative with friends than with strangers, they did not display

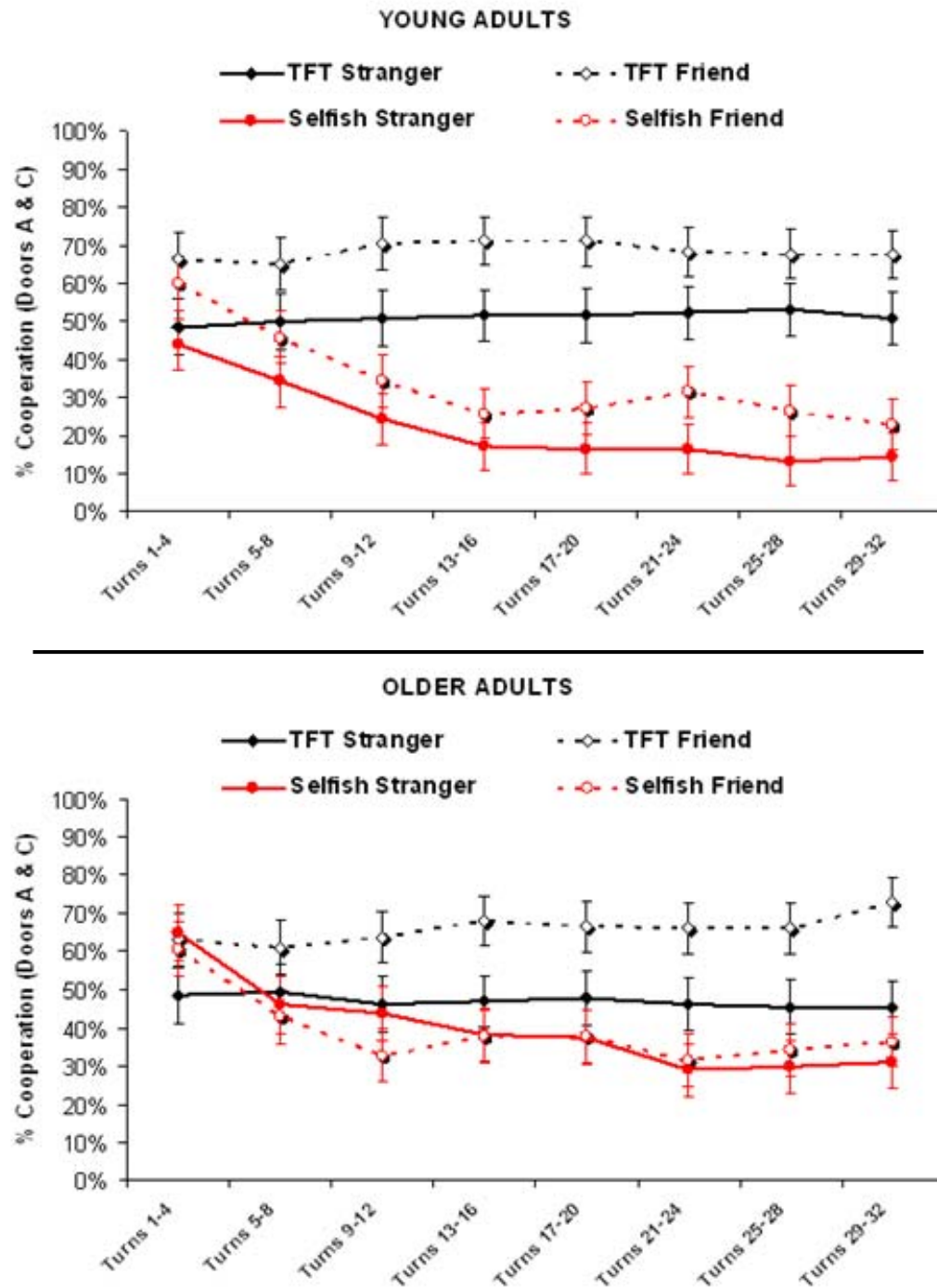


Figure 13. Percentage of cooperation in the Interactive Round for each of the eight 4-turn blocks, displayed separately for young and older adults by partner type (Experiment 1 = Strangers; Experiment 2 = Friends).

differential decline in their levels of cooperation with each Partner Type (i.e., TFT versus Selfish) over time. The Age Group x Partner Type interaction emerged because, across Partner Relation (i.e., in both experiments), older adults ( $M = 0.40$ ,  $SE = 0.04$ ) were more cooperative than young adults ( $M = 0.28$ ,  $SE = 0.04$ ) with Selfish partners. However, it is important to note that this interaction accounts for only those older adults from Experiment 1 who interacted with the Selfish Stranger in the first of the two Interactive Rounds. These older adults displayed higher levels of cooperation than (a) those older adults who interacted with the Selfish Stranger in the second round of the Interactive Rounds (i.e., after interacting with the TFT Stranger) and (b) all young adults regardless of when they interacted with the Selfish Stranger. In Experiment 2, young and older adults displayed equivalent trajectories of cooperation with their Selfish Friend. Overall, these findings suggest that young and older adults were both more likely to cooperate with friends than with strangers. Also, older adults displayed a marginally higher propensity for cooperating with Selfish partners than did young adults, but this effect was driven by older adults more cooperative behavior when interacting with the Selfish Stranger early in the Interactive Round of Experiment 1. Also, the above findings are inconsistent with age specific predictions that older adults would not show as substantial of a decline in cooperation when interacting with friends as opposed to strangers (Hypothesis 7). Regardless of Partner Relation, young and old adults showed similar mean level changes throughout the game.<sup>20</sup>

#### *4.5.3 Trait Impressions for Friends Were More Favorable than for Strangers*

A 2 (Age Group) x 2 (Partner Relation: Stranger and Friend) x 2 (Partner Type: TFT and Selfish) between-subjects ANOVA conducted on the aggregate positive attributions yielded significant main effects of Age Group,  $F(1,270) = 24.84$ ,  $\eta^2 = .08$ , Partner Relation,  $F(1,270) = 60.31$ ,  $\eta^2 = .18$ , and Partner Type,  $F(1,270) = 63.03$ ,  $\eta^2 = .19$ . These main effects were qualified by significant Age Group x Partner Relation,  $F(1,270) = 7.73$ ,  $\eta^2 = .03$ , and Partner Relation x Partner Type,  $F(1,270) = 4.86$ ,  $\eta^2 = .02$ , interactions. The Age Group x Partner Relation interaction emerged because older adults' attributions were proportionally more positive than young adults when describing friends relative to strangers (Young Stranger:  $M = 76$ ,  $SE = 1.8$ ; Young Friend:  $M = 88$ ,  $SE = 1.7$ ; Old Stranger:  $M = 83$ ,  $SE = 1.9$ ; Old Friend:  $M = 99$ ,  $SE = 1.8$ ). Contrary to age non-specific expectations, participants made more favorable attributions about friends when interacting with the TFT program than when interacting with the Selfish program (Hypothesis 2); no differences were expected. However, consistent with age non-specific predictions, young and older adults' offered more favorable attributions for friends than for strangers (Hypothesis 3). Finally, older adults provided more favorable attributions than did young adults, and, in particular, they provided proportionally more favorable ratings for their friends than did young adults.

#### *4.5.4 Young and Older Adults Hold a More Cooperative Focus when Interacting with Friends than with Strangers*

Before the Interactive Round, participants indicated which strategy they thought would maximize the number of nickels they could earn when playing with another person. As mentioned earlier, participants' responses were coded as reflecting

competitive intentions, cooperative intentions, or neither cooperative nor competitive intentions (a.k.a. ambivalent). Chi-square tests were conducted to compare the participants' distribution of responses to this question between experiments (Strangers versus Friends) separately by age group. Young adults' distributions of responses were not different across experiments,  $\chi^2(2) = 1.45, n = 147, p > .48$  (Stranger: Competitive = 39%, Cooperative = 39%, and Ambivalent = 21%; Friend: Competitive = 30%, Cooperative = 47%, and Ambivalent = 22%). Older adults, on the other hand, were more cooperative in their responses when interacting with friends than with strangers,  $\chi^2(2) = 8.21, n = 136, p < .05$  (Stranger: Competitive = 26%, Cooperative = 19%, and Ambivalent = 55%; Friend: Competitive = 21%, Cooperative = 41%, and Ambivalent = 38%).<sup>21</sup>

After the Interactive Round, participants described the goal that they had in mind while playing. These responses were also coded as either reflecting competitive or cooperative intentions or as being ambivalent. Chi-square tests were conducted to compare the participants' distribution of responses to this question between experiments (Strangers versus Friends) separately by age group. Young adults and older adults were both more cooperative in their responses when interacting with friends than with strangers,  $\chi^2(2) = 8.20, n = 147, p < .05$  and  $\chi^2(2) = 7.03, n = 136, p < .05$ , respectively (Young Stranger: Competitive = 52%, Cooperative = 25%, and Ambivalent = 23%; Young Friend: Competitive = 29%, Cooperative = 38%, and Ambivalent = 33%; Old Stranger: Competitive = 35%, Cooperative = 12%, and Ambivalent = 52%; Old Friend: Competitive = 25%, Cooperative = 31%, and Ambivalent = 44%). These results are

convergent with those found for cooperative behavior during the game. Participants were more cooperative when interacting with friends than with strangers.

#### *4.5.5 More Nickels Accrued when Interacting with Friends than with Strangers and when Interacting with TFT Partners than Selfish Partners*

A 2(Age Group) x 2 (Partner Relation: Stranger and Friend) x 2 (Partner Type: TFT and Selfish) between-subjects ANOVA conducted on the total number of nickels earned in the Interactive Round yielded main effects of Partner Relation,  $F(1,272) = 7.78$ ,  $\eta^2 = .03$ , Partner Type,  $F(1,272) = 83.07$ ,  $\eta^2 = .23$ , which were qualified by a marginal Partner Relation x Partner Type interaction,  $F(1,272) = 3.63$ ,  $\eta^2 = .01$ ,  $p < .06$ .

Participants earned more nickels (a) when interacting with friends than when with strangers, and (b) when interacting with the TFT partner than with the Selfish partner. However, the difference in the number of nickels that individuals earned when playing with Selfish Friends and Strangers,  $t(138) = 1.10$ , *ns*,  $M_{\text{diff}} = 3.6$ ,  $SE_{\text{diff}} = 3.2$  (Strangers:  $M = 87$ ,  $SE = 2.2$ ; Friends:  $M = 90$ ,  $SE = 2.4$ ), was smaller than the difference in nickels that individuals earned when playing with TFT Friends and Strangers,  $t(138) = 2.66$ ,  $M_{\text{diff}} = 16.7$ ,  $SE_{\text{diff}} = 6.3$  (Strangers:  $M = 113$ ,  $SE = 4.8$ ; Friends:  $M = 130$ ,  $SE = 4.1$ ). Overall, these findings are inconsistent with the age specific prediction that older adults would earn more nickels than young adults in the Interactive Round, as there were no age-related differences in the number of nickels earned when individuals interacted with any of the partners.

#### *4.5.6 Summary of Comparisons of Results between Experiments 1 and 2*

Overall, comparisons between the two experiments demonstrated that young and older adults both (a) were more likely to cooperate with friends than with strangers, and (b) were more likely to cooperate with the Tit-for-Tat partner than with the Selfish partner. Over time, both young and older adults displayed decreasing levels of cooperation as the Selfish partner took advantage of them in the game. However, both young and older adults were slightly more tolerant of friends than of strangers. Contrary to expectations, participants rated their friends less favorably when they interacted with the Selfish partner than the TFT partner. Consistent with predictions, though, young and older adults both had more favorable impressions of their friends than of the strangers. Older adults provided more favorable attributions of all of their partners than did young adults. Participants were also more likely to report a cooperative focus when interacting with friends than when interacting with strangers. Across experiments, young and older adults did not differ in the nickels that they were able to accumulate during the Interactive Round. Given that participants cooperated more with friends than with strangers, earnings were higher in Experiment 2 than Experiment 1. However, within each experiment, participants earned more nickels when interacting with the Tit-for-Tat partner than the Selfish partner.



## **CHAPTER 5**

### **CONCLUSIONS**

These two experiments used an objective measure of interpersonal problem solving to examine how effective young and older adults were at managing conflict that emerged when interacting with others. Overall, young and older adults demonstrated similar patterns of behavior when interacting with friends and strangers. Members of both age groups displayed higher levels of cooperation and earned more nickels when interacting with friends than with strangers. Likewise, they displayed higher levels of cooperation and earned more nickels when playing with Tit-for-Tat partners than with Selfish partners. When conflict emerged during the interaction, young and older adults both reduced their average level of cooperation as the number of their partner's indiscretions increased. But in the Tit-for-Tat rounds, participants generally developed a single pattern of choices and maintained this pattern throughout the round. Although these two experiments sought to provide evidence that advancing age is characterized by the development of a social expertise that allows older adults to more flexibly and effectively implement strategies when faced with interpersonal conflict than young adults, for the most part, young and older adults displayed very similar patterns of cooperative behavior when interacting with friends and strangers.

Despite these similarities between young and older adults, a few important differences did emerge. Unexpectedly, young adults were more likely than older adults to figure out and implement the game's ideal strategy during the Alone Round of play. However, young adults displayed a sharper decline in performance than did older adults

between the Alone Round and the Interactive Rounds in both experiments, suggesting a reluctance to implement a strategy of consistent cooperation when interacting with others. Given that both age groups displayed a decline in performance between the Alone and Interactive Rounds, the mere thought of playing with another person (be it a friend or a stranger) elicited competitive behavior very early in the Interactive Rounds. Although young and older adults were similar in the competitiveness that they displayed toward their partners, older adults were more likely to cooperate with Selfish Strangers and held more favorable impressions of them as well. In fact, overall, older adults had more favorable impressions of all of their gaming partners than did young adults, suggesting that competitive behavior displayed in the game had less of a detrimental impact on older adults' subjective experience of the interaction than it did on that of young adults. Although not found in all conditions of the two experiments, the differences that did emerge between young and older adults partially support the hypothesis that advancing age is associated with the use of more passive interpersonal problem solving strategies (Blanchard-Fields et al., 2004) that may be aimed at managing conflict and attenuating the negative emotions experienced when one's goals are blocked in an interaction (Birditt & Fingermann, 2005; Blanchard-Fields, 2007; Hoppmann et al., in press). Again, aside from this single condition involving an interaction with a Selfish Stranger, young and older adults were equally effective at managing their simulated interactions.

### **5.1 Problem Solving Strategies Used in the Game**

One of the objectives of these two experiments was to characterize the strategies that young and older adults implemented during the game. When playing the game,

participants were limited to two possible courses of action in each turn: (Choice 1) self-sacrificial cooperation or (Choice 2) self-interested defection. That is, in each turn, participants had to decide whether (1) they would choose a door that offered them one nickel less than the maximum that they could earn on their turn and would put their partner in a position to attain the maximum, or (2) they would choose a door that gave them the maximum possible nickels but would prevent their partner from being able to earn an equivalent amount. In the long run, consistently choosing self-sacrificial cooperation allowed each person to maximize the number of nickels that they earned, whereas choosing self-interested defection allowed one to take the lead over his or her partner (and possibly to “win” the game). These choices were embedded in the context of a sequence of turns. Participants interacted with partners over a set period of time, allowing for a mental track record of game-related events to build up in the participant’s mind. Although these events were not recorded from the participant’s perspective in such a way as to create a narrative that could be analyzed for the motives underlying the participants’ choices, meanings could be inferred from a participant’s choices by also examining their partners’ choices.

Overall, six patterns (A-F) of decisions emerged from both young and older adults’ choices. Participants chose self-sacrificial cooperation (A; Choice 1 above) to establish a track record of cooperation with his or her partner at the beginning of the game. They also chose self-interested defection (B; Choice 2 above) to establish a track record of competitiveness. Sometimes, participants chose (C) self-sacrificial cooperation after their partner had chosen self-interested defection to try to communicate to their partner that cooperation was the goal and that defection was not be necessary to earn a lot

of nickels. Conversely, participants chose self-sacrificial cooperation after having earlier chosen self-interested defection (D), possibly signaling regret and a renewed interest in working towards the game's objective. They also chose self-interested defection in response to their partner's choice of self-interested defection (E) to let the partner know that anything less than cooperation would not be tolerated. And finally, on occasion, young and older adults both chose self-interested defection after having first re-established mutual cooperation with a once-selfish partner, possibly as a way to help the partner experience what it felt like to be taken advantage of (F). All of these behaviors were demonstrated by young and older adults in similar frequencies in each experiment.

For example, when interacting with friends, young and older adults were more hospitable to TFT than Selfish partners, so more participants engaged in sustained self-sacrificial cooperation. When the Selfish Friend defected, young and older adults were equally likely to respond with self-sacrificial cooperation. Moreover, when interacting with strangers, more sustained patterns of self-interested defection were found for both young and older adults. However, young adults consistently defected on more turns than did older adults after the Selfish Stranger defected (E above). This means that older adults were more conciliatory than young adults, as they were more likely to respond to the transgressions of the Selfish Stranger with self-sacrificial cooperation (C above). However, it is important to note that this difference in young and older adult strategy use only emerged when interacting with the Selfish Stranger. It is not clear why older adults were not more cooperative overall than young adults, as was predicted at the outset of the experiments. One possibility is that participants did not have adequate time to use multiple strategies or to determine how best to sequence the strategies that they had

chosen to be effective. Future examinations of young and older adults' reactions to gaming partners might allow for more turns in each round or for multiple rounds with the same partners so that micro-genetic changes in strategy implementation can be investigated (Luwel, Siegler, & Verschaffel, 2008; Siegler, 2007; Siegler & Chen, 2002). One might expect that, although young and older adults display similar behavior in the first interaction with a partner, perhaps older adults would be more likely than young adults to begin to implement more cooperative sequences of strategies (i.e., more strings of choosing Doors A and C) in repeated exposures to the same partner. Given the limited length of the rounds, the data do not speak to subtle changes in variability that may signal emergent cooperative tendencies. Nevertheless, this would be a promising direction in which to take this interactive paradigm. From a more macro-behavioral level, participants did react differently to the four partner types. Theoretical accounts for why young and older adults both were differentially cooperative with friends and strangers are discussed below, separately for the TFT and Selfish partner types.

## **5.2 No Change in Levels of Cooperation Displayed with TFT Strangers and Friends**

Despite learning in the Alone Round that the optimal strategy for the game involved opening yellow doors, about half of the participants chose to defect on their first turn when interacting with the TFT Stranger (similar to Biel & Thøgersen, 2007). Young and older adults were equally likely to do this. Also, it was not uncommon for this first self-interested choice to lead participants down a steady path of defection during the entire round with the TFT Stranger. What is striking about this finding is that participants spontaneously chose to be competitive even though it did not help them to achieve the

game's objective. One reason why this could have happened is that the individuals who engaged in consistent defection might have valued competition and winning (i.e., earning more nickels than their partner) over promoting mutual success. Given that young adults are generally more achievement-oriented (Erikson, 1966; Hoppmann et al., in press), they may prefer to compete rather than cooperate because success in competition illustrates their competencies (Houston, Kinnie, Lupo, Terry, & Ho, 2000). On the other hand, older adults are expected to hold more affiliative goals, so they generally value shared positive social experiences over individual achievement (Diehl et al., 2004; Fung & Carstensen, 2004). Unexpectedly, older adults were as competitive as young adults. Because affiliative goals tend to operate in the context of close interpersonal relationships (e.g., friends and family members), it is possible that older adults displayed competitive or confrontational behaviors when interacting with the TFT Stranger because these goals were not active. Another possibility is that the game situation used in these two experiments naturally evoked the competitiveness that is engrained in the individualistic psyche of our culture. As a result, age differences that are normally observed in affiliative goals do not play out in interactions with strangers. Previous research demonstrates that older adults are not immune to holding a competency-oriented focus when forming blame attributions in instrumental/achievement oriented situations (Blanchard-Fields, Baldi, & Stein, 1999; Blanchard-Fields, Chen, Schocke, & Hertzog, 1998). The results from Experiments 1 and 2 are consistent with this finding.

The goals that young and older adults reported having in their minds during the Interactive Rounds with strangers provide some support for the interpretation that participants brought a competitive focus to the game even though optimal performance

demanded cooperation. First, young adults offered proportionally more competitive goals than cooperative or ambivalent goals when interacting with the TFT Stranger. Second, despite the fact that older adults were more likely to report ambivalent goals than cooperative or competitive goals, they too reported more competitive than cooperative goals when interacting with the TFT Stranger. Besides reporting a competitive focus, both young and older adults tended not to strictly favor consistent (100% of the time) cooperation. Presumably, because more communal and affiliative goals are active when individuals are engaged in a task with friends, cooperation was higher in Experiment 2. Consistent with this finding, young and older adults both proportionally had more of a cooperative focus than a competitive one when interacting with friends and thus cooperated more with the TFT Friend than with the TFT Stranger. This replicates previous research in which young adults made more cooperative choices when interacting with friends than with strangers in a similar iterated PD game (Majolo et al., 2006).

### **5.3 Cooperation Declines over Time in Interactions with Selfish Strangers and Friends**

Participants were no less competitive on their first turn with the Selfish Stranger than on their first turn with the TFT Stranger. Again, some participants chose to defect immediately and then to continue to defect throughout the round. Others shifted between defection and cooperation based on the behavior of the Selfish Stranger. When interacting with a Selfish partner, defection served as a means to block that partner from obtaining larger amounts of nickels on every turn. However, defection also prevented the participant from being able to maximize the amount of nickels that they themselves

earned. As a result, participants would benefit from defecting only sparingly in response to a defection by the Selfish Stranger. Excessive retaliation during the round with the Selfish Stranger would further exacerbate the conflict as neither individual would be able to pursue the game's objective. Previous research suggests that young adults are more confrontational than older adults in interpersonal problems (Birditt & Fingerman, 2005; Blanchard-Fields, 2007), and that older adults tend to suppress anger rather than express it openly in a conflict (Blanchard-Fields, 1998; Blanchard-Fields et al., 2004; Gross, Carstensen, Pasupathi, Tsai, Skorpen, & Hsu, 1997). Consistent with these predictions, older adults retaliated less frequently after the Selfish Stranger's first defection. Additionally, when the Selfish Stranger was the first partner that participants played in the Interactive Rounds, older adults were more cooperative than young adults. In other words, older adults were more likely to passively choose to cooperate with the Selfish Stranger after a defection in hopes that the stranger would break this pattern and reciprocate. In the future, a follow-up experiment is needed to replicate this finding for two reasons. First, although the difference in overall cooperation for the Selfish Stranger was significant between Player Order and Age Group, the Age Group x Player Order x Partner Type interaction reported in Experiment 1 was marginal. Second, this single condition was the only one in which young adults were outperformed by older adults and thus can appear to be an aberration (however, see endnote 4).

In terms of the participants' goals, just as when the participants interacted with the TFT Stranger, it can be argued that affiliative goals should not strongly influence the choices of young and older adults when interacting with the Selfish Stranger. Consistent with this assertion, young adults were proportionally more likely to describe competitive



goals than cooperative or ambivalent goals when interacting with the Selfish Stranger. Again, although older adults were more likely to report ambivalent goals than cooperative or competitive goals, they too reported more competitive than cooperative goals when interacting with the Selfish Stranger. Given the similarity between young and older adults competitive approach to the round with the Selfish Stranger, what accounts for older adults' increased willingness to choose self-sacrificial cooperation in the face of conflict with this partner? Two possible explanations emerged from the data.

First, older adults who cooperated more with the Selfish Stranger held marginally more communal values than those who cooperated less. Although this finding is inconsistent with the substantial difference in older adults' self-reported competitive and cooperative goals for the round, it is possible that some of those who reported ambivalent goals were also interested in fostering a positive interaction with the Selfish Stranger. However, this suggestion must be tempered until the qualitative responses are re-examined using a more discriminating coding scheme. Another possible explanation is that older adults were cooperating more because they were trying not to express their frustration with the Selfish Stranger. The literature on emotion regulation and aging demonstrates that older adults will suppress their negative emotions or avoid expressing anger in order to prevent an interpersonal conflict from growing larger (Birditt & Fingerman, 2005; Blanchard-Fields, 1988; Coats & Blanchard-Fields, 2008). Although the participants' emotional reactions to the Selfish Stranger were not directly assessed, the data do indirectly speak to the affective tone created by the simulated interaction. First, in response to being taken advantage of by the Selfish Stranger, older adults used retaliatory defection less frequently than did young adults. By minimizing retaliation

immediately after a defection, older adults might have been attempting to dampen their frustration with the Selfish Stranger. In so doing, they would have been more likely than young adults to have noticed that the Selfish Stranger reciprocated 75% of the time (i.e., defected less than expected). By retaliating less and cooperating more, older adults might have had a subjectively more positive experience than young adults. Additional evidence for possible age differences in the affective tone that developed during the interaction with the Selfish Stranger can be found in the participants' trait impressions. Although not a direct measure of the participants' emotional reactions to each round, trait impression judgments provide a window into the experience that participants had while interacting with their partners during the game. More favorable impressions should emerge from those interactions where participants felt like they were able to make progress towards achieving the game's objective. Consistent with the interpretation that older adults experienced a more positive interaction with the Selfish Stranger, older adults' impressions of the Selfish Stranger were more favorable than were those of young adults.

Finally, it is worth noting that participants also had more favorable impressions of the Selfish Friend than of the Selfish Stranger. Although their interactions with the Selfish Friend were competitive, participants presumably held more affiliative goals when interacting with friends than with strangers. Young and older adults were both more likely to cooperate with the Selfish Friend; however, there was a limit to their willingness to be taken advantage of by their friends in the game. Interestingly, this reluctance to remain their friend's patsy carried over to their attributions, as both young and older adults formed less favorable impressions of their friends when in the Selfish condition than in the TFT condition. Although older adults did hold more favorable impressions of

their friends than did young adults, no age differences emerged in level of cooperation toward the Selfish Friend, suggesting that young and older adults managed conflict with their friends in exactly the same manner.

Overall, members of both age groups displayed cooperative and confrontational behavior during the course of the game. Consistent with the literature, older adults used confrontational retaliation more sparingly than young adults when interacting with Selfish Strangers (Birditt & Fingerman, 2005). However, inconsistent with the literature, older adults were just as antagonistic as young adults when interacting with partners who did not themselves instigate conflict. Of course, young and older adults were both less likely to create an obstacle to their partner's goal when they interacted with friends than with strangers. The everyday problem solving literature is replete with experiments that examine how young and older adults react to problems that develop in their lives (e.g., Thornton & Dumke, 2005). These two experiments examined this as well. However, in addition, these two experiments also examined how likely young and older adults were to create an obstacle for their interaction partner. More research is needed to characterize the underlying motivation of those individuals who create conflicts in close relationships or in interactions with strangers. The participants had nothing to gain from the experiment by competing with their partner other than bragging rights for winning the game. Certainly, some degree of competition is inherent to (or a demand characteristic of) all games, and this is definitely a limitation of the two current experiments. However, problems do arise in social interactions when one party deviates from expectations and a second party has to cope with this deviation. Future research should determine the conditions under which creating obstacles in a relationship (e.g., competition in games)

elicits positive (e.g., pride/ accomplishment) and negative (e.g., guilt/shame) emotions in an aggressor.

#### **5.4 Defining Problem Solving Effectiveness:**

##### **Earning Nickels Versus Controlling the Interaction**

A second goal of these two experiments was to examine how effective young and older adults were at reaching the objective of the game given that they had to interact with another person. The objective of each round was to earn as many nickels as possible. When playing on one's own, each player was responsible for their own success. Here the optimal strategy was simply choosing Door A and collecting 5 nickels on every turn. The Alone Round instantiation of the game thus resembled a standard mathematical reasoning problem, or instrumental everyday problem. Consistent with age-related differences typically found on tests of fluid abilities and on instrumental everyday problem solving tasks, young adults outperformed older adults in this round. By the end of the Alone Round, however, young and older adults both were opening yellow doors at least two-thirds of the time or more. Interestingly, when participants began to play the Interactive Rounds, cooperation immediately dropped to close to 50% when interacting with Strangers and 65% when interacting with Friends early on in the Interactive Rounds, and age-related differences disappeared. Of course, given their superior performance in the Alone Round, young adults' performance dropped more than did that of older adults. What is striking about this finding is that young adults were more likely than older adults to discover the optimal solution for the game in the Alone Round, yet they were not more likely than older adults to apply this strategy when interacting with others, regardless of

whether the partner was a Selfish partner or a TFT partner. This finding suggests that superior cognitive functioning does not serve as a substitute for motivated affiliative goal pursuit in social interactions. In other words, young adults had the right tool for the job, but they did not use this tool for the mutual benefit of both partners in the game.

For both young and older adults, the shift from the Alone Round to the Interactive Round came at a cost. On average, both age groups were less successful in the Interactive Rounds than in the Alone Rounds. However, the costs were less severe when interacting with friends than interacting with strangers. Unlike research on collaborative cognition, the participants did not benefit when the instructions of the game dictated that their success would be dependent upon the choices of a partner (e.g., Cheng & Strough, 2004). This should not be surprising, however, as the participants did not actually communicate nor work directly with (i.e., side-by-side in plain view of one another) their partners. Success in the iterated PD game adapted in these two experiments required that each player trust the intentions of the other player. Any deviation from self-sacrificial cooperation reduced how effective the participants were at meeting the game's objective. This intriguing finding, the drastic drop in cooperation between the end of the Alone Round and the beginning of the Interactive Round, begs the question of what participants were thinking when they shifted their strategy away from a tendency of delayed gratification when playing on their own to one of immediate reward when interacting with others. One possibility is that the participants were unsure of how their partner would behave in the game, so, rather than blindly choosing to cooperate on their first turn, they would wait for their partner to display cooperative intentions first. Of course, this would never happen as the computer programs were specifically designed to

reciprocate cooperation but never to initiate it. This design feature of the computer programing is a limitation of both experiments, as it likely exaggerated the competitive intentions of the participants. To address this limitation, future studies should see how the participants react if (a) the computer-simulated partner goes first in the game and cooperates (Riegelsberger, Sasse, & McCarthy, 2003), and (b) they are purposefully instructed to work with their gaming partner (Burnham, McCabe, & Smith, 2000). In both cases, a more cooperative tone may emerge at the start of the game if either manipulation alleviates the participants' initial skepticism towards their partner's intentions.

In each of the two experiments, participants displayed specific reactions to the two different player types (i.e., TFT and Selfish partners). When interacting with TFT partners, the most effective strategy involved choosing Door A in the first turn and then continuing to open Door A on every other turn. On average, young and older adults displayed equivalent levels of cooperation with TFT partners in each experiment. A substantial number of participants remained consistent throughout the round and only repeated their first choice (i.e., 100% cooperation or defection). Additionally, a number of young and older adults never fully took advantage of the TFT partner's willingness to reciprocate, nor did they attempt to learn over time if their partner would be willing to cooperate for mutual gain. This finding is inconsistent with previous research demonstrating that young adults learn to cooperate with a TFT Stranger over time (Baker & Rachlin, 2001; however, see Biel & Thøgersen, 2007). As alluded to above, young and older adults might have failed to display higher or increasing levels of cooperation toward the TFT Stranger because they did not trust that the stranger would choose self-

sacrificial cooperation. Young and older adults' tendencies toward adopting competitive goals when playing with the TFT Stranger were consistent with this interpretation. Interestingly, young and older adults held more cooperative goals when interacting with friends, and thus levels of cooperation were higher with friends than with strangers. Before one can conclude that participants are generally less cooperative with friends than with strangers, an additional confound needs to be addressed. Participants in Experiment 2 knew who their partners were and had some personal information upon which to base their choices early on in the Interactive Round. In Experiment 1, participants did not have any information about the other player. Based on the data from Experiments 1 and 2, it is not possible to determine if participants were less cooperative because they were interacting with strangers in Experiment 1 or because they were highly skeptical of the intentions of their partners given the complete anonymity of the interaction. Future research can address this concern by manipulating the character of the TFT Stranger (i.e., volunteers at a soup kitchen / steals car emblems off of expensive cars) to determine which traits in a partner best predicts first-choice self-sacrificial cooperation on the part of young and older participants. Alternately, Experiment 1 could be repeated in such a way that multiple strangers are recruited in a single session and made to believe that they are interacting with one another. It is important to keep in mind that, despite having more information in the friend-to-friend interactions, average cooperation never approached ceiling, suggesting that neither age group was completely effective when interacting with the TFT partner.

When interacting with Selfish partners, again the most effective strategy involved choosing Door A in the first turn and in every other turn in which one held a yellow key.

Because the Selfish partners would pass blue keys 25% of the time, the participant would have to choose Door C and pass the Selfish partner a yellow key, despite the conflict, if they were ever to have an opportunity to raise their per-turn average over 2 nickels. As was the case with the TFT partners, some participants immediately chose Door B on their first turn to again avoid the risk of being taken advantage of by their partners. Although these individuals would earn more nickels than their partner, they were less effective than those individuals who did cooperate with the Selfish partner. Interestingly, although the average level of cooperation of young and older adults decreased over time, older adults were more likely than young adults to consistently use self-sacrificial cooperation when interacting with the Selfish Stranger and thus more effective in their interactions with them. One side effect of this difference was that older adults allowed themselves to be taken advantage of more frequently by Selfish Strangers than did young adults. This is consistent with reports which suggest that older adults are more likely to be the victims of scams than are young adults (Mackin, 1994). However, it is important to keep in mind that the participants never verbally communicated with or interacted with the Selfish Stranger face-to-face, so the findings in Experiment 1, although consistent with this claim, should not be taken as evidence for it.

Rather than considering older adults as being more susceptible to scams, perhaps a stronger case can be made for the suggestion that there are some circumstances in which older adults' greater reliance on passive problem solving strategies help them to be more effective at solving interpersonal problems (Blanchard-Fields, 2007). In social interactions with strangers, an older adult may actually benefit from using passive or avoidant strategies (a) if use of such strategies does not come at a substantial or



meaningful loss to the older adult, and (b) if use helps to minimize or eliminate any negative or hostile emotions being directed at or experienced by the older adult. If costs are greater (e.g., elder abuse), use of more direct instrumental (e.g., restraining order) or proactive emotion regulation (e.g., seek consultation or social support) strategies might actually be more effective. However, the obstacles that participants faced in the game conducted in Experiments 1 and 2 posed no serious costs. Of course, this is also a limitation of the two experiments. In everyday life, there are benefits gained by phasing out social interaction with those individuals who are recurrent sources of stress. Previous work suggests that older adults report lower levels of well-being and life satisfaction when they experience interpersonal stressors (Newsom, Nishishiba, Morgan, & Rook, 2003; Rook, 2003) and when they do not prune their social networks to eliminate those partners that frequently create negative interactions (Fingerman & Birditt, 2003; Krause & Rook, 2004). Given the minimal costs associated with using passive, self-sacrificing cooperation in the iterated PD game, it is fair to suggest that older adults were more effective than young adults at managing conflict with the Selfish Stranger.

When interacting with the Selfish Friend, young and older adults were equally effective at managing conflicts. Both cooperated more with the Selfish Friend than the Selfish Stranger, and both reduced their level of cooperation in response to self-interested defections by the Selfish Friend. Even though young and older adults had a track record of positive previous experiences with their friends, they were generally not willing to passively cooperate after every noticeable defection. However, despite the obstacles created by the Selfish Friend, both young and older adults were more likely to report having approached this round with cooperative goals in mind rather than competitive

goals. This is also consistent with the notion that interactions with close others activate affiliative goals that motivate individuals to behave in ways to protect the already established social bond (Hoppmann, et al., in press; Timmers, Fischer, & Manstead, 1998).

## **5.5 Final Summary**

Overall, these two experiments originally sought to provide evidence to support the claim that older adults had more social expertise (i.e., were more likely to flexibly adapt to the demands of various social situations) than young adults. However, with one exception, young and older adults displayed nearly identical patterns of cooperation and were equally effective in managing their interactions with friends and with strangers. Two important differences emerged between young and older adults behavior in these two experiments. First, older adults were more cooperative than young adults when interacting with the Selfish Stranger, particularly when they interacted with this partner in the first of the two Interactive Rounds (in Experiment 1). Second, older adults held more favorable impressions of Selfish partners than did young adults (in Experiments 1 and 2). When considered together, these findings suggest that older adults may choose to implement passive interpersonal strategies in order to lessen the negative impact that conflicts impose upon social interaction and to create as positive as of an experience as possible given the behavior of the Selfish partner. This is consistent with previous research which suggests that older adults may use passive strategies to avoid worsening conflict (Birditt & Fingerman, 2005) and to create an opportunity to minimize negative emotions (Blanchard-Fields, 2007). From an objective standpoint, young and older adults

were nearly equally effective in all conditions. However, from a subjective standpoint older adults may have experienced more positive social interactions than did young adults. Future experiments will need to directly test the impact that interactions such as those simulated in an iterated PD game have on the well-being of young and older adults. Although these two experiments were originally developed so as to provide an objective measure of interpersonal problem solving success, no one clear answer emerged. Young and older adults were equally effective at working towards the game's instrumental goal, and neither consistently displayed more cooperative intentions or behaviors in the game.

Although these two experiments attempted to use an iterated PD paradigm to investigate how young and older adults might react to conflict, the findings reported generated a number of additional questions that future research will need to address. First, in the current experiments, participants were not provided with any information about the character of the strangers with whom they were interacting. Lower levels of cooperation may have resulted as previous research suggests that participants may be reluctant to risk their success in the game to the decisions of a partner who, through such anonymity, is completely unpredictable (Hoffman, McCabe, & Smith, 1996). Any form of positive personal identification is likely to improve early levels of cooperation (Brañas-Garza, 2006; Burnham, 2003; Eckel & Grossman, 1996; Postemes, Spears, Sakhel, & de Groot, 2001). Future research will have to examine whether cooperative trends improve when strangers actually meet each other prior to the start of the session or if providing positive or negative character information about fictional strangers influences young and older adults' initial willingness to cooperate. Similarly, future research may purposefully instruct participants to work together with their gaming

partners to meet the game's objective goal (Burnham et al., 2000). Doing this might help to reduce the participants' skepticism towards their partner's intentions or help to dampen some of the competitiveness that participants displayed when these instructions were absent. Future research might also manipulate the social standing of the fictional stranger (e.g., interact with authority figure or arrange a cross-generational interaction) to see if social factors other than interpersonal closeness influence levels of cooperation in the interaction. Of course, participants in these two experiments never really interacted with their partners during the game. Future studies should also compare the behavior of strangers and friends who interact with one another in separate rooms to the behavior of strangers and friends who actually interact with one another in the same room (e.g., Eckel & Wilson, 2006). Previous research suggests that a group of individuals may require more time to effectively work together from long distances using computers because the rate of information uptake about one's partners is reduced through this means of interacting (Wilson, Straus, & McEvily, 2006).

## CHAPTER 6

### ENDNOTES

<sup>1</sup> Of the 153 participants, 17 (11%) were excluded from data analysis. Six participants were excluded being they did not believe that they were playing with real people in the Interactive Rounds (5 young adults and 1 older adult). Ten participants (5 young and 5 older adults) were excluded because they served as pilot experiment participants to calibrate the timing of the decisions made by the computer partners. Finally, one older adult was excluded because E-prime failed to record a data file. After these exclusions, the total sample size for Experiment 1 was  $n = 136$ . Participant assignment was counterbalanced across the order with which individuals played the two stranger programs. Participants played the Tit-for-Tat player first in the first counterbalance, but played the Selfish player first in the second counterbalance. Overall, there were 33 young adults (18 men and 15 women) and 33 older adults (14 men, 18 women, and 1 unspecified) assigned to the first counterbalance and 38 young adults (23 men and 15 women) and 32 older adults (15 men and 17 women) assigned to the second counterbalance.

<sup>2</sup> Although the optimal strategy involved choosing Door A on every turn, it was not uncommon to deviate from this pattern. Each deviation reduced the average number of nickels earned per turn below the optimal average of 5 and more toward 4 nickels per turn (e.g., Doors A-B-C). The example mentioned, A-A-B-C, yielded an average of 4.25 nickels per turn. If a participant chose the combination A-B-C-A-B-C... then the Selfish Stranger would have still been able to instigate conflict. If the participant had chosen to use the strategy B-C-B-C-B-C... then they would have averaged 3.5 nickels per turn. More importantly, it would have only been possible for such a participant to experience 4 of the 8 possible defections. At the end of the Alone Round, consistent use of the ideal strategy was preferred, but consistent use of a slightly less ideal strategy was still acceptable and did not hinder the participant from noticing the Selfish Stranger's self-interested behavior.

<sup>3</sup> A difference score was calculated for each participant's change in average level of cooperation (i.e., choosing Doors A or C) between the last four turns of the Alone Round and the first four turns of the Interactive Rounds. Consistent with the findings reported above, young adults ( $M = 0.42$ ,  $SE = 0.06$ ) displayed a larger average decrease in cooperation between the two rounds than did older adults ( $M = 0.18$ ,  $SE = 0.05$ ),  $t(134) = 3.13$ . For young adults, the size of this drop was marginally related to a number of individual difference variables. Specifically, larger declines in cooperation for young adults were associated (a) with being less capable of talking to a third party about a conflict ( $r = -.21$ ,  $n = 70$ ,  $p < .09$ ), (b) with being less capable of avoiding a person with whom a conflict has developed ( $r = -.20$ ,  $n = 70$ ,  $p < .10$ ), (c) with having more difficulty working with someone to find a mutually satisfying solution to a conflict ( $r = -.20$ ,  $n = 69$ ,  $p < .10$ ), and (d) with having a less expansive view of one's future time ( $r = -.20$ ,  $n =$

70,  $p < .10$ ). For older adults, larger declines in cooperation between the Alone and Interactive Rounds were significantly ( $p < .05$ ) associated (a) with having greater inductive reasoning ability ( $r = .28$ ,  $n = 64$ ), (b) with being less capable of putting an interpersonal disagreement out of one's mind ( $r = -.25$ ,  $n = 64$ ), (c) with holding fewer communal values ( $r = -.27$ ,  $n = 62$ ), and (d) with being less conscientious ( $r = -.36$ ,  $n = 64$ ). Also, larger declines in cooperation between the Alone and Interactive Rounds were marginally associated with having higher verbal ability ( $r = .22$ ,  $n = 64$ ,  $p < .09$ ) and holding fewer agentic values ( $r = -.23$ ,  $n = 62$ ,  $p < .07$ ) for older adults.

<sup>4</sup> A post-hoc power analysis was conducted on the marginal Stranger Type x Player Order x Age Group interaction using G\*Power 3 software (Faul, Erdfelder, Lang, & Buchner, 2007). This software estimated the effect size for the analysis at 0.15, which is considered to be a medium effect size using Cohen's standards for multivariate analysis of variance (at 0.80 level of power; Cohen, 1992). Power ( $1-\beta$ ) was estimated to be 0.84 at  $\alpha = .05$  (or 0.64 at  $\alpha = .01$ ). This suggests that there is a 16% chance of falsely rejecting the null hypothesis for this interaction. The data were re-analyzed using only those individuals who chose Doors A or C on two out of every three turns in the last quarter (i.e., last eight turns) of the Alone Round (66.7%; Young  $n = 54$ , Old  $n = 41$ ). Once again, the Stranger Type x Player Order x Age Group interaction was marginal,  $F(1,91) = 3.88$ ,  $p < .06$ ,  $\eta^2 = .041$ . Once again, older adults cooperated more with the Selfish Stranger when they interacted with the Selfish Stranger first ( $M = 0.44$ ,  $SE = 0.06$ ) as opposed to after the TFT Stranger ( $M = 0.24$ ,  $SE = 0.06$ ),  $t(39) = 2.32$ . Additionally, older adults ( $M = 0.44$ ,  $SE = 0.06$ ) in this counterbalance (i.e., Selfish Stranger first) cooperated more with the Selfish Stranger than did young adults ( $M = 0.23$ ,  $SE = 0.05$ ),  $t(52) = 2.65$ . A power analysis conducted on the three-way interaction resulting from this additional analysis estimated power to be 0.91 at  $\alpha = .05$  (or 0.76 at  $\alpha = .01$ ). This means that there is a 9% chance of falsely rejecting the null hypothesis for this interaction. Overall, these additional analyses suggest that there is sufficient power to detect the reported marginal three-way interaction (at power level = 0.80), and that the power for detecting this interaction is improved by only focusing on those participants who were consistently cooperating at the end of the Alone Round.

<sup>5</sup> It is worth noting that the above findings fail to support two additional a priori predictions. First, contrary to expectations, young and older adults displayed equivalent levels of cooperation with the TFT Stranger,  $t(134) = .86$ , *ns*. In fact, in looking at turn-by-turn behavior, the proportions of young and older adults who created conflict with the intention of getting ahead (i.e., did not later choose C to balance scores) when interacting with the TFT Stranger did not differ (Hypothesis 5),  $\chi^2(1) = .001$  ( $n = 97$ ,  $p = .97$ ). Second, although Player Order did interact Stranger Type and Age Group in the ANOVA examining overall cooperation in the Interactive Rounds, there was no evidence that young adults would cooperate less with the TFT Stranger if they interacted with this stranger after interacting with the Selfish Stranger rather than interacting with the TFT Stranger first (Hypothesis 8),  $t(69) = .20$ , *ns*. Contrary to expectations, young adults did not hold a grudge against the TFT Stranger after first playing with the Selfish Stranger.

<sup>6</sup> The three categories were coded relative to degree of cooperation, with 100% Defection = 0, “Somewhere in between” = 0.5, and 100% Defection = 1. The Wilcoxon signed-rank test compares repeated measures scores to determine which of a pair is larger. Equivalent scores are called ties. The resulting statistic indicates which variable had a higher average rank across all members of a sample. For more information about this test, see Wilcoxon (1945) or p. 188 of Higgins (2004).

<sup>7</sup> Contrary to predictions (Hypothesis 9), Player Order did not impact the aggregate positive trait attributions of young adults. Young adults did not rate the TFT Stranger less favorably if they played this stranger after the Selfish Stranger rather than before,  $t(69) = 0.03$ , *ns*. Also, it is possible that those individuals who had more difficulty with the game (i.e., older adults more so than young adults) might rate the Selfish Stranger more favorably than those who did well in the Alone Round and were subsequently taken advantage of in the Selfish Round. To examine this possibility, a 2 (Age Group) x 2 (Stranger Type) x 2 (Player Order) mixed model ANOVA was conducted on the aggregate positive attribution scores of those individuals who chose Doors A or C at least two-thirds of the time during the last quarter of the Alone Round. Once again, main effects of Age Group,  $F(1,88) = 18.75$ ,  $\eta^2 = .18$ , and Stranger Type,  $F(1,88) = 31.55$ ,  $\eta^2 = .26$ , were qualified by a Stranger Type x Age Group interaction,  $F(1,88) = 13.84$ ,  $\eta^2 = .14$ . Older adults held more favorable impressions of the Selfish Stranger than did young adults (Young TFT:  $M = 85.0$ ,  $SE = 2.0$ ; Old TFT:  $M = 86.0$ ,  $SE = 2.3$ ; Young Selfish:  $M = 65.7$ ,  $SE = 1.8$ ; Old Selfish:  $M = 82.1$ ,  $SE = 2.0$ ). Overall, these results are identical to those reported above; older adults held more favorable impressions of strangers than did young adults, particularly the Selfish Stranger.

<sup>8</sup> Examples of *cooperative* statements included: “Keep choosing Door A and hope the other person does as well”, “Both participants would essentially have to cooperate and award each other yellow keys”, and “Click only on Door A”; Examples of *competitive* statements included: “Try to give the other person a blue key which is worth less”, “Pick a door that will give your partner a key to a door with fewer nickels”, and “Beat my opponent and get the most”; Examples of *neither cooperative nor cooperative* statements included: “Try to find a repetitive sequence”, “Try to get as many nickels as possible”, and “To be alert to pick the right key from the right door”. It is important to note that the responses that participants provided before and after the Interactive Rounds were temporally different from one another. Before the Interactive Rounds, participants were predicting how one should behave to maximize their nickels. After the Interactive Rounds, participants indicated the goal that they held in mind during the round. Given this difference, participants would sometimes offer “wait and see” types of responses. These responses were coded as ambivalent. Unfortunately, all responses that included task irrelevant information were also coded as ambivalent. As a result, the ambivalent category includes items that reflect partner-contingent strategies, instrumental strategies (e.g., maximize nickels), and non-codeable responses. Future coding schemes will have to further tease apart the responses beyond the three categories used here (and in Experiment 2) in order to draw comparisons between the before and after responses. Within-subjects analyses reported here are limited to responses provided to the same

open-ended question asked of participants immediately after each of the Interactive Rounds.

<sup>9</sup> Age differences in each of the social individual difference measures are characterized in Appendix A for each experiment. For the Alone Round, tertiles were calculated separately on percentage of cooperation for each age group. Although the top and bottom groups did not differ in cognitive performance for young adults, the two groups did differ for older adults. Specifically, older adults in the top tertile of the Alone Round had higher mean scores on inductive reasoning (Top:  $M = 18.8$ ,  $SE = 1.1$ ; Bottom:  $M = 14.6$ ,  $SE = 1.1$ ) and verbal ability (Top:  $M = 25.3$ ,  $SE = 1.7$ ; Bottom:  $M = 19.6$ ,  $SE = 1.5$ ),  $t(43) = 2.65$  and  $t(43) = 2.52$ , respectively. The top tertile was also more educated (Top:  $M = 7.8$ ,  $SE = 0.3$ ; Bottom:  $M = 5.5$ ,  $SE = 0.5$ ) and reported better overall health (Top:  $M = 3.9$ ,  $SE = 0.2$ ; Bottom:  $M = 3.3$ ,  $SE = 0.2$ ),  $t(39) = 3.95$  and  $t(41) = 2.34$ , respectively. The following were the demarcations for the tertiles for young and older adults when interacting with the TFT Stranger: Young 0.0 ( $n = 28$ ), 0.0001-0.9999 ( $n = 19$ ), and 1.0 ( $n = 24$ ); Old  $< 0.1251$  ( $n = 22$ ), 0.1251-0.7187 ( $n = 21$ ), and  $> 0.7187$  ( $n = 22$ ). The following were the demarcations for the tertiles for young and older adults when interacting with the Selfish Stranger: Young  $< 0.0314$  ( $n = 24$ ), 0.0314-0.2812 ( $n = 17$ ), and  $> 0.2812$  ( $n = 30$ ); Old  $< 0.1564$  ( $n = 24$ ), 0.1564-0.4687 ( $n = 18$ ), and  $> 0.4687$  ( $n = 23$ ).

<sup>10</sup> The use of a median- or tertile-split to divide a sample into equally-sized groups along a normally-distributed continuous variable can be problematic from a methodological stand point (MacCallum, Zhang, Preacher, & Rucker, 2002; Owen & Froman, 2005; Preacher, Rucker, MacCallum, & Nicewander, 2005). Two limitations to this approach are (1) that variance found in the middle of the distribution is discarded as error variance, and (2) that the analyst assumes that the groups that are created accurately capture distinct differences between participants rather than creating an artificial dichotomy that does not truly reflect the response distribution. For the current experiment, the distributions of the average cooperation displayed in the Interactive Rounds were not normal (especially those for the TFT Stranger which were bipolar). Although some explanatory variance is lost by dividing the sample into tertiles, doing so is justified by the distinctiveness of the groups that result. Relative to the TFT Stranger distributions, the tertile-split captured the tendencies for many participants to cooperate or to defect 100% of the time. With respect to the Selfish Stranger distributions, although these distributions were not normal, a fair number of participants did fall in the middle tertile. Some response variance was ignored when this middle tertile was excluded from the above analyses. To address this limitation, nonparametric rank-order correlations (Spearman's  $\rho$ ,  $\rho$ ) were computed for average cooperation with each stranger type and the individual difference measures (i.e., social values and goals and the cognitive measures). When young adults interacted with the TFT Stranger, there was a significant positive relationship between average cooperation and how difficult it was for the participant to put disagreements out of their mind ( $\rho = .26$ ,  $n = 69$ ) and a marginal negative relationship between cooperation and how much difficulty the participants felt when it came to disengaging from a goal that was being blocked by someone else ( $\rho = -.22$ ,  $n = 70$ ,  $p < .07$ ). When young adults interacted with the Selfish Stranger, there was a significant negative relationship between average cooperation and competitiveness level



( $\rho = -.25, n = 70$ ) and a marginal negative relationship between cooperation and extraversion level ( $\rho = -.22, n = 70, p < .07$ ). When older adults interacted with the TFT Stranger, there was a significant positive relationship between average cooperation and one's tendency to suppress one's emotions ( $\rho = .29, n = 64$ ), a marginal positive relationship between cooperation and one's conscientiousness level ( $\rho = .21, n = 64, p < .10$ ), and a marginal negative relationship between cooperation and how much difficulty the participants felt they would have in finding a mutually satisfying solution to a conflict with someone else ( $\rho = -.21, n = 64, p < .10$ ). Finally, when older adults interacted with the Selfish Stranger, there was a significant positive relationship between average cooperation and how difficult participants found it would be to blame themselves for a disagreement ( $\rho = .26, n = 64$ ), a marginal positive relationship between cooperation and the number of communal values endorsed by participants ( $\rho = .22, n = 62, p < .09$ ), and a marginal negative relationship between cooperation and how likely participants were to try to regulate or change their partners in a conflict ( $\rho = -.22, n = 63, p < .09$ ).

<sup>11</sup> Of the 147 participants, data for the Interactive Round were not saved by E-prime for three young adults, all of which were assigned to the Selfish Friend condition. The Alone Round data for these participants were included in analyses. Overall, there were 38 young adults (21 men and 17 women) and 36 older adults (15 men and 21 women) assigned to the TFT Friend condition. There were 35 young adults (20 men and 15 women) and 35 older adults (14 men and 21 women) assigned to the Selfish Friend condition.

<sup>12</sup> When comparing Experiment 1 with Experiment 2, only the participants' first interaction from the two Interactive Rounds were used from Experiment 1.

<sup>13</sup> A 2 (Age Group) x 2 (Experiment: Strangers versus Friends) x 2 (Partner Type) x 8 (Time) mixed model ANOVA conducted on the participants' Alone Round cooperation proportions revealed that main effects of Age Group,  $F(1,275) = 56.88, \eta^2 = .17$ , and Partner Type,  $F(1,275) = 4.26, \eta^2 = .02$ , and Time,  $F(7,1925) = 11.77, \eta^2 = .04$ , were qualified by a Time x Age Group interaction,  $F(7,1925) = 8.75, \eta^2 = .03$ . This interaction was driven by older adults' significant improvement in the game over time. For example, the contrast between older adults' first and last 4-turn blocks revealed a significant difference in performance,  $t(135) = 4.21 (M_{\text{diff}} = 0.12, SE = 0.03)$ . As mentioned previously mentioned for both experiments, young adults remained stable in their performance and outperformed older adults at every time point during the Alone Round. The main effect of Partner Type occurred because, across experiments, participants assigned to play the TFT Player ( $M = 0.76, SE = 0.02$ ) in the interactive round (first in E1) had slightly less success in the Alone Round than those assigned to play the Selfish Player (first in E1;  $M = 0.81, SE = 0.02$ ).

<sup>14</sup> E-prime failed to save data in the Interactive Rounds for three of the young adults. All three of these players were assigned to the Selfish Friend condition. Although excluded from analyses of the Interactive Rounds, they were included in analyses of the Alone Round.

<sup>15</sup> A difference score was calculated for each participant's change in average level of cooperation (i.e., choosing Doors A or C) between the last four turns of the Alone Round and the first four turns of the Interactive Round. Consistent with the findings reported above, young adults ( $M = 0.26$ ,  $SE = 0.05$ ) displayed a larger average decrease in cooperation between the two rounds than did older adults ( $M = 0.09$ ,  $SE = 0.04$ ),  $t(142) = 2.48$ . For young adults, large declines in cooperation were significantly ( $p < .05$ ) associated (a) with reduced verbal ability ( $r = -.26$ ,  $n = 73$ ), (b) with increased self-reported difficulty in flexibly implementing coping strategies ( $r = .24$ ,  $n = 69$ ), (c) with a reduced capacity for ( $r = -.33$ ,  $n = 69$ ) and increased difficulty in ( $r = .24$ ,  $n = 69$ ) giving into the demands of others, (d) with a reduced tendency to hold generative motives ( $r = -.32$ ,  $n = 69$ ), and (e) with being less open to new experiences ( $r = -.24$ ,  $n = 69$ ). For older adults, larger declines in cooperation between the Alone and Interactive Rounds were significantly ( $p < .05$ ) associated (a) with having greater processing speed ( $r = .28$ ,  $n = 71$ ) and verbal ability ( $r = .24$ ,  $n = 71$ ), (b) with being more capable of expressing a range of emotions when interacting with others ( $r = .27$ ,  $n = 69$ ), (c) with being less capable of ( $r = -.32$ ,  $n = 69$ ) and having more difficulty with putting an interpersonal disagreement out of one's mind ( $r = .24$ ,  $n = 69$ ), and (d) with being less able to disengage from a goal that is being blocked by a partner in a conflict ( $r = -.40$ ,  $n = 69$ ).

<sup>16</sup> Although relationship quality was originally predicted to be positively related to how participants would behave early on in the Interactive Round, items from the friendship quality questionnaire were only minimally predictive. Young adults' friendship quality responses in no way predicted behavior early on in the game in either the TFT Friend or Selfish Friend conditions. For older adults in the TFT Friend condition, friendship length was positively related to the average proportion of cooperation in the first quarter (i.e., turns 1-8) of the game,  $r(34) = .41$ ,  $p < .05$ . For older adults in the Selfish Friend condition, "how well the participant felt that they know their friend" and "how well the participant feels that their friend knows them" were both negatively related to cooperation in the first quarter of the game,  $r(34) = -.37$  and  $r(34) = -.35$ , respectively ( $p$ 's  $< .05$ ).

<sup>17</sup> Age differences in each of the social individual difference measures are characterized in Appendix A for each experiment. For the Alone Round, tertiles were calculated separately on percentage of cooperation for each age group. The top and bottom tertile groups did not differ from one another in cognitive performance for either the young or older adults. The following were the demarcations for the tertiles for young and older adults when interacting with the TFT Friend: Young  $< 0.5314$  ( $n = 13$ ),  $0.5314-0.9999$  ( $n = 8$ ), and  $1.0$  ( $n = 17$ ); Old  $< 0.4687$  ( $n = 12$ ),  $0.4687-0.9999$  ( $n = 10$ ), and  $1.0$  ( $n = 14$ ). The following were the demarcations for the tertiles for young and older adults when interacting with the Selfish Friend: Young  $< 0.1564$  ( $n = 13$ ),  $0.1564-0.4687$  ( $n = 10$ ), and  $> 0.4687$  ( $n = 12$ ); Old  $< 0.1564$  ( $n = 12$ ),  $0.1564-0.4687$  ( $n = 11$ ), and  $> 0.4687$  ( $n = 12$ ).

<sup>18</sup> As mentioned previously for the results of Experiment 1, the use of a tertile-split to divide a sample into equally-sized groups along a variable can be problematic because variance from the middle region of the distribution is discarded (MacCallum et

al., 2002; Preacher et al., 2005). Also, interpretations of differences that emerge from a tertile-split assume that the extreme groups that are created accurately capture distinct differences between participants. As with Experiment 1, the distributions of the average cooperation displayed in the Interactive Rounds were not normal. Once again, the distributions of average cooperation with the TFT Friend were bipolar, whereas those for the Selfish Friend were positively skewed. Relative to the TFT Friend distributions, the tertile-split captured the tendencies for many participants to cooperate or to defect 100% of the time. With respect to the Selfish Friend distributions, although these distributions were not normal, a fair number of participants did fall in the middle tertile. Some response variance was ignored when this middle tertile was excluded from the above analyses. To address this limitation, nonparametric rank-order correlations (Spearman's  $\rho$ ,  $\rho$ ) were computed for average cooperation with each friend type and the individual difference measures (i.e., social values and goals and the cognitive measures). When young adults interacted with the TFT Friend, there was a significant positive relationship between average cooperation and self-reported generative intentions ( $\rho = .38, n = 36$ ), a significant negative relationship between average cooperation and how capable they felt they were at standing their ground in a disagreement ( $\rho = -.34, n = 36$ ), and a significant negative relationship between average cooperation and the endorsement of implementing self-protective social comparisons as a means of coping with conflict ( $\rho = -.39, n = 36$ ). When young adults interacted with the Selfish Friend, cooperation had significantly negative relationships with neuroticism ( $\rho = -.38, n = 33$ ) and how difficult participants felt it would be to blame themselves for an interpersonal conflict ( $\rho = -.51, n = 36$ ). When interacting with the Selfish Friend, young adults' average cooperation was significantly positively related to self-reported generative intentions ( $\rho = .43, n = 33$ ), to a tendency to endorse emotion regulation strategies geared towards reappraisal ( $\rho = .39, n = 33$ ), to the capacity to use many types of coping strategies when a conflict emerges in a relationship ( $\rho = .38, n = 33$ ), to being capable of giving into the demands of others ( $\rho = .49, n = 33$ ), and to using self-protective intra-individual comparisons when faced with conflict ( $\rho = .42, n = 33$ ). When older adults interacted with the TFT Friend, cooperation was significantly positively related to agreeableness ( $\rho = .38, n = 35$ ). Cooperation was also positively related to how difficult older adults thought it would be to stand their ground in a disagreement ( $\rho = .46, n = 35$ ) and negatively related to how capable older adults felt they were at standing their ground ( $\rho = .46, n = 35$ ). Finally, when older adults interacted with the Selfish Friend, average cooperation was only marginally positively related to how capable older adults thought they would be at getting their partner to concede during a disagreement ( $\rho = .33, n = 34, p < .06$ ) and marginally negatively related to the older adults' perceived quality of their relationship with their friend ( $\rho = -.33, n = 34, p < .06$ ). Perhaps the most consistent finding across analyses (i.e., tertile-split and nonparametric rank order correlations) was that those young adults who reported more generative intentions for their relationships were more likely to cooperate with their friends.

<sup>19</sup> The only effects that emerge when gender is added to this mixed model ANOVA are a Partner Type x Gender interaction,  $F(1,263) = 5.34, \eta^2 = .02$ , and a marginal Partner Type x Gender x Age Group interaction,  $F(1,138) = 3.34, \eta^2 = .01, p < .07$ . Separate 2 (Gender) x 2 (Partner Relation) x 2 (Partner Type) x 8 (Time) mixed

model ANOVAs were conducted on young and older adults' cooperation percentages in the Interactive Round. For older adults, no significant effects involving gender emerged. For young adults, a significant Gender x Partner Type interaction emerged,  $F(1,136) = 8.67, \eta^2 = .06$ . (TFT Female:  $M = 0.74, SE = 0.06$ ; TFT Male:  $M = 0.48, SE = 0.06$ ; Selfish Female:  $M = 0.23, SE = 0.07$ ; Selfish Male:  $M = 0.32, SE = 0.05$ )

<sup>20</sup> A 2 (Age Group) x 2 (Partner Relation) between-subjects ANOVA conducted on the participants average percentage of cooperation over the first four turns of the Interactive Round with the TFT partners displayed a significant main effect of Partner Relation,  $F(1,136) = 5.34, \eta^2 = .04$ . Consistent with age non-specific predictions (Hypothesis 5), participants were more likely to cooperate with the TFT Friend ( $M = 0.65, SE = 0.05$ ) at this early point in the game than with the TFT Stranger ( $M = 0.49, SE = 0.05$ ). Participants who interacted with Selfish Friends ( $M = 2.93, SE = 0.31$ ) experienced the same number of noticeable defections as those interacting with Selfish Strangers ( $M = 2.37, SE = 0.28$ ),  $t(138) = 1.34, ns$ . Also, after the first noticeable defection, participants (both young and old) (a) passed a blue key back to the Selfish partner for the same number of consecutive turns regardless of whether this partner was a friend ( $M = 6.39, SE = 1.26$ ) or a stranger ( $M = 5.06, SE = 1.21$ ),  $t(105) = 0.75, ns$ , and (b) were just as likely (~33% of the time) to immediately pass a blue key to their partner after having just broken the first sequence of defection started by that partner (i.e., "get even") if that partner was a friend or a stranger, Young:  $\chi^2(1) = 1.09, n = 30, p > .29$ ; Old:  $\chi^2(1) = 0.01, n = 38, p > .91$ .

<sup>21</sup> It is worth noting that, for older adults, it appears that fewer ambivalent responses are offered before the start of the Interactive Round with friends than are offered with strangers. Instead, more cooperative responses are provided. As was mentioned earlier, it is difficult to characterize participants as being more or less cooperative or competitive using the ambivalent responses as a guide, as these responses include a wide range of content. However, here it appears that older adults' self-nominated ideal strategies were more cooperative when they were interacting with friends than when interacting with strangers.

## APPENDIX A

### *Descriptions of Individual Difference Measures*

Below are descriptions of the individual difference measures that were included in the packet of questionnaires that participants completed prior to the laboratory sessions in both Experiments 1 and 2 (abbreviated E1 and E2 when describing internal consistency below).

*Interpersonal Flexibility.* This 32-item measure was adapted from the Functional Flexibility Inventory (Paulhus & Martin, 1988), and it asked participants to consider 16 positive and negative traits that are thought to be important during interpersonal interactions. Participants indicated the degree to which they were capable of displaying each trait and how difficult it would be to display each trait. (Capable: E1  $\alpha = 0.75$ , E2  $\alpha = 0.77$ ; Difficulty: E1  $\alpha = 0.84$ , E2  $\alpha = 0.83$ )

*Coping Flexibility.* This 18-item survey asked participants to indicate the extent to which they were capable (E1  $\alpha = 0.56$ , E2  $\alpha = 0.49$ ) of using 9 different coping styles and how difficult (E1  $\alpha = 0.64$ , E2  $\alpha = 0.54$ ) it would be to use each. This measure was adapted from a coping style inventory developed by Sorkin and Rook (2006) to examine global reactivity to problems. Given the low internal consistency of these two forms in both experiments, exploratory analyses included the item aggregates as well as the individual items.

*Emotion Regulation Questionnaire.* This 10-item survey assesses a person's tendency to use antecedent-focused (i.e., reappraisal) or response-focused (i.e.,

suppression) emotion regulation when managing emotions (Gross & John, 2003).

(Reappraisal: E1  $\alpha = 0.79$ , E2  $\alpha = 0.70$ ; Suppression: E1  $\alpha = 0.72$ , E2  $\alpha = 0.69$ )

*Loyola Generativity Scale.* This 20-item scale assesses the degree to which a person is concerned with being generative (McAdams & de St. Aubin, 1992). (E1  $\alpha = 0.86$ , E2  $\alpha = 0.85$ )

*Future Time Perspective.* This 10-item scale assesses a participant's view of how much time they have left in life (Lang & Carstensen, 2002). (E1  $\alpha = 0.91$ , E2  $\alpha = 0.90$ )

*Interpersonal Trust Scale.* This 15-item scale measures the degree to which a person can rely on others to act based on their word (Rotter, 1967). (E1  $\alpha = 0.76$ , E2  $\alpha = 0.72$ )

*Interpersonal Control Strivings.* This 14-item scale assesses the global use of selective and compensatory control to maintain harmony in relationships (Sorkin & Rook, 2004). The selective control (SC) subscale includes items that assess how a person decides to invest personal time and energy into maintaining relationship harmony (E1  $\alpha = 0.77$ , E2  $\alpha = 0.74$ ). The compensatory primary control (CPC) subscale includes items that examine the extent to which a person asks others to be involved in helping resolve relational problems (E1  $\alpha = 0.72$ , E2  $\alpha = 0.71$ ). The compensatory secondary control (CSC) subscale includes items that assess a person's strategies for internally regulating their emotions or disengaging from unattainable goals (E1  $\alpha = 0.41$ , E2  $\alpha = 0.48$ ). Given the low internal consistency of the CSC subscale, each of the four items (i.e., goal disengagement, self-protective attribution, self-protective social comparison, and self-protective intraindividual comparison) were considered separately in exploratory analyses. Finally, two additional items were included to examine participants'

endorsement of strategies that try to regulate (e.g., train or direct) the behavior of the individual with whom they are directly in conflict (E1  $\alpha = 0.78$ , E2  $\alpha = 0.72$ ).

*Internal-External Locus of Control Scale.* This 29-item scale assesses the extent to which outcomes are attributed to internal and external forces (Rotter, 1966). (E1  $\alpha = 0.71$ , E2  $\alpha = 0.76$ )

*Measures of Agentic and Communal Values.* The 24-item Personal Attributes Questionnaire (Ward, Thorn, Clements, Dixon, & Sanford, 2006) was used to assess the extent to which a person holds agentic (E1  $\alpha = 0.73$ , E2  $\alpha = 0.76$ ) and communal values (E1  $\alpha = 0.78$ , E2  $\alpha = 0.83$ ). The questionnaire also includes an Emotional Vulnerability subscale that taps emotional expressivity and a need for social encouragement (E1  $\alpha = 0.65$ , E2  $\alpha = 0.67$ ).

*Competitiveness Index.* This 20-item scale assesses interpersonal competitiveness (Smither & Houston, 1992), and it has previously been used in conjunction with assessing individual differences in competitiveness in a PD game (Houston, Kinnie, Lupo, Terry, & Ho, 2000). (E1  $\alpha = 0.86$ , E2  $\alpha = 0.86$ )

*Big Five Inventory.* This 10-item scale is the short version of the BFI-44 (John, Donahue, & Kentle, 1991) and it includes 2 items for each of the big five dimensions (i.e., neuroticism, extroversion, openness to experience, conscientiousness, and agreeableness). The internal consistency for each dimension was quite low (E1  $\alpha$ 's 0.29 to 0.57, E2  $\alpha$ 's 0.18 to 0.63).

#### *Age-Related Differences in Social Individual Difference Measures*

*Experiment 1.* Independent samples t-tests were conducted to compare young and older adults on each of the above social individual difference measures. Significant differences emerged on the Functional Flexibility Index for both the Capable (Young:  $M = 83$ ,  $SE = 1.0$ ; Old:  $M = 79$ ,  $SE = 1.4$ ) and Difficulty (Young:  $M = 49$ ,  $SE = 1.4$ ; Old:  $M = 57$ ,  $SE = 2.0$ ) forms,  $t(130) = 2.47$  and  $t(131) = 3.28$ , respectively. Differences also emerged on the items of the Index of Coping assessing (a) how capable individuals are of putting a disagreement out of their mind,  $t(132) = 2.06$  (Young:  $M = 3.5$ ,  $SE = 0.2$ ; Old:  $M = 4.0$ ,  $SE = 0.2$ ), (b) how capable one is to make someone else concede when a problem arises in a relationship,  $t(132) = 2.00$  (Young:  $M = 4.6$ ,  $SE = 0.1$ ; Old:  $M = 4.2$ ,  $SE = 0.2$ ), and (c) how difficult it is for one to keep their distance from or avoid the other person involved in a problem,  $t(131) = 2.20$  (Young:  $M = 3.3$ ,  $SE = 0.1$ ; Old:  $M = 2.7$ ,  $SE = 0.2$ ). Older adults reported more generative intentions than did young adults,  $t(132) = 2.45$  (Young:  $M = 57$ ,  $SE = 1.0$ ; Old:  $M = 62$ ,  $SE = 1.3$ ), whereas young adults reported having a more expansive future time perspective than did older adults,  $t(132) = 8.96$  (Young:  $M = 57$ ,  $SE = 0.9$ ; Old:  $M = 41$ ,  $SE = 1.6$ ). Relative to young adults, older adults endorsed using more self-protective intraindividual comparisons (Interpersonal Control Strivings - Compensatory Secondary Control),  $t(131) = 2.79$  (Young:  $M = 2.4$ ,  $SE = 0.1$ ; Old:  $M = 2.9$ ,  $SE = 0.1$ ). Relative to young adults, older adults had a more internal locus of control,  $t(131) = 3.03$  (Young:  $M = 10.3$ ,  $SE = 0.4$ ; Old:  $M = 8.5$ ,  $SE = 0.4$ ). Older adults also reported having more agentic values,  $t(130) = 2.55$  (Young:  $M = 3.8$ ,  $SE = 0.1$ ; Old:  $M = 4.0$ ,  $SE = 0.1$ ), and more communal values,  $t(130) = 2.25$  (Young:  $M = 4.0$ ,  $SE = 0.1$ ; Old:  $M = 4.2$ ,  $SE = 0.1$ ), than young adults. In terms of personality dimensions, older adults were more agreeable (Young:  $M = 7.1$ ,  $SE = 0.2$ ; Old:  $M = 8.1$ ,  $SE = 0.2$ ) and



more conscientious (Young:  $M = 7.3$ ,  $SE = 0.2$ ; Old:  $M = 8.7$ ,  $SE = 0.2$ ) than young adults,  $t(132) = 3.75$  and  $t(132) = 4.94$ , respectively, and young adults were more marginally more neurotic than older adults,  $t(132) = 1.82$ ,  $p < .09$  (Young:  $M = 5.3$ ,  $SE = 0.2$ ; Old:  $M = 4.7$ ,  $SE = 0.3$ ).

*Experiment 2.* Independent samples t-tests were conducted to compare young and older adults on each of the above social individual difference measures. Significant differences emerged on the Functional Flexibility Index for both the Capable (Young:  $M = 85$ ,  $SE = 1.2$ ; Old:  $M = 79$ ,  $SE = 1.2$ ) and Difficulty (Young:  $M = 49$ ,  $SE = 1.4$ ; Old:  $M = 56$ ,  $SE = 1.8$ ) forms,  $t(139) = 3.90$  and  $t(138) = 3.32$ , respectively. Young adults also reported being marginally more capable than older adults at using a variety of coping functions,  $t(139) = 1.96$ ,  $p < .06$  (Young:  $M = 43$ ,  $SE = 0.6$ ; Old:  $M = 41$ ,  $SE = 0.7$ ). Relative to older adults, young adults reported higher emotional suppression scores,  $t(139) = 2.43$  (Young:  $M = 3.7$ ,  $SE = 0.1$ ; Old:  $M = 3.2$ ,  $SE = 0.1$ ), a more expansive future time perspective,  $t(139) = 8.32$  (Young:  $M = 56$ ,  $SE = 1.0$ ; Old:  $M = 42$ ,  $SE = 1.5$ ), less interpersonal trust,  $t(139) = 2.04$  (Young:  $M = 3.2$ ,  $SE = 0.1$ ; Old:  $M = 3.4$ ,  $SE = 0.1$ ), and marginally fewer generative intentions,  $t(139) = 1.79$ ,  $p < .08$  (Young:  $M = 58$ ,  $SE = 1.1$ ; Old:  $M = 61$ ,  $SE = 1.0$ ). When faced with interpersonal problems, young adults were more marginally likely than older adults to endorse strategies geared at attempting to regulate a partner's behavior,  $t(139) = 1.69$ ,  $p < .10$  (Young:  $M = 2.3$ ,  $SE = 0.1$ ; Old:  $M = 2.1$ ,  $SE = 0.1$ ), or at formulating self-protective attributions,  $t(139) = 1.69$ ,  $p < .10$  (Young:  $M = 2.4$ ,  $SE = 0.1$ ; Old:  $M = 2.2$ ,  $SE = 0.1$ ). Older adults were more likely than young adults to endorse the use of self-protective intraindividual comparisons when faced with a relationship conflict,  $t(139) = 3.75$  (Young:  $M = 2.5$ ,  $SE = 0.1$ ; Old:  $M = 3.0$ ,  $SE =$

0.1), and to hold a more internal locus of control,  $t(138) = 2.02$  (Young:  $M = 10.3$ ,  $SE = 0.5$ ; Old:  $M = 8.9$ ,  $SE = 0.5$ ). Older adults also held more communal values,  $t(139) = 3.21$  (Young:  $M = 4.0$ ,  $SE = 0.1$ ; Old:  $M = 4.3$ ,  $SE = 0.1$ ), were more emotionally expressive,  $t(139) = 2.58$  (Young:  $M = 3.0$ ,  $SE = 0.1$ ; Old:  $M = 3.3$ ,  $SE = 0.1$ ), were less competitive,  $t(139) = 2.92$  (Young:  $M = 13.7$ ,  $SE = 0.5$ ; Old:  $M = 11.4$ ,  $SE = 0.7$ ), were more agreeable,  $t(139) = 2.01$  (Young:  $M = 7.0$ ,  $SE = 0.2$ ; Old:  $M = 7.6$ ,  $SE = 0.2$ ), were more conscientious,  $t(139) = 5.27$  (Young:  $M = 6.8$ ,  $SE = 0.2$ ; Old:  $M = 8.4$ ,  $SE = 0.2$ ), and more open to new experiences,  $t(139) = 2.25$  (Young:  $M = 7.2$ ,  $SE = 0.2$ ; Old:  $M = 7.9$ ,  $SE = 0.2$ ), than were young adults.

## APPENDIX B

### *Nickels Game Instructions Read to the Participants by the Experimenter for Experiment 1*

*Overview.* As described in the consent form, you will be playing a coin game with two other people whom you do not know. I don't know who they are either. Both individuals are students at Georgia Tech (or senior citizens from the Atlanta community), just like you, and they were recruited separately by another lab on the second floor. Other than that, I don't have any additional information about them. You are being kept apart from the other two players so that their proximity – or physical closeness- to you does not influence your responses during the game. In a separate experimental condition, all of the players will actually sit in the same room. In each experiment, anonymity will be maintained, but how close you are to the other players will be systematically varied. After all of the data are collected, we will compare the performance of groups who play in the same room with those of groups who cannot see each other. In a moment I will come around to your computer to start one of the programs that runs the coin game called “Nickels”. Before playing with the two other players, you will first play a practice round to become oriented with the game. After the practice round, you will play one round of the game by yourself. In Rounds 2 and 3, you will play the game with two other players. Overall, the purpose of each round of the game is to earn as many coins, as many nickels, as possible. When you play the game by yourself, the decisions that you make in the game will only affect your own score. However, when you play the game with someone else, your decisions will affect their score and their decisions will affect yours.

*Practice Round and Round 1.* Today's game is called Nickels. It is a game of strategy that requires you to figure out how you can earn as many nickels as possible in every round. To earn nickels, you will be using keys to open doors. Each round consists of a random number of turns. During each turn, you will use the key that you have available to you to open a door. Yellow keys open yellow doors and blue keys open blue doors. If you look at the picture, you see that Doors A and B are yellow doors. You must use a yellow key to open these doors. Doors C and D are blue doors, so you will need a blue key to open each of these doors. Behind each door that you open, you will find some nickels and another key. You can tell in advance what you will get when you open a door by looking into the window at the bottom of the door. This window shows you how many nickels you will get when you open the door. These nickels will be added to your total. The window also shows you that a key is behind the door. The key that you find when you open the door is the key that will be available on your very next turn. For example, if you look at the window at the bottom of Door A, you will see that if you open Door A, you will find 5 nickels and a yellow key. The 5 nickels will be added to your total, and you will have a yellow key to use on your next turn. So if you have a yellow key for your next turn, your choice will be limited to choosing between Door A and Door B. Suppose you open Door B. If you look at the window at the bottom of Door B, you will see that you will find 6 nickels and a blue key. The 6 nickels will be added to your total, and you will have a blue key to use on your next turn. Again, when you choose a door to open, you get nickels and a key. Be careful because the key that you get when you open a door will limit your choices on the very next turn. For example, if you open Door B, you receive a blue key. This means that during your next turn your choice will be limited to

choosing between Door C and Door D. Again, the key that you find when you open the door is the key that will be available on your very next turn. This is where the strategy part of the game comes in. The decision that you make in one turn, the decision to open a specific door, will influence the decision that you can make in your next turn. You have to figure out how to get the key that you need to open the door that you want to open. Remember, the goal of the game is to get as many nickels as you can, so you have to figure out how you can earn as many nickels as possible in every round. Here's a hint to help you get started. If you want to maximize the number of nickels that you earn, try to figure out the average number of nickels that you are earning during each turn. The higher the average number of nickels is that you earn during each turn, the more likely you are to meet the game's objective. If you have any questions during the game, please let me know by opening your door slightly. During each round, I will not stand over your shoulder. At the end of each round, please open your door slightly to let me know that you are ready to go on. Do not go on until I come to check your computer. Because we programmed the game in the lab, sometimes it is sensitive. I want to make sure that nothing is wrong with the game before you continue.

*Rounds 2 and 3.* In a moment we will start Round 2. During Rounds 2 and 3, you will play the game with two other people. For these two rounds, the rules of the game have changed slightly. Before, when you opened a door, you would collect the coins and the key behind that door. In Rounds 2 and 3, you will play with another player. When you open a door, you will still keep the nickels behind that door. However, rather than keep the key, you will give it to the other player for their turn. So you and the other player will

take turns opening doors. When you open a door, the key that you find will be given to the other player. The key that the other player finds will be given to you. This means that your choices will be dependent on the other player's choices, and that the other player's choices will be dependent upon yours. While playing the game, everyone should have the same goal of trying to earn as many nickels as possible. How you go about doing this is up to each of you. Let's go over two examples. Suppose you had a yellow key and chose Door A, then you would collect 5 nickels and the other player would be given the yellow key to use on their turn. Please notice that your choice will limit the choice of the other player to Door A or Door B. Suppose you opened Door B with a yellow key instead of Door A. Then you would collect 6 nickels and you would give the blue key found behind Door B to the other player. This means that your choice would limit the choice of the other player to Door C or Door D. Because you gave them a blue key, they would only be able to open blue doors. Let's go over two more examples. Suppose the other player had a yellow key and chose Door A, then they would collect 5 nickels and they would give the yellow key to you for your next turn. With a yellow key, you would have to choose between Door A or Door B. However, the other player might decide instead to use a yellow key to open Door B. This means that they would collect 6 nickels and that they would give you a blue key to use on your next turn. With a blue key, you would then have to choose between Door C and Door D. During the round you will be taking turns with the other player. You will use a key to open a door, and then they will use a key to open a door. You can keep track of whose turn it is by keeping track of a red box that surrounds the tokens. When the red box surrounds your game piece, it is your turn to make a decision. When the red box surrounds the other player's game piece, you will

have to wait and allow them to make a selection. Please be patient while the other person that you are playing with thinks about their responses. But if the other players consistently take a really long time to choose, or if the computer seems to freeze up, please let me know and I will contact the other experimenter to make sure that nothing is wrong with their equipment. Our server does a good job to keep things synchronized, but you never know when a problem might come up. I will be keeping in touch with the other experimenter to make sure that everything is running smoothly upstairs. (Participants play first Interactive Round. Afterwards, the following was read.) In Round 3, you will play against the second participant upstairs. The other experimenter said that everything seems to be going fine, so we'll continue. Again, if the player takes too long to make up their mind, please let me know so that I can ask the other experimenter to check on them. Please let me know when you get done with the round.

*Pre-Debriefing Interview Questions.* 1. What did you think about the study? Did you have any thoughts or questions? 2. Before participating, had you heard anything about this study in advance? 3. While playing the game, did you have any specific strategies in mind? 4. What about the other players? Did they use any strategies? 5. Were you able to get a sense for the personality of the other players? 6. Were you at all surprised by the choices that the other players made? 7. Some people say that it's hard to know if they were playing with a real person because they don't actually see them while playing the game. Did it ever seem like you were not interacting with a real person?

## APPENDIX C

### *Nickels Game Instructions Read to the Participants by the Experimenter for Experiment 2*

*Overview.* As described in the consent form, you will be playing a coin game with one another. For this experiment, we are interested in how participants communicate with one another. Here communication is limited to the decisions that we make in the context of a game. There is no direct verbal communication between players. In a previous experiment, participants played the game with two strangers who were situated in another lab. Today, you will each play one full round of the game by yourself. Afterwards, you will play the game with one another. Overall, the purpose of each round of the game is to earn as many nickels as possible. When you play the game by yourself, the decisions that you make in the game will only affect your own score. However, when you play the game with each other, your decisions will affect one another's scores. To keep the procedure standard for all participants, please do not ask any questions while I read through the instructions for the game. After I go through the instructions, each of you will go in separate rooms and begin the first round. At this point, when you are each in separate rooms, you may individually ask any questions that you might have.

*Instructions for Practice Round and Round 1.* Today's game is called Nickels. It is a game of strategy that requires you to figure out how you can earn as many nickels as possible in every round. Each round consists of a random number of turns. During each turn, you will be using keys to open a door. Yellow keys open yellow doors and blue keys open blue doors. If you look at the picture, you see that Doors A and B are yellow



doors. You must use a yellow key to open these doors. Doors C and D are blue doors, so you will need a blue key to open each of these doors. Behind each door that you open, you will find some nickels and another key. You can tell in advance what you will get when you open a door by looking into the window at the bottom of the door. This window shows you how many nickels you will get when you open the door. These nickels will be added to your total. The window also shows you that a key is behind the door. The key that you find when you open the door is the key that will be available on your very next turn. For example, if you look at the window at the bottom of Door A, you will see that if you open Door A, you will find 5 nickels and a yellow key. The 5 nickels will be added to your total, and you will have a yellow key to use on your next turn. So if you have a yellow key for your next turn, your choice will be limited to choosing between Door A and Door B. Suppose you open Door B. If you look at the window at the bottom of Door B, you will see that you will find 6 nickels and a blue key. The 6 nickels will be added to your total, and you will have a blue key to use on your next turn. Again, when you choose a door to open, you get nickels and a key. Be careful because the key that you get when you open a door will limit your choices on the very next turn. For example, if you open Door B, you receive a blue key. This means that during your next turn your choice will be limited to choosing between Door C and Door D. Again, the key that you find when you open the door is the key that will be available on your very next turn. This is where the strategy part of the game comes in. The decision that you make in one turn, the decision to open a specific door, will influence the decision that you can make in your next turn. There are two questions that I am commonly asked. First, "Door B is a yellow door, but the key in the window is blue. Does this mean that I need to have

a blue key to open Door B?” The answer to this question is “No.” To open Door B, you have to use a yellow key. When you open Door B with a yellow key, you give up that yellow key to get 6 nickels and a blue key to use on your next turn. Likewise, Door C is a blue door that has a yellow key in the window. When you open Door C with a blue key, you give up that blue key to get 1 nickel and a yellow key to use on your next turn. So to open Door B, you need a yellow key. To open Door C, you need a blue key. When you open either of these two doors, the key that you get is opposite in color to the key that you used to open the door. The second question that is commonly asked is: “Once I open a door, is it off-limits in the future?” The answer to this question is “No.” A door is never off-limits. You can open up every door as many times as you want to. To open a door, you have to have the key that matches that door’s color. Overall, you have to figure out how to get the key that you need to open the door that you want to open. Remember, the goal of the game is to get as many nickels as you can, so you have to figure out how you can earn as many nickels as possible in every round. Here’s a hint to help you get started. If you want to maximize the number of nickels that you earn, try to figure out the average number of nickels that you are earning during each turn. The higher the average number of nickels is that you earn during each turn, the more likely you are to meet the game’s objective. If you have any questions during the game, please let me know by opening your door slightly. During each round, I will not stand over your shoulder. At the end of this round, please open your door slightly to let me know that you are ready to go on. Do not go on until I come to check your computer. Sometimes the program is sensitive, so I want to make sure that nothing is wrong with the game before you continue.

*Round 2.* In a moment we will start Round 2. During this round, you will play the game with one another. To keep the method of the experiment the same for all participants, please do not ask any questions or say anything from this point forward. For Round 2, the rules of the game have changed slightly. Before, when you opened a door, you would collect the coins and the key behind that door. When you open a door, you will still keep the nickels behind that door. However, rather than keep the key, you will give it to the other player for their turn. So you and the other player will take turns opening doors. When you open a door, the key that you find will be given to the other player. The key that the other player finds will be given to you. This means that your choices will be dependent on the other player's choices, and that the other player's choices will be dependent upon yours. While playing the game, everyone should have the same goal of trying to earn as many nickels as possible. How you go about doing this is up to each of you. Let's go over two examples. Suppose at the start of the game, one of you begins with a yellow key. This person would have to choose between Door A and Door B. If you open Door B, you would collect 6 nickels and pass a blue key to the other player to use on their turn. If you open Door A, you would collect 5 nickels and pass a yellow key to the other player to use on their turn. Suppose at the start of the game, someone starts the game with a blue key. This person would have to choose between Door C and Door D. If you open Door C, then you would collect 1 nickel and give the yellow key to the other player. If you open Door D, then you would collect 2 nickels and give the blue key to the other person. During the round you will be taking turns with one another to open doors. You will use a key to open a door, and then they will use a key to open a door. You can keep track of whose turn it is by keeping track of a red box that

surrounds the tokens. When the red box surrounds your game piece, it is your turn to make a decision. When the red box surrounds the other player's game piece, you will have to wait and allow them to make a selection. There will be text in the top right hand corner of the screen which also tells you whose turn it is. When the other person is making their decision, please be patient. After you respond, there will be a short delay before the other person can see your decision. This delay is built in so that the computer can update your scores while also passing the information to our server in the main lab. The length of the typical round varies between 8 to 12 minutes, and the computer determines when to end the game using some minimum number of turns and the total time of the round. At the end of the round, please stay seated in your testing room and complete the packet of questionnaires that I will give to you in a moment. I am timing the round from here, and I will check up on you after about 15 minutes have passed.

## APPENDIX D

### Friendship Questionnaire

**Instructions:** During the experiment in the lab, you will play an interactive game with your friend. Please take a moment to answer the following questions about your relationship with the friend who will attend the lab session with you. Please keep in mind that the answers to these questions will never be reported to your friend.

1. **Approximately how long have you known your friend?** \_\_\_\_ years \_\_\_\_ months
2. **During a typical month, how frequently do you visit with your friend?**  
(please circle one)
  - a. Less than once per month
  - b. 1 or 2 times per month
  - c. 3 to 5 times per month (or once per week)
  - d. 6 to 10 times per month (or twice per week)
  - e. 11 to 15 times per month (almost every other day)
  - f. Every day
3. **Have you ever attended a major family gathering of your friend's family?**  
(please circle one) 1. Yes 2. No
4. **Has your friend ever attended one of your family's major family gatherings?**  
(please circle one) 1. Yes 2. No
5. **How well do you believe that you know your friend?** (please circle one)  
1. Not at all 2. Slightly 3. Moderately well 4. Very well
6. **How well do you believe that your friend knows you?** (please circle one)  
1. Not at all 2. Slightly 3. Moderately well 4. Very well
7. **How would you rate the quality of your relationship with your friend?**  
(please circle one) 1. Poor 2. Fair 3. Good 4. Very Good 5. Outstanding
8. **How close are you with your friend?** (please circle one)  
1. Not at all close 2. Slightly close 3. Moderately close 4. Very close
9. **Is this friend your best or closest friend?** (please circle one) 1. Yes 2. No
10. **Are you at all related to your friend by birth or by marriage?** (please circle one)  
1. Yes 2. No

## REFERENCES

- Akiyama, H., Antonucci, T., Takahashi, K., & Langfahl, E. S. (2003). Negative interactions in close relationships across the life span. *Journal of Gerontology: Psychological Sciences*, 58B, P70-P79.
- Allaire, J. C., & Marsiske, M. (2002). Well- and ill-defined measures of everyday cognition: Relationship to older adults' intellectual ability and functional status. *Psychology & Aging*, 17, 101-115.
- Artistico, D., Cervone, D., & Pezzuti, L. (2003). Perceived self-efficacy and everyday problem solving among young and older adults. *Psychology & Aging*, 18, 68-79.
- Aumann, R. J. (1959). Acceptable points in general cooperative n-person games. In A. W. Tucker and R. D. Luce (Eds.), *Contributions to the Theory of Games IV, Annals of Mathematics Study, Vol. 40* (pp. 287-324). Princeton, NJ: at the University Press.
- Axelrod, R. (1984). *The Evolution of Cooperation*. New York: Basic Books.
- Baker, F., & Rachlin, H. (2001). Probability of reciprocation in repeated prisoner's dilemma games. *Journal of Behavioral Decision Making*, 14, 51-67.
- Baltes, P. B. (1997). On the incomplete architecture of human ontogeny: Selection, optimization, and compensation as foundation of developmental theory. *American Psychologist*, 52, 366-380.
- Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful Aging: Perspectives from the Behavioral Sciences* (pp. 1-34). New York: Cambridge University Press.
- Berg, C. A., Meegan, S. P., Klaczynski, P. (1999). Age and experiential differences in strategy generation and information requests for solving everyday problems. *International Journal of Behavioral Development*, 23, 615-639.
- Berg, C. A., Strough, J., Calderone, K. S., Sansone, C., & Weir, C. (1998). The role of problem definitions in understanding age and context effects on strategies for solving everyday problems. *Psychology & Aging*, 13, 29-44.
- Biel, A., & Thøgersen, J. (2007). Activation of social norms in social dilemmas: A review of the evidence and reflections on the implications for environmental behaviour. *Journal of Economic Psychology*, 28, 93-112.

- Birditt, K.S. & Fingerman, K. L. (2003). Age and gender differences in adults' descriptions of emotional reactions to interpersonal problems. *Journal of Gerontology: Psychological Sciences*, 58B, P237-P245.
- Birditt, K. S., & Fingerman, K. L. (2005). Do we get better at picking our battles? Age group differences in descriptions of behavioral reactions to interpersonal tensions. *Journal of Gerontology: Psychological Sciences*, 60B, P121-P128.
- Blanchard-Fields, F. (1998). The role of emotion in social cognition across the adult life span. In K. W. Schaie & M. P. Lawton (Eds.), *Annual review of gerontology and geriatrics: Volume 17* (pp. 206-237). New York: Springer.
- Blanchard-Fields, F. (2007). Everyday problem solving and emotion: An adult developmental perspective. *Current Directions in Psychological Science*, 16, 26-31.
- Blanchard-Fields, F., Baldi, R., & Stein, R. (1999). Age relevance and context effects on attributions across the adult lifespan. *International Journal of Behavioral Development*, 23, 665-683.
- Blanchard-Fields, F., Chen, Y., & Norris, L. (1997). Everyday problem solving across the adult life span: Influence of domain specificity and cognitive appraisals. *Psychology & Aging*, 12, 684-693.
- Blanchard-Fields, F., Chen, Y., Schocke, M., & Hertzog, C. (1998). Evidence for content-specificity of causal attributions across the adult life span. *Aging, Neuropsychology, and Cognition* 5, 241-263.
- Blanchard-Fields, F., Jahnke, H., & Camp, C. (1995). Age differences in problem-solving style: The role of emotional salience. *Psychology & Aging*, 10, 173-180.
- Blanchard-Fields, F., Mienaltowski, A., & Seay, R. B. (2007). Age differences in everyday problem-solving effectiveness: Older adults select more effective strategies for interpersonal problems. *Journal of Gerontology: Psychological Sciences*, 62B, P61-P64.
- Blanchard-Fields, F., Stein, R., Watson, T. L. (2004). Age differences in emotion-regulation strategies in handling everyday problems. *Journal of Gerontology: Psychological Sciences*, 59B, P261-P269.
- Brañas-Garza, P. (2007). Promoting helping behavior with framing in dictator games. *Journal of Economic Psychology*, 28, 477-486.
- Brown, J., & Rachlin, H. (1999). Self-control and social cooperation. *Behavioural Processes*, 47, 65-72.

- Burnham, T. C. (2003). Engineering altruism: A theoretical and experimental investigation of anonymity and gift giving. *Journal of Economic Behavior and Organization*, 50, 133-144.
- Burnham, T. C., McCabe, K., & Smith, V. L. (2000). Friend-or-foe intentionality priming in an extensive form trust game. *Journal of Economic Behavior & Organization*, 43, 57-73.
- Carstensen, L. L. (2006). The influence of a sense of time on human development. *Science*, 312, 1913-1915.
- Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, 54, 165-181.
- Coats, A. H., & Blanchard-Fields, F. (2008). Emotion regulation in interpersonal problems: The role of cognitive-emotional complexity, emotion regulation goals, and expressivity. *Psychology & Aging*, 23, 39-51.
- Cheng, S. L., & Strough, J. (2004). A comparison of collaborative and individual everyday problem solving in younger and older adults. *International Journal of Aging & Human Development*, 58, 167-195.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155-159.
- Denney, N. W. (1990). Adult age differences in traditional and practical problem solving. In E. Lovelace (Ed.) *Aging and Cognition: Mental Processes, Self Awareness, and Interventions* (pp. 329-349). Amsterdam: North Holland.
- Diehl, M., Owen, S. K., & Youngblade, L. M. (2004). Agency and communion attributes in older adults' spontaneous self-representations. *International Journal of Behavioral Development*, 28, 1-15.
- Eckel, C. C., & Grossman, P. J. (1996). Altruism in anonymous dictator games. *Games and Economics Behavior*, 16, 181-191.
- Eckel, C. C., & Wilson, R. K. (2006). Internet cautions: Experimental games with internet partners. *Experimental Economics*, 9, 53-66.
- Ekstrom, R. B., French, J. W., Harman, H. H., & Dermen, D. (1976). *Manual for kit of factor referenced cognitive tests*. Princeton, NJ: Educational Test Services.
- Erikson, E. (1966). Eight ages of man. *International Journal of Psychiatry*, 2, 281-300.
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G\*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191.



- Fingerman, K. L., & Birditt, K. S. (2003). Do age differences in close and problematic family ties reflect the pool of available relatives?. *Journal of Gerontology: Psychological Sciences*, 58B, P80-P87.
- Finucane, M. L., Mertz, C. K., Slovic, P., & Schmidt, E. S. (2005). Task complexity and older adults' decision making competence. *Psychology & Aging*, 20, 71-84.
- Finucane, M. L., Slovic, P., Hibbard, J. H., Peters, E., Mertz, C. K., & MacGregor, D. G. (2002). Aging and decision-making competence: An analysis of comprehension and consistency skills in older versus younger adults considering health-plan options. *Journal of Behavioral Decision Making*, 15, 141-164.
- Freund, A. M., & Baltes, P. B. (2002). Life-management strategies of selection, optimization, and compensation: Measurement by self-report and construct validity. *Journal of Personality and Social Psychology*, 82, 642-662.
- Fung, H. H. & Carstensen, L. L. (2004). Motivational changes in response to blocked goals and foreshortened time: Testing alternatives to socioemotional selectivity theory. *Psychology & Aging*, 19, 68-78.
- Gigerenzer, G., Czerlinski, J., & Martignon, L. (2002). How good are fast and frugal heuristics?. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment*, (pp.559-581). New York: Cambridge University Press.
- Green, L., Fry, A. F., & Myerson, J. (1994). Discounting of delayed rewards: A life-span comparison. *Psychological Science*, 5, 33-36.
- Green, L., Myerson, J., & Ostraszewski, P. (1999). Discounting of delayed rewards across the life span: Age differences in individual discounting functions. *Behavioural Processes*, 46, 89-96.
- Gross, J. J. (2001). Emotion regulation in adulthood: Timing is everything. *Current Directions in Psychological Science*, 10, 214-219.
- Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, 85, 348-362.
- Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Skorpen, C. G., & Hsu, A. Y. C. (1997). Emotion and aging: Experience, expression, and control. *Psychology & Aging*, 12, 590-599.
- Gutmann, D. (1994). *Reclaimed Powers: Men and Women in Later Life*. Evanston, IL: Northwestern University Press.

- Heckhausen, J., & Schulz, R. (1995). A life-span theory of control. *Psychological Review*, 102, 284-304.
- Heidrich, S. M., Denney, N. M. (1994). Does social problem solving differ from other types of problem solving during the adult years?. *Experimental Aging Research*, 20, 105-126.
- Higgins, J. J. (2004). *Introduction to non-parametric statistics*. Pacific Grove, CA: Thomson.
- Hoffman, E., McCabe, K., & Smith, V. L. (1996). Social distance and other-regarding behavior in dictator games. *The American Economic Review*, 86, 653-660.
- Hoppmann, C., Coats, A., & Blanchard-Fields, F. (in press). Goals and everyday-problem solving: Examining the link between age-related goals and problem-solving strategy use across the adult lifespan. *Aging, Neuropsychology, and Cognition*.
- Houston, J. M., Kinnie, J., Lupo, B., Terry, C., & Ho, S. S. (2000). Competitiveness and conflict behavior in simulation of a social dilemma. *Psychological Reports*, 86, 1219-1225.
- Jopp, D., & Smith, J. (2006). Resources and life-management strategies as determinants of successful aging: On the protective effect of selection, optimization, and compensation. *Psychology & Aging*, 21, 253-265.
- Krause, N., & Rook, K. S. (2003). Negative interaction in late life: Issues in the stability and generalizability of conflict across relationships. *Journal of Gerontology: Psychological Sciences*, 58B, P88-99.
- Lang, F. R. & Carstensen, L. L. (2002). Time counts: Future time perspective, goals, and social relationships. *Psychology & Aging*, 17, 125 - 139.
- Lang, F. R., & Heckhausen, J. (2001). Perceived control over development and subjective well-being: Differential benefits across adulthood. *Journal of Personality and Social Psychology*, 81, 509-523.
- Li, L. Z. H., Lindenberger, U., Freund, A. M., & Baltes, P. B. (2001). Walking while memorizing: Age-related differences in compensatory behavior. *Psychological Science*, 12, 230-237.
- Luce, R. D., & Raiffa, H. (1985). *Games and Decisions: Introduction and Critical Survey* (pp. 89-113). New York: Dover.
- Luwel, K., Siegler, R. S., & Verschaffel, L. (2008). A microgenetic study of insightful problem solving. *Journal of Experimental Child Psychology*, 99, 210-232.

- MacCallum, R. C., Zhang, S., Preacher, K. J., & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods*, 7, 19-40.
- Mackin, J. (1994, April). Fraud artists target the elderly. Consumer News. Retrieved June 4, 2008, from [http://www.totse.com/en/bad\\_ideas/scams\\_and\\_rip\\_offs/eldfraud.html](http://www.totse.com/en/bad_ideas/scams_and_rip_offs/eldfraud.html)
- Majolo, B., Ames, K., Brumpton, R., Garratt, R., Hall, K., & Wilson, N. (2006). Human friendship favours cooperation in the iterated prisoner's dilemma. *Behaviour*, 143, 1383-1395.
- Marsiske, M., & Margrett, J. A. (2006). Everyday problem and decision making. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the Psychology of Aging*, 6<sup>th</sup> ed. (pp. 315-342). San Diego, CA: Academic Press.
- Marsiske, M., & Willis, S. L. (1995). Dimensionality of everyday problem solving. *Psychology & Aging*, 10, 269-283.
- McAdams, D. P., & de St. Aubin, E. (1992). A theory of generativity and its assessment through self-report, behavioral acts, and narrative themes in autobiography. *Journal of Personality and Social Psychology*, 62, 1003-1015.
- McAdams, D. P., de St. Aubin, E., & Logan, R. L. (1993). Generativity among young, midlife, and older adults. *Psychology & Aging*, 8, 221-230.
- McCabe, J. (1989). Psychological androgyny in later life: A psychocultural examination. *Ethos*, 17, 3-31.
- Mienaltowski, A., & Blanchard-Fields, F. (2005). The differential effects of mood on age differences in the correspondence bias. *Psychology & Aging*, 20, 589-600.
- Morling, B., & Evered, S. (2006). Secondary control reviews and defined. *Psychological Bulletin*, 132, 269-296.
- Newsom, J. T., Nishishiba, M., Morgan, D. L., & Rook, K. S. (2003). The relative importance of three domains of positive and negative social exchanges: A longitudinal model with comparable measures. *Psychology & Aging*, 18, 746-754.
- Owen, S. V., & Froman, R. D. (2005). Why carve up your continuous data? *Research in Nursing & Health*, 28, 496-503.
- Paulhus, D. L., & Martin, C. L. (1988). Functional flexibility: A new conception of interpersonal flexibility. *Journal of Personality and Social Psychology*, 55, 88-101.
- Phillips, L. H., Smith, L., & Gilhooly, K. J. (2002). The effects of adult aging and induced positive and negative mood on planning. *Emotion*, 2, 263-272.

- Postmes, T., Spears, R., Sakhel, K., & de Groot, D. (2001). Social influence in computer-mediated communication: The effects of anonymity on group behavior. *Personality and Social Psychology Bulletin*, 27, 1243-1254.
- Poundstone, W. (1992). *Prisoner's Dilemma*. New York: Anchor Books.
- Preacher, K. J., Rucker, D. D., MacCallum, R. C., & Nicewander, W. A. (2005). Use of the extreme groups approach: A critical reexamination and new recommendations. *Psychological Methods*, 10, 178-192.
- Rachlin, H. (2000). *The Science of Self-control*. Cambridge, MA: Harvard Press.
- Riediger, M., & Freund, A. M. (2006). Focusing and restricting: Two aspects of motivational selectivity in adulthood. *Psychology & Aging*, 21, 173-185.
- Riediger, M., Li, S., & Lindenberger, U. (2006). Selection, optimization, and compensation as developmental mechanisms of adaptive resource allocation: Review and practice. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the Psychology of Aging*, 6<sup>th</sup> ed. (pp. 289-313). San Diego, CA: Academic Press.
- Riegelsberger, J., Sasse, A. M., & McCarthy, J. D. (2003). The researcher's dilemma: Evaluating trust in computer-mediated communication. *International Journal Human-Computer Studies*, 58, 759-781.
- Rook, K. S. (2003). Exposure and reactivity to negative social exchanges: A preliminary investigation using daily diary data. *Journal of Gerontology: Psychological Sciences*, 58B, P100-P111.
- Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied*, 80(1), 1-28.
- Rotter, J. B. (1967). A new scale for the measurement of interpersonal trust. *Journal of Personality*, 35, 651-665.
- Salthouse, T. A. (1992). What do adult age differences in the Digit Symbol Substitution Test reflect? *Journal of Gerontology: Psychological Sciences*, 47, P121-P128.
- Schindler, I., Staudinger, U. M., & Nesselroade, J. R. (2006). Development and structural dynamics of personal life investment in old age. *Psychology & Aging*, 21, 737-753.
- Siegler, R. S. (2007). Cognitive variability. *Developmental Science*, 10, 104-109.
- Siegler, R. S., & Chen, Z. (2002). Development of rules and strategies: Balancing the old and the new. *Journal of Experimental Child Psychology*, 81, 446-457.

- Smither, R. D., & Houston, J. M. (1992). The nature of competitiveness: The development and validation of the competitiveness index. *Educational and Psychological Measurement*, 52, 407-418.
- Sorkin, D. H., & Rook, K. S. (2004). Interpersonal control strivings and vulnerability to negative social exchanges in later life. *Psychology & Aging*, 19, 555-564.
- Sorkin, D. H., & Rook, K. S. (2006). Dealing with negative social exchanges in later life: Coping responses, goals, and effectiveness. *Psychology & Aging*, 21, 715-725.
- Thompson, E. H. (2006). Images of old men's masculinity: Still a man?. *Sex Roles*, 55, 633-648.
- Thornton, W. J. L., & Dumke, H. A. (2005). Age differences in everyday problem-solving and decision making effectiveness: A meta-analytic review. *Psychology & Aging*, 20, 85-99.
- Timmers, M., Fischer, A. H., & Manstead, A. S. R. (1998). Gender differences in motives for regulating emotions. *Personality and Social Psychology Bulletin*, 24, 974-985.
- Ward, L. C., Thorn, B. E., Clements, K. L., Dixon, K. E., & Sanford, S. D. (2006). Measurement of agency, communion, and emotional vulnerability with the personal attributes questionnaire. *Journal of Personality Assessment*, 86, 206-216.
- Watson, T. L., & Blanchard-Fields, F. (1998). Thinking with your head and your heart: Age differences in everyday problem-solving strategy preferences. *Aging, Neuropsychology, and Cognition*, 5, 225-240.
- Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics*, 1, 80-83.
- Willis, S. L., & Marsiske, M. (1993). *Manual for the Everyday Problems Test*. University Park: Pennsylvania State University.
- Wilson, J. M., Straus, S. G., & McEvily, B. (2006). All in due time: The development of trust in computer-mediated and face-to-face teams. *Organizational Behavior and Human Decision Processes*, 99, 16-33.