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THE EFFECT OF COMPETITION ON TESTOSTERONE RESPONSES

by

Eric T. Steiner

Bachelor of Commerce
University of Calgary
2002

A thesis submitted in partial fulfillment
of the requirements for the

Master of Arts Degree in Psychology
Department of Psychology
College of Liberal Arts

Graduate College
University of Nevada, Las Vegas
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ABSTRACT

The Effect of Competition on Testosterone Responses

by

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Numerous studies have looked at the effect of competition on testosterone (T) responses in humans. Winners' and losers' T responses varied considerably across experiments. Researchers suggest that moderating variables may account for the inconsistencies found in previous studies. One aim of this study was to determine if winning/losing a poker competition influenced T responses. All participants as a group produced a significant increase in T during the competition, but no difference between winners and losers was discovered. Another aim of this study was to determine if individual and personality differences act as moderating variables in the relationship between poker competition and T responses. Internal/External Attribution, Competitiveness, and Locus of Control showed some degree of moderation, but Importance of the Competition did not.

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CHAPTER 1

INTRODUCTION

High levels of testosterone (T) are linked with a variety of behaviors. Patterns of behaviors, in turn, are linked with personalities. For example, repeatedly and predictably seeking out competition, and placing a high level of importance on winning, are part of what comprise a competitive personality. Dabbs (2000) argues that high T is associated with competitiveness, aggression, dominance, confidence, toughness, and other traits. Most empirical research on T and behavior has focused on aggression and dominance. Archer (2006) provided an extensive review on T and aggression, as did Mazur and Booth (1998) on T and dominance. Furthermore, several lines of research explain how T has a reciprocal relationship with behavior, where one affects the other, as described by Zitzmann and Nieschslag (2001). Thus, gaining a better understanding of T responses would be enhanced by studying its relationship with personality.

One of the ways to study the relationship between T and personality is to investigate a particular context that elicits a T response as it relates to a trait. For instance, competition is a context that may provoke a change in T in those who exhibit certain personality characteristics. Studies on the effects of competition on T responses in humans stem from research on status in primates. Rose, Bernstein, and Gordon (1975) described how successful efforts at maintaining or increasing status appear to increase T,

whereas unsuccessful efforts appear to decrease T in rhesus monkeys. More recently, Muller and Wrangham (2004) described a study where male chimpanzees showed rises in T when competing with other males for access to ovulating females. As well, dominance and aggression were linked with higher T. Mazur and Lamb (1980) conducted the first study of its kind on the effects of competition on T in humans.

Mazur and Lamb's 1980 study initiated a line of research that investigated the effect of competition on T responses. The competitions in these studies came in many forms. Some were physical, and some were not. Some of the competitions had an outcome that depended on competitors' skill, and other competitions had an outcome that depended on chance. Differences in these competitions may have important implications for eliciting a change in T. The following section is a review of studies on the effect of competition on T responses, but first a short background on the nature of T is provided.

There are two types of hormones in the body: peptides and steroids. T is a steroid hormone. T plays a central role in sex differentiation and thus many aspects of personality, cognition and behavior exhibiting sex differences. Prior to birth, elevations in T masculinize the brain. For example, fetuses exposed to high T levels will later show more masculine patterns of "rough-and-tumble" play as children. T levels decline to low levels within a few months postpartum, then exhibit dramatic increases during puberty. The increases in T among adults promote the development and maintenance of male sex characteristics. T promotes skeletal muscle growth, the production of red blood cells and sperm, and can modulate the release of neurotransmitters.

T is secreted from the testes via a hypothalamus-pituitary-testis feedback loop. Gonadotropic hormone releasing hormone (GnRH) secreted by the hypothalamus

stimulates the pituitary gland to release lutenizing hormone (LH) which, in turn, facilitates the secretion of T from the testis. The testes produce virtually all of the T found in males. In females, however, approximately half of T is secreted from the ovary and the other half from the adrenal gland via stimulation by adrenocorticotropic hormone (ACTH) secreted from the pituitary gland.

In some cases, T exerts direct physiological effects after binding with the androgen receptor in an appropriate target tissue. In other cases, T acts as a prohormone, exerting its effects only after conversion to a different steroid. Many of the effects of T on genital growth occur after T is converted into dihydrotestosterone (DHT) by the enzyme five-alpha-reductase. In rodents, but apparently not in primates, many of the neural effects of T occur after T is converted to estradiol by the enzyme aromatase. Recent evidence suggests that T can exhibit both "classical" effects by altering gene expression as well as rapid effects occurring within minutes as described by James, Nyby, and Saviolakis (2006). Men produce a few mg of T daily, and have eight to ten times as much as women. Typical levels of T range from 300 to 1000 nanograms per deciliter (ng/dL) of serum in healthy adult males. The average T level for individuals is an inherited characteristic, according to Dabbs (2000).

Physical, Skilled Competition

Mazur and Lamb (1980) investigated the effect of tennis matches on T responses. The experiment involved four subjects who played three matches of doubles tennis. Two of the three matches had a decisive victory and resulted in a greater T increase for the winners than the losers. The third match had an indecisive win and resulted in no significant difference in T between the winners and losers.

Elias (1981) investigated the effect of winning/losing in wrestling matches on changes in T. The study included 15 males between 18 and 22 years of age. Blood samples showed that T increased for all participants during the wrestling match. However, winners showed greater increases in T than losers.

Salvador, Simon, Suay, and Llorens (1987) conducted an experiment to investigate the effect of exercise and a judo competition on changes in T. The study included 14 males between 16 and 19 years of age. The exercise session and the judo competition were held on different days. Blood samples showed that T increased after exercise and decreased slightly after judo. Subjects who were regional team members showed an increase in T after competition, whereas non-members showed a decrease. Also, those who had a successful sporting record showed a significant increase in T during competition. There was no significant difference in T change between the winners and losers. However, a relationship between success and rises in T was suggested.

Booth and Mazur (1989) looked at the effect of winning/losing at tennis matches on T responses. The study included six males from a varsity tennis team. T was measured by way of saliva samples. Generally, T rose before a match. T also rose for winners more than losers. Winners with increasing T had higher T before their next match. Furthermore, losers with decreasing T had lower T before their next match.

Gonzalez-Bono, Salvador, Ricarte, Serrano, and Arnedo (2000) investigated the effect of basketball competition on T in 17 players. The average age was 22. Participants were divided into two teams. Each team won a game against another opponent. Saliva samples showed a marginally significant increase in T for one team. Participants also answered three questions regarding personal and team performance, and Internal/External

Attribution about the outcome of the game. Team one, whose score for the basketball game was higher than team two, showed higher internal attribution concerning their win.

Gonzalez-Bono, Salvador, and Serrano (1999) conducted an experiment involving basketball competition's effect on T responses. Two basketball teams, with eight players per team, competed against each other. Each player answered a question on Internal/External Attribution about the outcome of the game. Saliva samples showed no significant difference in T between the winners and losers. There was a nonsignificant increase in T for the winners, and a decrease in T for the losers. T correlated positively with Internal Attribution in winners, and negatively with losers.

Filaire, Maso, Sagnol, Ferrand, and Lac (2001) looked at 22 males for changes in T during a judo competition. Ages ranged from 21-24 years. Three weeks before the competition, participants filled out the Bortner Test which measures Type A/B behavior. After the last fight, the "Ways of Coping Checklist" was administered. Saliva samples showed no significant increase in T for winners or losers, yet losers had significantly higher levels of T than winners after the competition. Losers were also more likely to have Type B personalities.

Suay, Salvador, and Gonzalez-Bono (1999) investigated the effects of judo competition on serum T. The study involved 26 males in their late teens who participated in three sessions on different days. In the first session (control session), baseline blood samples were taken. In session two, participants competed and provided pre- and post-competition blood samples. Paired against each other, there were an equal number of winners and losers. Before the competition, a question on motivation to win and a question on perceived ability to win were asked. The third session was a noncompetitive

effort session in an attempt to replicate the physical effort required during the fight session. Significant changes in T were found. Increases in T from pre- to post-sessions two and three were found, and decreases in T from pre- to post-session one were found. T levels were significantly higher in session two than session one or three. Also, there was an increase in T from baseline to pre-competition. No significant differences in motivation were found between groups. As well, positive relationships were found between changes in T and motivation to win.

Serrano, Salvador, and Gonzalez-Bono (2000) looked at 12 male judo competitors, 17-23 years of age, in a judo competition against other clubs. Participants answered questions after the competition about how hard they thought they exerted themselves. Participants also answered if they attributed the outcome to internal or external causes. Salivary T increased for winners and decreased for losers, although the change was not statistically significant. Blood samples that were checked for lactate levels showed that winners showed slightly less, although nonsignificant, physical exertion than losers. There was a significant correlation between objective and subjective measures of physical exertion. No significant differences were found between winners and losers in attribution.

Salvador, Suay, Gonzalez-Bono, and Serrano (2003) investigated the effects of a judo competition on anticipatory hormonal changes and psychological responses. The study included 17 males whose average age was 19. T was measured over eight resting sessions during the season and before a competition. There was a nonsignificant increase in T before the competition. Also before the competition, competitors were asked two questions about expectation: one concerning their motivation to win, and one concerning

their chances of doing so. One group of participants showed higher increases in T and had a higher motivation to win. These individual were also more likely to win.

Edwards, Wetzel, and Wyner (2006) conducted a study on T changes in male and female collegiate soccer players. Participants were 18 to 22 years of age. The study involved three games: one for the men, which they won, and two for the women, one of which they won and one of which they lost. The 13 males who played, and won, experienced a nonsignificant rise in T. The 15 women who played in the game that they won experienced a significant rise in T. The 11 women who played in the game that they lost also experienced a significant rise in T. Note that 10 of the women played in both games.

Nonphysical, Skilled Competition

Mazur and Lamb (1980) looked at five blood samples from five medical school graduates for changes in T. Graduation was on a Sunday. The next day, all five subjects showed an increase in T. Three subjects experienced the highest sample T one day after. The other two subjects experienced the highest T two days after graduation.

Mazur, Booth, and Dabbs (1992) investigated the effect of winning/losing at chess on changes in T. Sixteen males participated in one or both of two chess tournaments. Eleven males participated in the first chess tournament, and eight participated in the second tournament. Ages ranged from 18 to 64. Generally, winners showed higher levels of T than losers.

Nonphysical, Nonskilled Competition

Mazur and Lamb (1980) conducted an experiment involving a lottery to look for changes in T in 14 participants. There were seven winners who each won a $100, and seven losers. No significant differences in T were found between the winners and losers.

Gladue, Boechler, and McCaul (1989) studied the effect of winning/losing in a mock-reaction time task on changes in T. The study included 39 males between the ages of 18 and 34. Participants were tested in pairs who, unbeknownst to them, were randomly assigned to win or lose in the task. Participants were unable to see how the other was performing. Also, one of each pair of individuals was randomly assigned to win decisively or by a narrow margin. Winners had higher levels of T than losers in both the decisive win and narrow win conditions. Before and after the task, an attribution questionnaire was completed by each participant. Decisive winners described internal causes for the win, and decisive losers described external causes for the loss.

McCaul, Gladue, and Joppa (1992) looked at the effect of winning/losing at a chance-controlled task on changes in T. Participants were males whose ages ranged from 18 to 50. In the first experiment, participants either won or lost five dollars on the task. In the second experiment, no money was exchanged. Winners experienced higher levels of T in both experiments.

Mazur, Susman, and Edelbrock (1997) conducted an experiment to determine if winners or losers of a video game contest would elicit hormonal responses. There were 28 males and 32 females in the study. Ages ranged from 17 to 35 years. There was no significant difference in T response between winners and losers. Overall, males showed a significant pre-match rise in T, and females did not.

Bernhardt, Dabbs, and Fielden (1998) studied the change in T in male fans after vicariously winning or losing through a favorite sports team. Ages of participants ranged from 20 to 42. The investigation involved two studies. The first study involved eight fans watching a college basketball game. The second study involved 21 fans watching a televised world cup soccer match: 12 of the fans supported one team; 9 supported the other team. In both studies, saliva samples showed that T increased for those who vicariously won, and decreased for those who vicariously lost.

Summary of Previous Studies

Overall, there appears to be an inconsistent link between winning/losing and changes in T. In some of the studies, T increased for winners and decreased for losers. Sometimes T increased for both winners and losers, and sometimes T increased for neither. There are several possible explanations why researchers cannot detect a consistent change in T in competitors.

Regarding the physical competitions, one explanation for the inconsistent findings is that physical exertion may have increased T and confounded any change in T caused by winning or losing. Crewther, Keogh, Cronin, and Cook (2006) investigated hormonal responses to various types of resistance exercise. After one of the weightlifting sessions, the authors found an acute increase in T of up to 72%. In addition, the study by Suay et al. (1999) that was summarized above showed significant increases in T after a noncompetitive physical exercise session. In the study by Serrano et al. (2000) listed earlier, researchers controlled for differences in physical exertion between competitors, but this did not separate an effect on T caused by exertion from an effect on T caused by

winning/losing. Thus, more studies on the effects of winning/losing on T in the absence of physical exertion are needed.

Another explanation for the inconsistent findings involves psychological processes that may moderate the link between winning/losing and T responses. Salvador (2005) argues that the level of importance of a competition to the competitor may be one such moderating factor. Internalizing the experience of winning/losing may have different hormonal effects on individuals who differ on how important a competition is to them. Collecting information on the level of importance of a competition may be a necessary step in drawing conclusions about changes in T. As noted earlier, Suay et al. (1999) found positive relationships between changes in T and motivation to win. Motivation to win probably has a strong positive correlation with the level of importance of a competition

Another psychological process that may moderate the link between winning/losing and T changes is the degree of Internal/External Attribution that an individual holds about the outcome of a competition, as described by Salvador (2005). Someone who feels personally responsible for the outcome of a competition (Internal Attribution) may show a different T response than someone who feels the outcome was due to factors beyond their control (External Attribution). Exactly how this process may occur is yet unclear. Individuals with an Internal Attribution mindset may have a different emotional and cognitive experience of winning/losing than someone with an External Attribution mindset. Several of the studies listed above suggest a link between winning, a rise in T, and Internal Attribution. To reiterate, in the Gonzalez-Bono et al. (2000) study, team one, whose score for the basketball game was higher than team two, showed higher

Internal Attribution concerning their win. In the Gonzalez-Bono et al (1999) study, T correlated positively with Internal Attribution in winners, and negatively with losers. In the Gladue et al. (1989) study, decisive winners attributed their win to internal causes, and losers attributed their loss to external causes. However, in the Serrano et al. (2000) study, no significant difference was found between winners and losers with regard to attribution.

It must be noted that the results of previous studies that addressed attribution may be confounded. According to Miller and Ross (1975), one of the major ways individuals make errors in attributing causes to past events is through self-serving bias. That is, most individuals have a tendency to attribute their successes to internal causes, and their failures to external causes. In a competitive context, the winner may be more likely to attribute the win to internal causes, whereas the loser may be more likely to attribute the loss to external causes. To remedy this confound, researchers could ask questions about attribution before the competition. This way, participants' responses are not confounded by the experience of winning or losing. In this regard, however, the researcher is no longer looking at perceptions about what caused an event in the past, but is looking at perceptions about what will cause things in the future.

Another possible reason for the inconsistent findings on the effects of winning/losing on T is personality differences among the competitors. This is not unrelated to Importance of the Competition and Internal/External Attribution. For example, Importance of the Competition may be part of a broader personality characteristic. Someone who places high importance on a particular competition may also place a high level of importance on all competitions. It may be indicative of a general

personality characteristic: Competitiveness. As mentioned earlier, the study by Filaire et al. (2001) demonstrated that losers were more likely to have Type B personalities. One of the central identifying features of Type A personalities is competitiveness.

Internal/External Attribution may also be indicative of a general personality characteristic: Locus of Control. Competitors with Internal Attribution regarding the outcome of a competition may have an Internal Locus of Control. Those with External Attribution may have an External Locus of Control. As was previously discussed, certain personality characteristics have a reciprocal relationship with T. In this sense, it seems to make sense that certain traits might moderate the effect of winning/losing on T. The benefit of looking at underlying personality variables, such as Competitiveness and Locus of Control, is an increase in the predictive power of whether or not a change in T will be observed under competitive conditions.

Most of the aforementioned studies involved a competition where the outcome was determined by skill. Two of the studies looked at competitions where the outcome was entirely determined by chance. No studies to date have examined T changes in a competition where the outcome is simultaneously determined by skill and chance. Poker is an example of this type of competition.

For the unfamiliar reader, poker is a game that involves 2 to 14 players and uses traditional Western cards. Players are dealt a round of cards, which is followed by one or more rounds of betting. Bets are represented by chips in the center of the table, or the "pot." The goal for each player is to win the pot, which is done by the individual who has the best hand. At that point, another round of cards is dealt and the betting begins all over again. The game ends after a predetermined amount of time, or when one of the players

has won all of the others' chips. How well players fare in poker depends on their skill in how well they bet according to the cards they hold and the cards they suspect others hold. Luck of the draw also plays a role, but the strength of this role decreases the longer players play.

One reason to study poker is because of its enormous popularity. Poker is played by millions of people worldwide and has experienced dramatic growth in recent years. The rapid rise of televised poker and online poker are just two of the ways that the game has increasingly become a part of modern culture. Indeed, poker has become a multi-billion dollar industry. Far from being a trivial game, possible hormonal changes that result from playing poker may be of interest to researchers and the general public alike.

Poker may also have implications for when a change in T is observed. For instance, it is possible that only those who believe the outcome of the poker competition is determined by internal causes will show a change in T from pre- to post-game. Those who believe the winner of a poker game is determined by external causes may not show a change in T. Yet one study had results that are contrary to this hypothesis. McCaul et al. (1992) looked at a competition where the outcome was entirely determined by chance, and found that winners showed higher T than losers. More studies involving competitions where chance plays a role in the outcome are warranted.

The conclusions listed above suggest a need to study nonphysical competitions whose outcome is determined a combination of skill and chance. Furthermore, the issue is raised about possible factors that moderate the relationship between winning/losing and T responses. This brings the discussion to the purpose of the current study. Specifically, this study will attempt to answer three questions: (1) Does winning/losing at poker affect

T? (2) Do individual characteristics of Importance of the Competition and Internal/External Attribution moderate the relationship between poker competition and changes in T? (3) Do personality characteristics of Competitiveness and Locus of Control moderate the relationship between poker competition and changes in T?

CHAPTER 2

METHODOLOGY

Participants

Thirty-two participants completed the study. Ages ranged from 18 to 32 years with a mean of 22.15 years and a standard deviation of 3.49. Ethic breakdown is as follows: 24 Caucasians, 2 Hispanics, 2 Asians, 2 Asian-Americans, 1 African-American, and 1 Hispanic-American. Participants were limited to males because, as Dabbs (1995) explains, females have significantly lower T than males and assaying female samples can be difficult. Participants were recruited by word of mouth and through the undergraduate psychology subject pool of a large southwestern university. Individuals recruited through the psychology subject pool received course credit in return for participating in the study. This study did not involve any type of monetary exchange.

Measures

Saliva samples were collected and assayed with Salivary Testosterone Enzyme Immunoassay Kit 1-1402 from Salimetrics, LLC. James and Baxendale (1984) and Wang (1981) portrayed how salivary T correlates highly with free T. Saliva samples are also easier and less intrusive to collect than blood samples. Collection and handling procedures were based on recommendations by Ellison (1988) and Salimetrics. For the assays of the three sample times, interassay coefficients of variation were 18.3% for low

controls and 3.0% for high controls. The intraassay coefficient of variation was 6.5%. Experiments were scheduled between 2:00pm and 4:00pm on weekdays to control for natural diurnal patterns of T. Dabbs (1990) found that T drops by approximately 50% from early morning to late evening, the largest drop occurring in the morning.

The Competitiveness Index (CI; Smither & Houston, 1992) is a measure of general competitiveness in interpersonal situations. That is, the CI measures competitiveness as a global concept. It is comprised of 20 true-false items that measure positive and negative attitudes toward competition. The items form three factors: emotion, argument, and games. In a validation study conducted by Houston, Farese, and La Du (1992), the authors provide evidence for construct validity in the CI. Specifically, the CI distinguished between individuals in a competitive profession from those in a less competitive profession. Smither and Houston (1992) also found evidence for construct validity in the CI as they investigated several tests of competitiveness. Finally, Houston, McIntire, Kinnie, and Terry (2002) reported a Cronbach's alpha of .90 for the CI. The items for the CI are located in Appendix I.

I have developed four items that were used to measure how important it is for a participant to win the poker game. Items were rated on a Likert 7-point scale where the possible values for each item response were: -3, -2, -1, 0, +1, +2, and +3. The items are located in Appendix II.

I have developed another twelve items that were used to measure Internal/External Attribution about winning/losing the poker game. Specifically, these items were designed to measure the degree to which an individual believes events are caused by themselves (Attribution-I), powerful others (Attribution-P), or chance

(Attribution-C). The first construct is a measure of Internal Attribution; the latter two are measures of External Attribution. The three constructs are based on Levenson's (1974) Internal, Powerful Others, Chance Scale. Again, items were rated on a Likert 7-point scale where the possible values for each item response were: -3, -2, -1, 0, +1, +2, and +3. The responses were then summed separately for Attribution-I, Attribution-P, and Attribution-C. It is important to recognize that an individual may score high or low on all or none of these three constructs. The items are located in Appendix III. For the study, the items in Appendices II and III were added to the CI. This questionnaire, now totaling thirty-six items, was administered under the title "Attitude Questionnaire" to avoid priming and labeling confounds.

The Internal, Powerful Others, Chance Scale (IPC Scale; Levenson, 1974) is a Locus of Control measure. Specifically, it measures the degree to which a person expects their life to be controlled by themselves (Locus of Control-I), powerful others (Locus of Control-P), or chance (Locus of Control-C). The first construct is considered Internal Locus of Control; the latter two are considered External Loci of Control. The IPC Scale is comprised of 24 items. There are eight items for each of the I, P, and C subscales. Once more, items were rated on a Likert 7-point scale where the possible values for each item response are: -3, -2, -1, 0, +1, +2, and +3. The responses were summed separately for Locus of Control-I, Locus of Control-P, and Locus of Control-C. A score of 24 was then added to each of the these three constructs. Again, an individual may score high or low on all or none of these subscales. Levenson (1974) reports internal consistency reliabilities of .62 to .68. Moreover, Furnham and Steele (1993) report concurrent,

construct, and discriminant validity for the IPC Scale. This questionnaire is located in Appendix IV.

Procedure

Before participants were recruited for the study, a question was asked about their level of experience in poker: "Have you played poker between 1 and 10 times, 11 and 50 times, or more than 50 times?" This allowed the experimenter to pair participants with equal levels of experience for a fairer competition. Individuals with no experience in poker were not recruited. Participants were also advised not to eat anything within one hour of the experiment, as food may contaminate saliva samples. The experiment was held on the university campus in a room that was relatively free of distractions. When participants arrived for the study, the experimenter explained the experiment and got informed consent before proceeding. Participants started by rinsing their mouths with water to reduce contamination of the saliva samples. Next, the experimenter asked for age, height, weight, ethnicity, and any drugs consumed with the last 30 days. The reason for asking these questions was for information purposes and for interpreting T samples. Next, the Attitude Questionnaire was administered. Participants were then given a short straw to dispense about 1 ml of saliva into a 1.8 ml capsule. This sample, and subsequent samples, were stored in a freezer at -20 Celsius. The first saliva sample served as the baseline measure of T, noted T1. A two-man poker game promptly followed. Participants were paired with strangers to standardize the level of familiarity between opponents. The experimenter served as the dealer, but did not participate in the game otherwise. Participants were each given 50 chips. There was one blind of two chips which alternated between the two players with each round. The maximum bet was four chips, with a

maximum of three raises per betting interval. These rules are very similar to Texas Holdem rules and helped make the games last at least 15 minutes. Participants were advised to treat the session like a real poker game. The game ended when someone won all of the opponent's chips or after 30 minutes of play. If the 30 minute time limit ran out before a winner was determined, the player with the most chips was deemed the winner. The players were informed of this rule in advance. Participants were permitted to complete a hand if the time limit ran out, and so games technically lasted up to 31 minutes. The purpose of restricting the length of game play was to control for any possible T effects that may occur from playing considerably less than 15 minutes or considerably more than 30 minutes. Five minutes after the game ended, a second saliva sample was collected. This sample served as a post-test measure, noted T2. Participants then completed the IPC Scale. Twenty minutes after the game ended (and shortly after the IPC Scale was completed), a third saliva sample was collected. This sample served as another post-test measure, noted T3. The reason for taking two post-test samples was to increase the chance of detecting a change in T, if one occurred.

Statistical Analyses

First, correlation analyses were used to determine if potential confounds had a significant relationship with T responses. Second, a mixed model ANOVA was then used to determine if there were significant changes in T from T1 to T2, T1 to T3, and T2 to T3 in all participants as a group. Third, a repeated measures ANOVA was used to determine if there were significant changes in T in winners and losers separately. Fourth, linear regression was used to determine if there were significant differences in T responses between winners and losers. Finally, linear regression was also used to determine if

Importance of the Competition, Internal/External Attribution, Competitiveness, and Locus of Control moderated the relationship between winning/losing the poker game and T responses, and the relationship between magnitude of the win/loss and T responses.

CHAPTER 3

RESULTS

Potential Confounds

A number of potential confounds must be ruled out in order to draw conclusions about the relationship between winning/losing and T responses. The main variables of interest here are age, length of game play, drugs, experience, and body mass index (BMI). Again, ages ranged from 18 to 32 years with a mean of 22.15 years and a standard deviation of 3.49. There was a significant positive correlation between age and T response T1 to T3 ($r = .35, p < .05$). In other words, as age increased, T response increased. Since T decreases from the late teens and early twenties, one would expect to find a negative correlation between age and T responses. Had age correlated inversely with T responses, it would have been justified to add age as a covariate in the T response analyses. It is probably safe to assume that the significant correlation was due to random error, yet conclusions should be drawn with caution.

Length of game play ranged from 9 to 31 minutes with a mean of 27.06 minutes and a standard deviation of 6.43 minutes. There was a significant inverse correlation between length of game play and T response T1 to T2 ($r = -.40, p < .05$). In other words, as game play increased, T response decreased. One game lasted only 9 minutes, which is an outlier being more than three standard deviations away from the mean length of game

play. When this game is removed from the analysis, the correlation is no longer significant (r = -.34, p > .05). This suggests that length of game play may be ruled out as a potential confound. Note that the following analyses did include this game.

Most of the participants consumed some form of drug within 30 days prior to the experiment. These drugs included, but were not limited to, marijuana, antidepressants, antibiotics, and cold medication. The most common drug used was marijuana, consumed by eight of the participants. There were no significant correlations between marijuana use and T responses (p > .05). This suggests that marijuana may be ruled out as a potential confound.

Twenty participants had a high level of poker experience (played more than 50 times in their life). Ten participants had a medium level of poker experience (played between 10 and 50 times in their life). Two participants had a low level of poker experience (played between 1 and 10 times in their life). There were no significant correlations between experience and T responses (p > .05). This suggests that experience may be ruled out a potential confound.

BMI is a crude measure of obesity, varying inversely with T level. For all participants as a group, BMI ranged from 16.77 to 35.38 with a mean of 24.33 and a standard deviation of 3.69. There were no significant correlations between BMI and T responses (p > .05). This suggests that BMI may be ruled out a potential confound.

Testosterone Levels and Responses

Figure 1 portrays the mean T levels for winners and losers across the three sample times. Descriptive statistics for T levels for all participants as a group, and winners and losers separately, are located in Table 1. T levels are expressed in picograms per milliliter

(pg/mL) of saliva. For all participants as a group, the means of T1, T2, and T3 are 145.51, 159.11, and 144.19, respectively. There was a significant increase from T1 to T2 of 9.35% ($p < .05$), a nonsignificant decrease from T1 to T3 of 0.91% ($p > .05$), and a significant decrease from T2 to T3 of 9.38% ($p < .001$). For winners, the means of T1, T2, and T3 are 147.43, 158.87, and 143.37, respectively. There was a nonsignificant increase from T1 to T2 of 7.76% ($p > .05$), a nonsignificant decrease from T1 to T3 of 2.75% ($p > .05$), and a significant decrease from T2 to T3 of 9.76% ($p < .05$). For losers, the means of T1, T2, and T3 are 143.59, 159.35, and 145.01, respectively. There was a nonsignificant increase from T1 to T2 of 10.98% ($p > .05$), a nonsignificant increase from T1 to T3 of 0.99% ($p > .05$), and a significant decrease from T2 to T3 of 9.00% ($p < .01$).

Tables 2, 3, and 4 show the results of Mixed Model ANOVAS for T responses T1 to T2, T1 to T3, and T2 to T3, respectively. There were no significant differences between winners and losers for any of the three T responses (Btwn Ss, Win/Lose, $p > .05$). However, the changes in T for winners and losers were included above for information purposes.

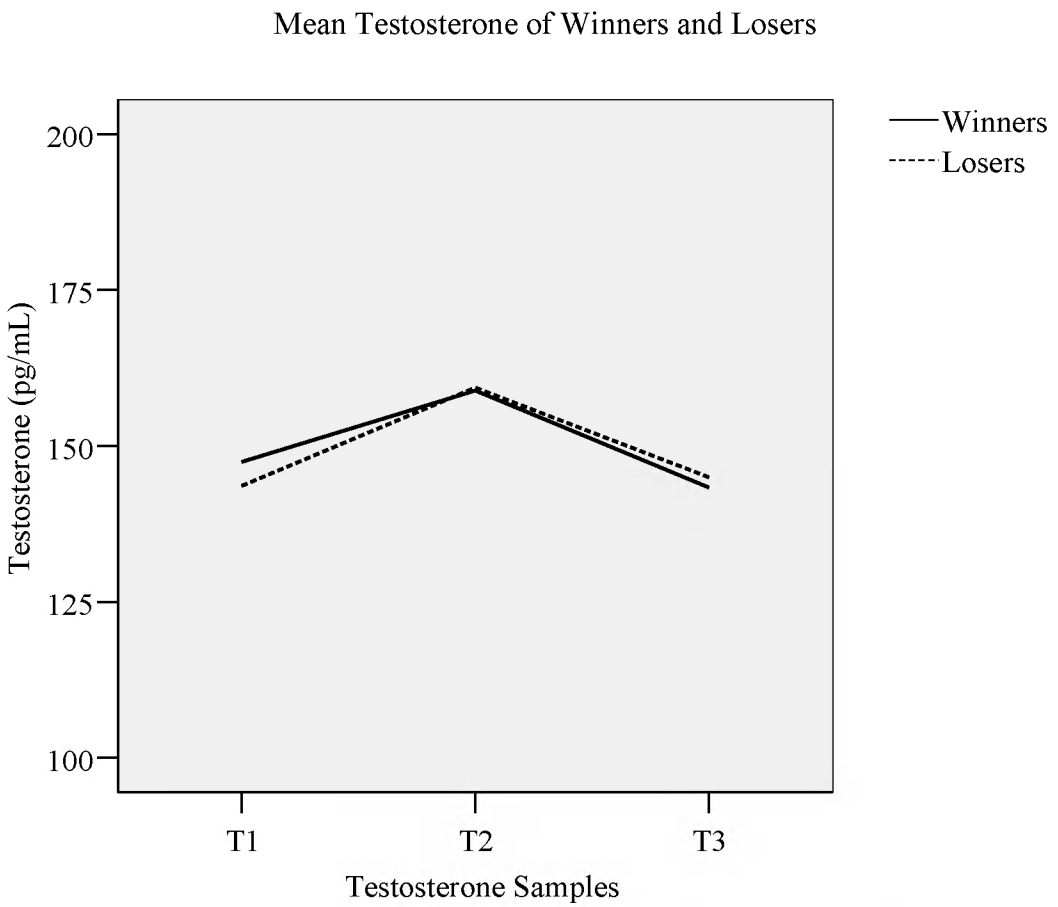

Figure 1. Average T levels of winners and losers at three sample times. T1 was taken shortly before the poker game. T2 was taken five minutes after the poker game. T3 was taken 20 minutes after the poker game. The average time between T1 and T2 was 36 minutes. The time between T2 and T3 was 15 minutes.

Importance of the Competition

Descriptive statistics for all moderators are located in Table 5. The possible range of scores on the items that measured Importance of the Competition was -12 to +12, where +12 indicates the most importance to the participant. For all participants as a group, scores ranged from -12 to 11 with a mean of .94 and a standard deviation of 5.80. For the winners, scores ranged from -11 to 11 with a mean of .81 and a standard

deviation of 6.15. For the losers, scores ranged from -12 to 9 with a mean of 1.06 and a standard deviation of 5.64.

Moderator analyses for Importance of the Competition are located in Table 6. Winning/losing is indicated by "Win/Loss," and magnitude of the win/loss is indicated by "Chips at End." The table shows that none of the interactions are significant. Thus, Importance of the Competition did not moderate the relationship between winning/losing and T responses ($p > .05$), nor did it moderate the relationship between magnitude of the win/loss and T responses ($p > .05$).

Internal/External Attribution

The possible range of scores on the items that measured Attribution-I with regard to the poker game was -12 to +12, where +12 indicates the highest degree of Internal Attribution. For all participants as a group, scores ranged from -11 to 11 with a mean of -.28 and a standard deviation of 5.24. For the winners, scores ranged from -10 to 11 with a mean of 1.19 and a standard deviation of 5.31. For the losers, scores ranged from -11 to 6 with a mean of -1.75 and a standard deviation of 4.89. Moderator analyses for Attribution-I are located in Table 7. Attribution-I approached significance ($p < .10$) in moderating the relationship between winning/losing and T responses T1 to T2, and T1 to T3. Attribution-I also moderated the relationship between magnitude of the win/loss and T responses T1 to T2 ($p < .01$), and T1 to T3 ($p < .05$).

The possible range of scores on the items that measured Attribution-P was -12 to +12, where +12 indicates the highest degree of Powerful Other Attribution. For all participants as a group, scores ranged from -12 to 1 with a mean of -7.13 and a standard

deviation of 4.16. For the winners, scores ranged from -12 to -3 with a mean of -7.94 and a standard deviation of 3.19. For the losers, scores ranged from -12 to 1 with a mean of -6.31 and a standard deviation of 4.92. Moderator analyses for Attribution-P are located in Table 8. Attribution-P moderated the relationship between magnitude of the win/loss and T responses T1 to T2 ($p < .05$), and T1 to T3 ($p < .01$).

The possible range of scores on the items that measured Attribution-C was -12 to +12, where +12 indicates the highest degree of Chance Attribution. For all participants as a group, scores ranged from -8 to 12 with a mean of 3.69 and a standard deviation of 5.81. For the winners, scores ranged from -8 to 12 with a mean of 2.50 and a standard deviation of 5.74. For the losers, scores ranged from -8 to 12 with a mean of 4.88 and a standard deviation of 5.81. Moderator analyses for Attribution-C are located in Table 9. Attribution-C moderated the relationship between winning/losing and T responses T1 to T2 ($p < .05$), and T1 to T3 ($p < .01$). Attribution-C also moderated the relationship between magnitude of the win/loss and T responses T1 to T2 ($p < .001$), and T1 to T3 ($p < .001$).

Competitiveness

The possible range of scores on the Competitiveness Index is 0 to 20, where 20 indicates the highest level of competitiveness. For all participants as a group, scores ranged from 7.50 to 20.00 with a mean of 15.23 and a standard deviation of 2.88. For the winners, scores ranged from 7.50 to 20.00 with a mean of 14.84 and a standard deviation of 3.19. For the losers, scores ranged from 10.00 to 19.00 with a mean of 15.63 and a standard deviation of 2.58. Houston and Smither (1999) state that definitive cutoff scores have not been obtained, yet provide the following guidelines for men: a CI score of 15 or

more is considered high and 7 or less is considered low. In a sample of approximately 500 undergraduate students, the average CI for men was 12.06 with a standard deviation of 4.88. Moderator analyses for Competitiveness are located in Table 10. Competitiveness approached significance in moderating the relationship between magnitude of the win/loss and T response T1 to T2 ($p < .10$). Competitiveness did moderate the relationship between magnitude of the win/loss and T response T1 to T3 ($p < .05$).

Locus of Control

The possible range of scores on the items that measured Locus of Control-I was 0 to 48, where 48 indicates the highest degree of Internal Locus of Control. For all participants as a group, scores ranged from 30 to 46 with a mean of 36.78 and a standard deviation of 4.02. For the winners, scores ranged from 32 to 44 with a mean of 35.94 and a standard deviation of 3.19. For the losers, scores ranged from 30 to 46 with a mean of 37.63 and a standard deviation of 4.66. Moderator analyses for Locus of Control-I are located in Table 11. Internal Locus of Control moderated the relationship between magnitude of the win/loss and T responses T1 to T2 ($p < .01$), and T1 to T3 ($p < .05$).

The possible range of scores on the items that measured Locus of Control-P was 0 to 48 to 48, where 48 indicates the highest degree of Powerful Other Locus of Control. For all participants as a group, scores ranged from 12 to 37 with a mean of 23.25 and a standard deviation of 5.90. For the winners, scores ranged from 12 to 37 with a mean of 23.56 and a standard deviation of 7.10. For the losers, scores ranged from 14 to 29 with a mean of 22.94 and a standard deviation of 4.61. Moderator analyses for Locus of Control-P are located in Table 12. Locus of Control-P did not moderate the relationship

between winning/losing and T responses ($p > .05$), nor did it moderate the relationship between magnitude of the win/loss and T responses ($p > .05$).

The possible range of scores on the items that measured Locus of Control-C was 0 to 48, where 48 indicates the highest degree of Chance Locus of Control. For all participants as a group, scores ranged from 9 to 34 with a mean of 20.38 and a standard deviation of 7.17. For the winners, scores ranged from 9 to 34 with a mean of 20.88 and a standard deviation of 7.60. For the losers, scores ranged from 9 to 30 with a mean of 19.88 and a standard deviation of 6.92. Moderator analyses for Locus of Control-C are located in Table 13. Locus of Control-C did not moderate the relationship between winning/losing and T responses, nor did it moderate the relationship between magnitude of the win/loss and T responses ($p > .05$).

CHAPTER 4

DISCUSSION

Conclusions

In sum, the poker competition caused a significant increase in T from T1 to T2 in all participants as a group. Furthermore, there was a significant decrease in T returning to baseline levels from T2 to T3 in all participants as a group. There appears to be an arousal effect in T that peaks near the end of the competition or soon after the competition is over. The precise timing and magnitude of this peak is unclear because T was not continuously sampled during the study. To reiterate a cautionary note, length of game play had a significant inverse correlation with T response T1 to T2.

The findings also indicated no significant difference between winners and losers in T responses. Overall, this suggests that winning or losing a nonphysical, skilled competition does not add variance to T responses, but that competition itself does add variance. An alternative explanation is that winning and losing do have different effects on T responses, but this study did not capture these effects.

A brief comment on why a significant increase in T occurred is warranted here. Mazur's (1985) Biosocial Model of Status may shed light in this regard. The Model posits that status is established among members of a primate group by way of face to face interaction. Furthermore, T is related to one's motivation to increase status within that

group. Those with high or increasing T are more likely to compete than those with low or decreasing T. Success at increasing status causes an increase in T; failure causes a decrease in T. Hence, T and dominance have a reciprocal relationship. In the current study, participants were competing and thus showing at least some degree of a motivation to increase status, which may explain the significant rise in T for winners and losers alike. Had the consequences of winning and losing been far greater, it is conceivable that a difference in T responses between winners and losers may have been found.

Importance of the Competition moderated neither the relationship between winning/losing and T responses, nor the relationship between magnitude of the win/loss and T responses. It is difficult to generalize from these findings that Importance of the Competition has no impact on T responses in various competitive situations. For instance, a competition for vast sums of money may very well cause different T responses than a trivial competition used to pass the time. It is possible that this study's poker competition did not have enough importance to be linked with changes in T.

Internal/External Attribution showed some degree of significant moderation in the relationship between winning/losing and T responses. Attribution-I approached significance in this capacity for changes in T from T1 to T2, and T1 to T3. For those who scored high on Attribution-I and won, T increased. Attribution-C showed significant moderation for changes in T from T1 to T2, and T1 to T3, too. For those who scored high on Attribution-C and won, T decreased.

Internal/External Attribution also showed some degree of moderation in the relationship between the magnitude of the win/loss and T responses. Attribution-I, Attribution-P, and Attribution-C all showed significant moderation for changes in T from

T1 to T2, and T1 to T3. For those who scored high on Attribution-I or Attribution-P, as Chips at End increased, T increased. For those who scored high on Attribution-C, as Chips at End increased, T decreased. The findings for Attribution-I and Attribution-C seem logical. The findings for Attribution-P are surprising. One might expect Attribution-P to have the opposite effect in moderation from Attribution-I. Yet there is a common link between Attribution-I and Attribution-P that may reconcile the findings: both involved a belief that the outcome of the competition was determined by a person and not an abstract concept such as chance. Perhaps the more an individual believes the outcome of such a competition is determined by a human, the more T increases.

Competitiveness did not moderate the relationship between winning/losing and T responses. However, Competitiveness did approach significance in moderating the relationship between the magnitude of the win/loss and the change in T from T1 to T2, and did reach significance for the change in T from T1 to T3. In both cases, for those who scored high on Competitiveness, as Chips at End increased, T decreased. This seems counterintuitive. One might expect to associate a stronger desire to win with a stronger T response. It seems unlikely, but perhaps competitive individuals exhibit a habituating effect that decreases T responses to a competitive stimulus. Conversely, noncompetitive individuals may exhibit a sensitizing effect that increases T responses to a competitive stimulus.

None of the three Locus of Control scales moderated the relationship between winning/losing and T responses. The belief about the cause of general life events may have no relationship with T responses in a competitive situation. There is probably enormous variation in individual and personality characteristics within each of the three

Loci of Control, and this variation may explain why Locus of Control is perhaps unable to predict T responses.

However, Locus of Control-I did moderate the relationship between the magnitude of the win/loss and T responses T1 to T2, and T1 to T3. Regardless of their score on Locus of Control-I, as Chips at End increased, T increased from T1 to T2 and from T1 to T3. However, the increase in T was much larger for those who scored low on Locus of Control-I. This was surprising. One might expect to associate a stronger belief about being personally responsible for general life events with a stronger T response.

Individual characteristics (Internal/External Attribution) appear to play a role in moderating the relationship between winning/losing in T responses. At this stage, that role seems to be limited and unclear. As well, individual characteristics (Internal/External Attribution) and personality characteristics (Competitiveness and Locus of Control) appear to play a role in moderating the relationship between magnitude of the win/loss and T responses. Again, the role is limited and unclear.

More moderation was found between magnitude of the win/loss and T responses than simply winning/losing and T responses. Perhaps only a large difference between a win and a loss results in a significant difference in T responses between a winner and a loser. This is more accurately captured by measuring magnitude of the win/loss versus just the win/loss itself. In this study, the difference between winning and losing was often very small. The lack of differentiation between winners' and losers' T responses may be a reflection of the close wins/losses. As a result, less moderation may have been detected in the relationship winning/losing and T responses, too.

Declaring a winner and a loser of a competition provides discrete data and makes for efficient data analyses in relation to T responses. However, simply declaring a winner and a loser does not capture the enormous range of experiences that could exist among competitors. Moreover, the variation in these experiences may be related to their physiological responses. By measuring the magnitude of the win/loss, more detail about the nature of a win/loss is included. This may have important implications about when differences in T responses between winners and losers occur.

Limitations of the Study

The study had a number of limitations that may have affected the results. One limitation was that the study did not involve any monetary exchange. Poker usually involves gambling for money. By removing the element of a potential loss or gain in money in this study, both the participants' manner of play and T responses may have been altered. For instance, players may have played more riskily since there was no chance of losing anything substantial. As well, it may have reduced participants' motivation to play seriously. Ultimately, removing the potential for monetary loss or gain may have lessened changes in T. It is possible that losers did not really feel like losers because they did not lose any money, and winners did not really feel like winners because they did not gain any money. Again, this may have been reflected by the lack of differentiation between winners' and losers' T responses.

A second limitation that is related to the first limitation was that the study was relatively unimportant to the participants. The experiment aimed to measure Importance of the Competition to the participants. Eliminating the potential for monetary loss or gain may have reduced participants' scores on this construct. Furthermore, the variance of

scores obtained for this construct may have been narrower than if money would have been introduced to the game. The result is an inability to determine if Importance of the Competition moderated the relationship between winning/losing and T responses.

A third limitation concerned the limit in the length of game play. The 30 minute time limit almost certainly changed how participants normally play poker. For instance, if someone was losing by a large margin near the end of the time limit, that individual may have been forced to bet heavily on each of the last several hands, even the poor ones that he may not typically bet on in a real game. On the other hand, those who were winning near the end of the game may have been playing more conservatively than normally in an attempt to "let the clock run out" while he was still ahead in chips. In the end, a limitation such as this makes it difficult to generalize findings to other competitive contexts.

A fourth limitation was that there was often no definitive winner. At times an individual won (or lost) by a margin of two chips. At other times an individual was clearly dominating the game and then in a few short hands lost the game. In cases like these it is difficult to determine who definitively won. As mentioned in the preceding section, perhaps this is why no significant difference in T responses was found between winners and losers. This may also be why considerably more moderation was found in the relationship between magnitude of the win/loss and T responses versus the relationship between winning/losing and T responses.

A fifth limitation concerned the sample of participants. The sample size was small which limited the ability to detect an effect if one existed. As well, over half of the participants were Psychology 101 students at UNLV. Thus, the sample may not have been representative of the population. Furthermore, Psychology 101 students received

course credit for participating in the study. Hence the motivation to play poker not just to win, but also for course credit, may have introduced another source of variance into the data.

Future Research

One option for a future study is to use poker games that involve a cash buy in. Doing so would accomplish two important goals. First, it would increase the difference in the consequences of winning and losing. A low stakes competition, such as the one the current study involved, may result in T responses that do not differ between winners and losers. A high stakes competition may produce different results between winners and losers. Second, a cash buy in will increase Importance of the Competition to the participants. Importance of the Competition may provide some degree of predictive power in T responses if the competition is indeed important, or varies in importance among participants.

On a similar note, in the future one could try to ensure that there is a definitive win versus a close win between competitors. For instance, a more standard poker game could be used where the game is not over until one player has won (or lost) all of the chips. Again, this may increase the difference between winners and losers in T responses. A definitive win could also be facilitated by playing "limit poker," as the current study did. This limits how much a player can win or lose in any hand. The result is that a player cannot win or lose the game in a few short hands. In other words, a player would have to definitively win (or lose) for a period of time before the outcome is declared. Granted, some control over the length of game play would be lost.

Yet another option is to use another nonphysical, skilled competition that fits within a gambling context, such as blackjack. Like poker, blackjack is a game of skill and chance. One could then compare the T responses of such a study to the T responses obtained in this study. This will help determine if these types of competitions produce a significant rise in T during the competition with no difference between winners and losers. If the results are similar, one has more confidence in generalizing the conclusions to other nonphysical competitions of skill and chance.

Edwards (2006) and Roney, Lukaszewski, and Simmons (in press) pointed out that individual and personality variables may hold clues about when T responses occur in various situations. In competitive situations, future research could look at the variables that were measured in this study, or look at new ones. Dominance and aggression have long been studied for their links with T, as discussed by Mazur and Booth (1998) and Archer (2006), respectively. Differences in dominance and aggression may change how competitors internalize the experience of the competition, and therefore provide different T responses. In other words, dominance and aggression may be viewed as filters that change the emotional or cognitive experience of winning/losing and cause different hormonal responses among competitors.

Table 1
Testosterone Descriptive Statistics

	N	Min.	Max.	Mean	Std. Dev.
All Participants					
T1	32	69.49	270.05	145.51	45.60
T2	32	84.10	294.44	159.11	56.46
T3	32	76.99	273.95	144.19	53.21
%IncreaseT1toT2	32	-21.45	77.35	9.90	20.44
%IncreaseT1toT3	32	-36.57	65.02	.21	22.29
%DecreaseT2toT3	32	-15.03	36.28	8.70	12.09
Winners					
T1	16	86.10	208.40	147.43	39.00
T2	16	84.10	283.72	158.87	55.72
T3	16	79.39	268.25	143.37	48.86
%IncreaseT1toT2	16	-19.71	58.21	7.36	20.52
%IncreaseT1toT3	16	-36.57	44.45	-1.57	22.79
%DecreaseT2toT3	16	-15.03	36.28	8.08	14.08
Losers					
T1	16	69.49	270.05	143.59	52.62
T2	16	84.59	294.44	159.35	59.01
T3	16	76.99	273.95	145.01	58.85
%IncreaseT1toT2	16	-21.45	77.35	12.45	20.71
%IncreaseT1toT3	16	-28.52	65.02	1.99	22.38
%DecreaseT2toT3	16	-6.52	28.54	9.31	10.14

Table 2

Mixed Model ANOVA: T Response T1 to T2 for All Participants

Source	SS	df	MS	F	p
Btwn Ss					
Win/Lose	44.98	1	44.98	0.01	.924
Ss x Win/Lose	144613.67	30	4820.46		
Within Ss					
T Samples	2958.49	1	2958.49	4.79	.037*
Interaction	74.81	1	74.81	0.12	.730
Ss x T Samples	18537.48	30	617.92		
Total	166229.43	63			

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 3

Mixed Model ANOVA: T Response T1 to T3 for All Participants

Source	SS	df	MS	F	p
Btwn Ss					
Win/Lose	19.48	1	19.48	0.00	.947
Ss x Win/Lose	131918.14	30	4397.27		
Within Ss					
T Samples	28.01	1	28.01	0.04	.840
Interaction	119.74	1	119.74	0.18	.676
Ss x T Samples	20193.23	30	673.11		
Total	152278.61	63			

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 4

Mixed Model ANOVA: T Response T2 to T3 for All Participants

Source	SS	df	MS	F	p
Btwn Ss					
Win/Lose	17.94	1	17.94	0.00	.957
Ss x Win/Lose	180044.34	30	6001.48		
Within Ss					
T Samples	3562.24	1	3562.24	16.38	.000***
Interaction	5.26	1	5.26	0.02	.877
Ss x T Samples	6522.70	30	217.42		
Total	190152.47	63			

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 5
Moderator Descriptive Statistics

	N	Min.	Max.	Mean	Std. Dev.
All Participants					
Importance	32	-12.00	11.00	.94	5.80
Attribution-I	32	-11.00	11.00	-.28	5.24
Attribution-P	32	-12.00	1.00	-7.13	4.16
Attribution-C	32	-8.00	12.00	3.69	5.81
Competitiveness	32	7.50	20.00	15.23	2.88
Locus of Control-I	32	30.00	46.00	36.78	4.02
Locus of Control-P	32	12.00	37.00	23.25	5.90
Locus of Control-C	32	9.00	34.00	20.38	7.17
Winners					
Importance	16	-11.00	11.00	.81	6.15
Attribution-I	16	-10.00	11.00	1.19	5.31
Attribution-P	16	-12.00	-3.00	-7.94	3.19
Attribution-C	16	-8.00	12.00	2.50	5.74
Competitiveness	16	7.50	20.00	14.84	3.19
Locus of Control-I	16	32.00	44.00	35.94	3.19
Locus of Control-P	16	12.00	37.00	23.56	7.10
Locus of Control-C	16	9.00	34.00	20.88	7.60
Losers					
Importance	16	-12.00	9.00	1.06	5.64
Attribution-I	16	-11.00	6.00	-1.75	4.89
Attribution-P	16	-12.00	1.00	-6.31	4.92
Attribution-C	16	-8.00	12.00	4.88	5.81
Competitiveness	16	10.00	19.00	15.63	2.58
Locus of Control-I	16	30.00	46.00	37.63	4.66
Locus of Control-P	16	14.00	29.00	22.94	4.61
Locus of Control-C	16	9.00	30.00	19.88	6.92

Table 6
Moderator Analyses: Importance of the Competition

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	-.163	.392		
Importance	-.011	.953	.234	.659
Interaction	.201	.294		
T1 to T3 Change				
Win/Loss	-.110	.563		
Importance	-.100	.597	.190	.790
Interaction	.151	.432		
T2 to T3 Change				
Win/Loss	-.059	.758		
Importance	.169	.371	.192	.784
Interaction	.063	.742		
T1 to T2 Change				
Chips At End	-.123	.508		
Importance	-.333	.290	.300	.444
Interaction	.444	.159		
T1 to T3 Change				
Chips At End	-.078	.684		
Importance	-.222	.492	.163	.858
Interaction	.183	.569		
T2 to T3 Change				
Chips At End	-.051	.780		
Importance	-.141	.652	.303	.434
Interaction	.400	.202		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 7
Moderator Analyses: Attribution-I

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	-.092	.620		
Attribution-I	-.052	.778	.361	.263
Interaction	.340	.065		
T1 to T3 Change				
Win/Loss	-.005	.977		
Attribution-I	-.205	.275	.364	.256
Interaction	.313	.088		
T2 to T3 Change				
Win/Loss	-.145	.448		
Attribution-I	.321	.099	.311	.408
Interaction	-.033	.857		
T1 to T2 Change				
Chips At End	-.061	.705		
Attribution-I	-.797	.007**	.554	.015*
Interaction	.919	.002**		
T1 to T3 Change				
Chips At End	-.027	.877		
Attribution-I	-.714	.022*	.430	.120
Interaction	.652	.035*		
T2 to T3 Change				
Chips At End	-.047	.797		
Attribution-I	.042	.893	.334	.337
Interaction	.296	.344		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 8
Moderator Analyses: Attribution-P

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	.230	.499		
Attribution-P	-.005	.978	.284	.493
Interaction	.438	.194		
T1 to T3 Change				
Win/Loss	.163	.638		
Attribution-P	-.040	.841	.211	.731
Interaction	.309	.365		
T2 to T3 Change				
Win/Loss	.071	.841		
Attribution-P	.056	.782	.096	.967
Interaction	.135	.695		
T1 to T2 Change				
Chips At End	.690	.062		
Attribution-P	-.730	.019*	.479	.060
Interaction	1.232	.011*		
T1 to T3 Change				
Chips At End	.863	.018*		
Attribution-P	-.841	.006**	.535	.022*
Interaction	1.417	.003**		
T2 to T3 Change				
Chips At End	-.455	.258		
Attribution-P	.348	.294	.225	.685
Interaction	-.595	.248		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 9
Moderator Analyses: Attribution-C

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	.155	.448		
Attribution-C	-.076	.657	.474	.064
Interaction	-.541	.011*		
T1 to T3 Change				
Win/Loss	.304	.120		
Attribution-C	.118	.465	.566	.012*
Interaction	-.655	.002**		
T2 to T3 Change				
Win/Loss	-.297	.164		
Attribution-C	-.326	.073	.424	.131
Interaction	.324	.126		
T1 to T2 Change				
Chips At End	.248	.166		
Attribution-C	.920	.002**	.634	.002**
Interaction	-1.191	.000***		
T1 to T3 Change				
Chips At End	.306	.093		
Attribution-C	1.090	.000***	.627	.003**
Interaction	-1.174	.000***		
T2 to T3 Change				
Chips At End	-.153	.479		
Attribution-C	-.493	.151	.335	.336
Interaction	.221	.526		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 10
Moderator Analyses: Competitiveness

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	.839	.421		
Competitiveness	.231	.228	.285	.491
Interaction	-.949	.361		
T1 to T3 Change				
Win/Loss	.996	.350		
Competitiveness	.052	.787	.210	.733
Interaction	-1.089	.305		
T2 to T3 Change				
Win/Loss	-.522	.613		
Competitiveness	.270	.158	.306	.425
Interaction	.517	.615		
T1 to T2 Change				
Chips At End	1.539	.093		
Competitiveness	.704	.043*	.397	.181
Interaction	-1.595	.071		
T1 to T3 Change				
Chips At End	1.957	.033*		
Competitiveness	.652	.057	.423	.132
Interaction	-2.011	.023*		
T2 to T3 Change				
Chips At End	-1.166	.202		
Competitiveness	-.084	.804	.380	.218
Interaction	1.177	.180		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 11
Moderator Analyses: Locus of Control-I

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	2.611	.131		
Locus of Control-I	.295	.115	.486	.053
Interaction	-2.689	.123		
T1 to T3 Change				
Win/Loss	1.386	.418		
Locus of Control-I	.409	.033*	.479	.060
Interaction	-1.387	.422		
T2 to T3 Change				
Win/Loss	1.497	.429		
Locus of Control-I	-.238	.248	.238	.646
Interaction	-1.608	.400		
T1 to T2 Change				
Chips At End	4.059	.008**		
Locus of Control-I	.899	.001**	.598	.006**
Interaction	-4.019	.008**		
T1 to T3 Change				
Chips At End	3.290	.032*		
Locus of Control-I	.865	.001**	.576	.009**
Interaction	-3.201	.033*		
T2 to T3 Change				
Chips At End	.256	.885		
Locus of Control-I	-.139	.632	.187	.798
Interaction	-.348	.840		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 12
Moderator Analyses: Locus of Control-P

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	.781	.349		
Locus of Control-P	.154	.448	.252	.602
Interaction	-.944	.264		
T1 to T3 Change				
Win/Loss	.360	.665		
Locus of Control-P	-.153	.454	.235	.657
Interaction	-.447	.595		
T2 to T3 Change				
Win/Loss	.536	.484		
Locus of Control-P	.490	.013*	.452	.089
Interaction	-.633	.414		
T1 to T2 Change				
Chips At End	.420	.630		
Locus of Control-P	.334	.429	.208	.739
Interaction	-.680	.499		
T1 to T3 Change				
Chips At End	.170	.845		
Locus of Control-P	-.086	.838	.218	.709
Interaction	-.279	.780		
T2 to T3 Change				
Chips At End	.267	.738		
Locus of Control-P	.615	.117	.449	.094
Interaction	-.458	.617		

*$p < .05$. ** $p < .01$. p *** $< .001$.

Table 13
Moderator Analyses: Locus of Control-C

	Standardized Coefficients: Beta	Significance	R for the Model	Overall Significance
T1 to T2 Change				
Win/Loss	-.173	.765		
Locus of Control-C	.076	.688	.149	.887
Interaction	.044	.940		
T1 to T3 Change				
Win/Loss	.139	.812		
Locus of Control-C	.003	.987	.111	.950
Interaction	-.233	.690		
T2 to T3 Change				
Win/Loss	-.507	.381		
Locus of Control-C	.088	.641	.192	.784
Interaction	.475	.412		
T1 to T2 Change				
Chips At End	-.308	.600		
Locus of Control-C	.038	.911	.185	.804
Interaction	.175	.803		
T1 to T3 Change				
Chips At End	.029	.961		
Locus of Control-C	.079	.818	.108	.953
Interaction	-.164	.817		
T2 to T3 Change				
Chips At End	-.523	.375		
Locus of Control-C	-.107	.750	.195	.775
Interaction	.563	.423		

*$p < .05$. ** $p < .01$. p *** $< .001$.

APPENDIX I

COMPETITIVENESS INDEX

Directions: Use the following response scale in answering the items below:
T=True F=False

1. I get satisfaction from competing with others. T F

2. It's usually not important to me to be the best. T F

3. Competition destroys friendships. T F

4. Games with no clear cut winners are boring. T F

5. I am a competitive individual. T F

6. I will do almost anything to avoid an argument. T F

7. I try to avoid competing with others. T F

8. I would like to be on a debating team. T F

9. I often remain quiet rather than risk hurting another person. T F

10. I find competitive situations unpleasant. T F

11. I try to avoid arguments. T F

12. In general, I will go along with the group rather than create conflict. T F

13. I don't like competing against other people. T F

14. I don't like games that are winner-take-all. T F

15. I dread competing against other people. T F

16. I enjoy competing against an opponent. T F

17. When I play a game I like to keep scores. T F

18. I often try to out perform others. T F

19. I like competition. T F

20. I don't enjoy challenging others even when I think they are wrong. T F

APPENDIX II

IMPORTANCE OF THE COMPETITION

Directions: Use the following response scale in answering the items below:

Strongly Disagree	= -3
Disagree Somewhat	= -2
Slightly Disagree	= -1
Neutral	= 0
Slightly Agree	= +1
Agree Somewhat	= +2
Strongly Agree	= +3

1. It is important to me that I win the poker game today.
   -3 -2 -1 0 +1 +2 +3

2. It matters to me that I win the poker game today.
   -3 -2 -1 0 +1 +2 +3

3. It means a lot to me that I win the poker game today.
   -3 -2 -1 0 +1 +2 +3

4. I feel a need to win the poker game today.
   -3 -2 -1 0 +1 +2 +3

APPENDIX III

INTERNAL/EXTERNAL ATTRIBUTION

Directions: Use the following response scale in answering the items below:

Strongly Disagree	= -3
Disagree Somewhat	= -2
Slightly Disagree	= -1
Neutral	= 0
Slightly Agree	= +1
Agree Somewhat	= +2
Strongly Agree	= +3

1. If I win the poker game today, it will be because I have more skill in poker.
   -3 -2 -1 0 +1 +2 +3

2. If I win the poker game today, it will be because I have more ability in poker.
   -3 -2 -1 0 +1 +2 +3

3. If I lose the poker game today, it will be because I have less skill in poker.
   -3 -2 -1 0 +1 +2 +3

4. If I lose the poker game today, it will be because I have less ability in poker.
   -3 -2 -1 0 +1 +2 +3

5. If I win the poker game today, it will be due to the dealer.
   -3 -2 -1 0 +1 +2 +3

6. If I win the poker game today, it will be because of the experimenter.
   -3 -2 -1 0 +1 +2 +3

7. If I lose the poker game today, it will be because of the dealer.
   -3 -2 -1 0 +1 +2 +3

8. If I lose the poker game today, it will be due to the experimenter.
   -3 -2 -1 0 +1 +2 +3

9. Chance will determine if I win the poker game today.
   -3 -2 -1 0 +1 +2 +3

10. Chance will determine if I lose the poker game today.
    -3 -2 -1 0 +1 +2 +3

11. Luck will determine if I win the poker game today.
    -3 -2 -1 0 +1 +2 +3

12. Luck will determine if I lose the poker game today.
    -3 -2 -1 0 +1 +2 +3

APPENDIX IV

IPC SCALE

Directions: Use the following response scale in answering the items below:

Strongly Disagree	= -3
Disagree Somewhat	= -2
Slightly Disagree	= -1
Neutral	= 0
Slightly Agree	= +1
Agree Somewhat	= +2
Strongly Agree	= +3

1. Whether or not I get to be a leader depends mostly on my ability.
   -3 -2 -1 0 +1 +2 +3

2. To a great extent my life is controlled by accidental happenings.
   -3 -2 -1 0 +1 +2 +3

3. I feel like what happens in my life is mostly determined by powerful people.
   -3 -2 -1 0 +1 +2 +3

4. Whether or not I get into a car accident depends mostly on how good a driver I am.
   -3 -2 -1 0 +1 +2 +3

5. When I make plans, I am almost certain to make them work.
   -3 -2 -1 0 +1 +2 +3

6. Often there is no chance of protecting my personal interest from bad luck happenings.
   -3 -2 -1 0 +1 +2 +3

7. When I get what I want, it's usually because I'm lucky.
   -3 -2 -1 0 +1 +2 +3

8. Although I might have good ability, I will not be given leadership responsibility without appealing to those in positions of power.
   -3 -2 -1 0 +1 +2 +3

9. How many friends I have depends on how nice I am.
   -3 -2 -1 0 +1 +2 +3

10. I have often found that what is going to happen will happen.
   -3 -2 -1 0 +1 +2 +3

11. My life is chiefly controlled by powerful others.
   -3 -2 -1 0 +1 +2 +3

12. Whether or not I get into a car accident is mostly a matter of luck.
   -3 -2 -1 0 +1 +2 +3

13. People like myself have very little chance of protecting our personal interests when they conflict with those of strong pressure groups.
   -3 -2 -1 0 +1 +2 +3

14. It's not always wise for me to plan too far ahead because many things turn out to be a matter of good and bad fortune.
   -3 -2 -1 0 +1 +2 +3

15. Getting what I want requires pleasing those people above me.
   -3 -2 -1 0 +1 +2 +3

16. Whether or not I get to be a leader depends on whether I'm lucky enough to be in the right place at the right time.
   -3 -2 -1 0 +1 +2 +3

17. If important people were to decide they didn't like me, I probably wouldn't make many friends.
   -3 -2 -1 0 +1 +2 +3

18. I can pretty much determine what will happen in my life.
   -3 -2 -1 0 +1 +2 +3

19. I am usually able to protect my personal interests.
   -3 -2 -1 0 +1 +2 +3

20. Whether or not I get into a car accident depends mostly on the other driver.
   -3 -2 -1 0 +1 +2 +3

21. When I get what I want, it's usually because I worked hard for it.
   -3 -2 -1 0 +1 +2 +3

22. In order to have my plans work, I make sure that they fit in with the desires of people who have power over me.
   -3 -2 -1 0 +1 +2 +3

23. My life is determined by my own actions.
-3 -2 -1 0 +1 +2 +3

24. It's chiefly a matter of fate whether or not I have a few friends or many friends.
-3 -2 -1 0 +1 +2 +3

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