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**Cognitive Interference:
An Examination of the Impact
Of Thoughts on
Athletic Performance**

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*Each year, by vote of the faculty, one
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the example it sets for subsequent classes.*

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Performance

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Abstract

The deleterious effect that intrusive thoughts can have on performance has been well documented (Sarason et al., 1996). The present research attempted to both disaggregate the types of thoughts that participants experience, as well as to more closely examine the interplay between thoughts and performance. Tennis players reported the frequency with which they experienced self-evaluative and other task-related thoughts at three assessment points over the course of a set of tennis. Results indicated that winners experienced significantly fewer intrusive thoughts, and a significantly smaller number of negative thoughts, than losers. A trend in the data also suggested that one subtype of thoughts in particular, negative self-evaluative thoughts, had the greatest impact on performance. These results support the idea that certain subtypes of thoughts uniquely impact performance.

Cognitive Interference: An Examination of the Impact of Thoughts on Athletic Performance

“Half this game is ninety percent mental.” Baseball player Yogi Berra uttered these infamous words, and while his math might require some revision, the idea that cognitions have the ability to impact performance has been well documented (Bandura, 1997; Pierce et al., 1998; Sarason et al., 1996). One way in which cognitions can have a deleterious effect on performance is through cognitive interference. Cognitive interference describes the worrisome thoughts that a person may experience while performing a specific task (Sarason & Stoops, 1978). These types of thoughts have been shown to affect performance across a number of academic and athletic settings. School performance (Comunian, 1993), exam performance (Pierce et al., 1998), and the performance of football players, cross country runners, and swimmers (Burton, 1988; Pierce et al., 2002) have all been shown to relate to the occurrence of these types of thoughts.

Athletes are a specific subgroup of people for whom performing well is especially important. Since it is integral to athletes' success that they consistently function at their peak performance level, it is not surprising that researchers have taken a particular interest in studying the role that cognitive interference plays in athletic performance. Consistently, athletes that report having a greater number of intrusive thoughts during a game perform worse than those who experience fewer thoughts. (Burton, 1988; Pierce et al., 2002; Christensen, 2000)

While previous research has made it clear that these cognitions can be detrimental to performance, research has not been able to provide an explanation for how

or why these types of thoughts decrease performance levels. Additionally, research has produced conflicting results regarding which types of thoughts are most responsible for decreases in performance (Baddeley, 1986; Carver, 1986; Wine, 1971; Zatz & Chassin, 1985). The present research looks to resolve some of these conflicts by examining the process of cognitive interference in more depth. Before I describe the methodology of the present research, I will provide an overview of the two most prominent models that have been used to explain the relationship between cognitive interference and performance. It is important to note, however, that these two models are in no way mutually exclusive. While each provides a different rationale to explain the impact that thoughts have on performance, they both agree that intrusive thoughts are deleterious to performance.

Information Processing Model

The information processing model postulates that any types of intrusive thoughts that people have while they are attempting to complete a task will negatively affect their performance. Two different explanations within this model have been proposed to describe how intrusive thoughts affect performance. The first contends that people have limited attentional resources. Therefore, any type of intrusive thought depletes the amount of attention a person can allocate to a task and impairs their performance on that task (Baddeley, 1986). According to this explanation, intrusive thoughts simply take up a portion of our attention that we would otherwise use to aid us in the completion of the task.

Eysenck (1992) also reported the deleterious effect that intrusive thoughts have on performance. However, he provided a slightly different explanation for how these thoughts affect performance. According to his reasoning, intrusive thoughts take up a

portion of our limited supply of working memory. The presence of these thoughts in working memory reduces the cognitive resources available for task-relevant processes (Sarason, 1984). In other words, intrusive thoughts impair performance by creating a reduction in the storage and processing capacity of our working memory.

Although slightly different rationales are presented for how intrusive thoughts interfere with the completion of tasks, the two explanations are very similar in most respects. Both are not concerned with analyzing the content of people's thoughts, because according to this model all types of thoughts should reduce one's processing efficiency to the same degree. All intrusive thoughts have the ability to negatively affect performance by limiting the mental resources that we have to designate to a task. Therefore, measurements of cognitive interference used in research under these models do not distinguish between task related thoughts and other types of thoughts, or between thoughts that are positively charged versus those that are negatively charged.

Self-Regulatory Model

The self-regulatory model is the second major theoretical perspective that attempts to explain the relationship between cognitive interference and performance. Recently, this model has become the focus of a great deal more attention within the field of cognitive interference. The self-regulatory model differs from the information processing model in that it categorizes the types of thoughts that people have and argues that some subtypes of thoughts will be more detrimental to performance than others (Carver, 1996). In particular, negative self-evaluative thoughts have been shown to uniquely predict the largest decreases in performance (Deffenbacher, 1980; Hembree, 1988; Pierce et al., 2002). In one study, researchers who coded the content of the

thoughts that tennis players' had during competition found that less successful athletes generated more negative and less enabling thoughts than more successful athletes (Zinsser et al., 1998).

Although this model has received support from recent research that has suggested that negative self-evaluative thoughts represent a unique subtype of thoughts, the effect that positive self-evaluative thoughts have on performance is still a contentious subject. Intuitively, it would seem that positive self-evaluative thoughts would enhance performance; however, research in the area has resulted in ambiguous findings. Zinsser, Bunker, and Williams (1998) found that more successful tennis players generated more positive thoughts. Similarly, Blankstein and Flett (1990) found that task-facilitative thoughts were positively related to performance on an anagram task. However, the research has been far from convincing, and the effect that positive self-evaluative thoughts have on performance is still unclear.

Self-Evaluative Thoughts

Considering the recent research that asserts that negative self-evaluative cognitions constitute a specific subtype of thoughts that are especially detrimental to performance, it might seem desirable to limit the frequency of these types of thoughts. However, in order to complete a task successfully it is critical that people have the ability to monitor their progress (Carver & Scheier, 1981; Theise & Hudson, 1999). Self-evaluation enables people to evaluate their own performance so that they can continue utilizing the skills or strategies that seem to be effective and modify the strategies that are less effective.

The process of self-evaluation seems especially significant in athletics. In tennis, for example, a player must monitor them self and their opponent in order to implement the strategies that will be most effective. If a player's forehand is especially effective during a match, it seems obvious that the player should hit as many forehands as possible. Similarly, if an opponent's backhand were significantly weaker than their forehand, it would seem good practice to hit the ball to the opponent's weaker backhand side. Only through the process of self-evaluation will a tennis player be able to make these analyses.

The importance of self-regulatory processes is best illustrated by research done on athletes who perform at the highest level. Cognitive strategies such as planning and self-monitoring during competition have been found to be important characteristics of elite performers (Williams & Krane, 1998). Even Albert Bandura (1997) points out that successful athletes need "to be able to improvise their skills in ever-changing situations full of unpredictable and stressful elements." Improvisation is only possible if athletes can take stock of what they are currently doing and decide how they should change their actions in order to produce better outcomes.

The results of one study that examined the thoughts that both novice and expert tennis players had during a match are consistent with this line of reasoning. Expert tennis players reported creating more strategies to monitor how effective their previous behavior was than a group of novice players. The expert players also made significantly more adjustments to their game plan when they felt that their behavior was ineffective (McPherson, 2000). It seems that one of the attributes that separated expert players from novice players was the experts' ability to evaluate their own performance and, consequently, to make the changes that were necessary to insure their success. Given that

athletes seem to need self-evaluative thoughts to be able to function at a high level, the self-regulatory model seems most relevant in trying to study the effects of intrusive thoughts on performance.

The standard methodology used in a majority of the research on cognitive interference has consisted of the completion of a cognitive interference self-report measure at the conclusion of a task (Comunian, 1993; Burton, 1998; Hatigeorgiadiadis & Biddle, 2001; Pierce, 1998; Pierce et al., 2002). Participants are generally asked to report on the types of thoughts that they had over the course of a task. This methodology has been useful in beginning to examine the general effects that intrusive thoughts have on performance. However, it has not allowed for an examination of how the process of cognitive interference plays out during a task. For instance, are the intrusive thoughts that people experience completely separate from each other, or are they, in fact, related so that the onset of one thought subsequently creates the formation of another thought? In other words, it seems possible that cognitive interference might be, in fact, one component in a larger feedback loop.

The example of a runner competing in a race illustrates this possibility well. A runner begins a race, and is immediately passed by his or her competitors. The runner might have thoughts such as "She is passing me, I need to run faster." Previous research suggests that this type of thought will negatively impact performance, possibly causing the runner to fall even farther back in the race. As further thoughts are produced in response to the decrease in performance (i.e. "I am too far back to win this race. I am not a good runner.") and performance continues to decline, it seems possible that the runner could fall into, for lack of a better term, a "vicious cycle" of cognitive interference. The

initial intrusive thoughts that the runner had in reaction to her poor start led to a decrease in her performance, which only led to the formation of further intrusive thoughts. These subsequent intrusive thoughts only decreased her performance level even more.

If indeed cognitive interference is part of a larger feedback loop, it would seem to follow that intrusive thoughts that occur towards the end of a task would be less detrimental to performance than intrusive thoughts that occur during the initial stages of a task. Intrusive thoughts that occur during the closing stages of a task would not produce the same decreases in performance as thoughts that occurred earlier in the task, because there would be less time for the feedback loop to cycle as often.

Because the methodologies used in previous research have limited our ability to examine precisely when intrusive thoughts occur over the course of a task, there are still many unanswered questions regarding how cognitive interference functions. For instance, it is unclear whether negative intrusive thoughts create short-term decreases in performance, or whether their impact on performance is evident only when their effects throughout an entire task are combined. The present research will assess cognitive interference on multiple occasions during the completion of a single task in the hopes of examining these types of questions.

Self-Efficacy

Another class of cognitions that has been the focus of a great deal of research regarding its effects on performance is self-efficacy. Self-efficacy refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance" (Bandura, 1997). People's self-efficacy has consistently been linked to performance levels on a variety of tasks (Feltz, Landers, &

Raeder, 1979; George, 1994; LaGuardia & Labbe, 1993; Lee, 1982; Schunk, 1995).

Barling and Abel (1983) focused on the importance of self-efficacy within a group of tennis players, and similarly found that self-efficacy was an important predictor of performance. It seems that people's beliefs in their ability to complete a specific task are directly related to their performance on that task. Consequently, self-efficacy appears to be able to both help and hinder performance.

Despite the large number of studies completed on self-efficacy that have allowed researchers to make great strides in their understanding of the phenomenon, there are still many questions that remain. Similar to the shortcomings of the research on cognitive interference, self-efficacy is seldom explored at many points over the course of one task. One study examined wrestlers' self-efficacy across many stages of a tournament (Kane, Marks, Zaccaro, & Blair, 1996). Although a tournament is made up of a number of smaller wrestling matches, and would not likely be considered a single task, the researchers still found differences in the effect that self-efficacy had on performance at the beginning of the tournament compared to the effect that it had on matches at the end of the tournament. Bandura (1997) noted this limitation in the current body of research, and suggested that efficacy expectations and performance continue to be assessed at many points in the process so that a better understanding of their reciprocal effects on each other can be reached. Researchers studying athletics have hypothesized that self-efficacy is likely to develop as a competition progresses (Schinke & daCosta, 2001). Gaining information, such as the strengths and weaknesses of the opposition, seems likely to increase self-efficacy. Evaluating self-efficacy on many occasions would allow us to examine if self-efficacy does shift in response to external feedback.

Because both self-efficacy and cognitive interference appear to have many similarities, including the large effect that they can have on performance, an examination of a possible relationship between the two classes of cognitions seems warranted. If self-efficacy levels do, in fact, fluctuate over the course of a task, research has not examined whether or not these increases and decreases are related to the types of intrusive thoughts that people have. Furthermore, according to self-efficacy theory, mastery experiences, or the prior experience that people have with a particular task, have the strongest influence on people's perceptions of their self-efficacy (Bandura, 1997). Succeeding at a task provides people with evidence that they are capable of completing the task again, while failing at a task can weaken people's self-efficacy. Given the strong relationship that self-efficacy has with performance, it also seems plausible that self-efficacy could play a role in the proposed feedback loop of cognitions and performance.

The present research examined the variability of self-efficacy by assessing state self-efficacy on three separate occasions throughout the duration of a set of tennis. It is hypothesized that people's self-efficacy levels, or their beliefs in their ability to successfully complete a task, will affect the types of thoughts that they have during their completion of a task. More specifically, it is predicted that initial lower self-efficacy, or later decreases in self-efficacy, will relate to the presence of more negative intrusive thoughts. To clarify, the current research attempts to explore the relationship between self-efficacy and cognitive interference, their potential role in a larger feedback loop, and the possible reciprocal effects that they have on performance.

The Present Research

In summary, the present research has three primary objectives. First, the research will examine the utility of the Self-Regulatory model and the utility of the Information Processing model in understanding cognitive interference. It is hypothesized that the results of this study will be consistent with recent research that supports the self-regulatory model. I expect negative self-evaluative thoughts to be uniquely related to decreases in performance. More specifically, I predict that tennis players who report having had more negative self-evaluative thoughts will perform more poorly in the games immediately following the onset of these thoughts. When combined, these smaller decreases in performance are expected to add up to less overall success, in terms of players overall win/loss record.

Secondly, this research will investigate the possibility of a cognitive interference-performance feedback loop by exploring tennis players' thoughts on multiple occasions throughout a set of tennis. It is hypothesized that the occurrence of intrusive thoughts will affect performance, that this change in performance will create more intrusive thoughts, and that these intrusive thoughts will only further affect performance. Therefore, intrusive thoughts occurring early in the set should lead to the formation of a greater number of thoughts as the task continues. Due to this primary hypothesis, the occurrence of negative self-evaluative thoughts towards the beginning of the set are also expected to be more detrimental to performance than those occurring later in the set.

Lastly, the variability of self-efficacy will be examined. It is hypothesized that, similar to cognitive interference, self-efficacy will shift according to external feedback. Because of the concurrent shifting of both self-efficacy and cognitive interference, I

expect the type of intrusive thoughts that athletes have to be related to their self-efficacy. Players' self-efficacy levels, combined with the frequency of negative self-evaluative thoughts, should uniquely predict players' performance. More specifically, it is hypothesized that low self-efficacy will correspond to an increase in the frequency of negative self-evaluative thoughts, and be predictive of poor performance. The possible role that self-efficacy might play in a cognitive interference – performance feedback loop will also be investigated.

*Method**Participants*

Sixty tennis players (men = 37, women = 23), between the ages of 13 and 61, participated in the study. Fourteen of the athletes were members of varsity tennis teams at a small, Division III, colleges in the northeast. Forty-three of the participants were varsity and JV level high school tennis players who participated in a weekly clinic at a tennis club located in close proximity to the college. The final seven athletes played weekly in a competitive adult league. All participants had a minimum of two years of playing experience, with an average of nine years of tennis experience.

Procedure

The researcher contacted the members of the collegiate varsity team, and made announcements at the local tennis club prior to each of the clinics, in order to recruit participants for the study. At that time, the participants were told that they would be asked to complete a number of questionnaires assessing the types of thoughts that they may experience while playing tennis. The participants were also informed that these questionnaires would be distributed and completed during stoppages in play throughout

the course of a set. The collegiate tennis players were then scheduled to meet the researcher at the courts at a convenient time. The researcher met the JV and Varsity high school players and the adult league players at their regularly scheduled playing time. Participants were all asked to play one set of tennis against an opponent of similar age and ability. The participants were asked to complete a questionnaire, administered by the researcher, at each changeover (a change-over occurs at the completion of every odd game; i.e. when the game score adds up to 1, 3, 5, etc). Due to time constraints, the participants only completed questionnaires during the first three changeovers (covering the first five games of the set). However, the participants were not initially informed of this fact. The researcher wanted to insure that the participants would be concerned with the final outcome of the set, and was worried that the data might become skewed if participants knew that they were not required to report on the final few games of the set.

Measures

Cognitive Interference. The CIQ (Sarason & Stoops, 1978; Sarason et al., 1986) was used to assess the frequency with which participants experienced various types of thoughts during the athletic competition. The CIQ consisted of 24 items, each of which was rated for the frequency with which the thoughts occurred to the participants. Participants responded to each of the statements on a 1 to 5 scale: (1) never, (2) once, (3) a few times, (4) often, and (5) very often. For the purpose of this study, the CIQ was revised in order to make the statements more relevant to the sport of tennis.

Two newly revised scales (Pierce et al., 2002) were also used in the present study. These scales measured the frequency with which participants experienced self-evaluative intrusive thoughts (i.e., those that dealt with thoughts about the individual's level of

performance) and other task-related intrusive thoughts (i.e., those that, while focused on the task, did not include an evaluation of the individual's own performance). Both the self-evaluative intrusive thoughts and the other task-related intrusive thoughts were revised in pairs so that there was both one positive version and one negative version of each statement. Consequently, the CIQ consisted of 6 positive self-evaluative statements (e.g., "I thought about how well I was playing"), 6 negative self-evaluative statements (e.g., "I thought about how poorly I was hitting my forehand"), 6 positive other task-related statements (e.g., "I thought about how the behavior of my opponent was making the match enjoyable for me"), and 6 negative other task-related statements (e.g., "I thought about how the court surface was in poor condition"). Eight items were randomly selected from the CIQ and presented to the participants on each of the three questionnaires. No items were duplicated, so by the completion of the fifth game all participants had responded to each of the 24 items (See Appendix A).

Self-Efficacy. One general statement was created to assess participants' state self-efficacy. Participants were asked to report how much they presently agreed or disagreed with the following statement: "I currently believe that I have the tennis ability needed to win this set." Participants responded on a 1 to 5 scale: (1) Strongly Disagree, (2) Disagree, (3) Not Sure, (4) Agree, and (5) Strongly Agree. The same statement was presented to the participants on each of the three questionnaires (See Appendix B).

Performance. The questionnaires asked the participants to record the current score in their match. Participants also recorded which specific games they won, by circling the number that corresponded to the game(s) won.

Results

Cognitive Interference

The mean and standard deviation were computed for each of the CIQ scales (positive self-evaluative, negative self-evaluative, positive other task-related, and negative other task related) at each of the three assessments. The resulting data is presented in Table 1. A 2 (valence of thought: Positive vs. Negative) X 2 (performance outcome: Win vs. Lose) X 2 (type of intrusive thought: Self-Evaluative vs. Other task-related) X 3 (time: First assessment at the conclusion of game 1 vs. Second assessment at the conclusion of game 3 vs. Third assessment at the conclusion of game 5) repeated measures ANOVA was conducted in order to examine any potential mean differences in participants' levels of cognitive interference.

Two significant main effects resulted from the statistical analysis. First, a main effect for performance outcome was observed, $F(1, 26) = 5.87, p < .05$. Losers ($M = 2.19$) reported having experienced significantly more intrusive thoughts than winners ($M = 1.93$). A second main effect described a significant difference between the occurrence of the two types of intrusive thoughts, $F(1, 26) = 23.74, p < .001$. Participants encountered self-evaluative thoughts ($M = 2.25$) significantly more frequently than other task-related thoughts ($M = 1.86$).

These main effects were qualified by two significant 2-way interactions, and a trend towards a three-way interaction. The first interaction between performance outcome and thought valence indicated that losers had more negative thoughts ($M = 2.32$ vs. $M = 1.79$), but not fewer positive thoughts ($M = 2.049$ vs. $M = 2.065$), than winners, $F(1, 26) = 5.94, p < .05$. These results are illustrated in Figure 1. Losers also reported

having a similar number of other task-related thoughts ($M = 1.92$ vs. $M = 1.81$), but significantly more self-evaluative thoughts ($M = 2.45$ vs. $M = 2.05$) than winners, $F(1, 26) = 4.79, p < .05$.

Finally, an interesting trend towards a three-way interaction between performance outcome, thought valence, and type of intrusive thought was observed, $F(1, 26) = 3.31, p = .08$. The data suggests that winners and losers experienced similar numbers of positive self-evaluative ($M = 2.22$ vs. $M = 2.22$) and positive other task-related ($M = 1.91$ vs. $M = 1.88$) thoughts. However, losers reported having experienced an appreciably greater number of negative self-evaluative thoughts ($M = 2.69$) than winners ($M = 1.88$). A similar trend was apparent with respect to the occurrence of other task-related thoughts. Losers described having more negative other task-related thoughts ($M = 1.95$) than winners ($M = 1.70$). These results are depicted in Figure 2.

Self-Efficacy

An additional 2 (performance outcome: Win vs. Lose) X 2 (time: First assessment at the conclusion of game 1 vs. Second assessment at the conclusion of game 3 vs. Third assessment at the conclusion of game 5) ANOVA was conducted to examine any potential mean differences in participants' self-efficacy levels. A significant main effect for participants' performance outcome was found, as winners reported being more self-efficacious ($M = 4.19$) than losers ($M = 3.46$), $F(1, 26) = 9.01, p < .01$. Additionally, a second main effect was observed for time, $F(2, 52) = 5.503, p < .01$. Participants' self-efficacy ratings continually and significantly decreased over the course of the five games (3.98 vs. 3.87 vs. 3.61).

A significant two-way interaction between performance outcome and time was also observed, $F(2, 52) = 4.35, p < .05$. While winners' self-efficacy ratings remained stable over the course of the three assessments, losers reported a steady decrease in their self-efficacy beliefs (Figure 4). Winners' mean self-efficacy ratings at the first, second, and third assessment points were 4.19, 4.22, and 4.15, respectively. Losers' reported their self-efficacy ratings at assessments one through three as 3.78, 3.52, and 3.07, respectively.

Discussion

While a good deal of research has been able to expose the deleterious effects that intrusive thoughts can have on performance, very little focus has been placed on examining the dynamic interplay between cognitions and behavior on a smaller scale. In addition to attempting to provide further evidence in support of the self-regulatory model, the present research also attempted to examine that interplay more closely. While many of my initial hypotheses were supported by the data, a number of unexpected and intriguing findings also arose as a result of this research. The deleterious effects that intrusive thoughts, specifically negative self-evaluative intrusive thoughts, have on performance were supported by this research. There was little evidence to support the hypothesized feedback loop that was predicted to describe the interplay between cognitions and behavior. However, the present research allowed for a more in depth analysis of the relationship between cognitions and behavior than any research has in the past. The findings, and their implications, are discussed below.

Intrusive Thoughts

Results from this study revealed significant differences in the mean number of intrusive thoughts that were experienced by winners versus losers. Supporting my hypothesis, and consonant with previous research, winners experienced fewer intrusive thoughts than losers (Blankstein, et al., 1989; Comunian, 1993).

While this part of the finding is consistent with past research, the present study expanded upon the idea that intrusive thoughts can negatively affect performance in one important way. In the past, participants have been asked to complete a task and report on the thoughts that they experienced over the course of the entire task. This type of methodology does not allow for the most accurate assessment of the participants thoughts for a number of reasons. First, it is likely that participants are able to recall the thoughts that they experienced towards the end of the task more easily than the thoughts that they experienced during the initial stages of the task. Secondly, recording one assessment at the completion of the task could allow for participants' performance on the task to influence the thoughts that they report having had. For instance, a participant who performs poorly on a task, and as a result is experiencing negative thoughts about himself and his performance, might only report having these negative thoughts even if he initially was optimistic about his performance.

The methodology that I used in the present research allowed me to assess, on multiple occasions, the types of thoughts that participants experienced. Due to the fact that there was no interaction between the number of intrusive thoughts and time, it seems that participants had a steady and continuous stream of intrusive thoughts. Participants were not simply bombarded with a large number of cognitions after they completed the

task, depending on if they won or lost. Instead, participants experienced intrusive thoughts, in equal numbers, throughout the task.

Positive and Negative Thoughts

One of the more interesting findings that resulted from this research concerns the number of positively and negatively charged thoughts that winning and losing participants experienced. Losers, as hypothesized, experienced more negative thoughts than winners. This finding was congruent with previous research that has indicated that more successful athletes have fewer negative thoughts (Zinsser et. al, 1998). However, the data analysis produced the somewhat surprising secondary finding that winners and losers had similar numbers of positive thoughts. This indicates that it was not a lack of positive thoughts that separated winners from losers, since both winners and losers reported having equivalent numbers of positive thoughts. Instead, an increased number of negative thoughts distinguished the losers from the winners. Previous research examining the effects of positive thoughts on performance has yielded mixed results. While many researchers contend that positive thoughts are task-facilitative, the research has been far from conclusive (Blankstein & Flett, 1990; Zinsser, Bunker, & Williams, 1998). The results from the present research seem to indicate that positive thoughts are not as much of a factor in determining performance outcomes as negative thoughts.

The fact that participants were able to experience a large number of positive thoughts, while also frequently experiencing negative thoughts, seems counter intuitive. Positive and negative thoughts are perceived as being located at opposite ends of the same continuum, so that an increase in one type of thought automatically produces a decrease in the other. This conceptualization might not be accurate. Instead, this

research seems to indicate that positive and negative thoughts could lie on two completely separate continuums and have no effect on each other.

A recent study conducted by Pierce, Yee, Schantz, & Grome (2002) produced results that support the idea that positive and negative thoughts represent two distinct categories of thought. Participants were rated on their performance in a college admissions interview, after reporting on the frequency with which they had experienced certain thoughts during the interview. Upon analysis of the data, the researchers found no correlation between the occurrence of positive thoughts and the occurrence of negative thoughts. Experiencing a large number of positive thoughts did not prevent participants from experiencing a large number of negative thoughts, and visa versa.

Self-Evaluative Thoughts

An investigation of the effects that self-evaluative thoughts had on performance generated two findings that were consistent with my initial hypotheses. First, participants reported having more self-evaluative thoughts than other task-related thoughts. Although this is an interesting finding, it is important to note that certain limitations prevent speculation about possible implications of this finding. In the present research, as in all research done in this field, participants responded to statements that asked how often they had experienced specific thoughts. Because this type of methodology was used, the total number of possible intrusive thoughts that a person has the potential to experience is unknown. It could be that the pool of other task-related thoughts that people may experience is much larger than the pool of self-evaluative thoughts. If it was possible to test for all thoughts, the occurrence of certain subtypes of thoughts could change as a function of the number of potential thoughts each participant could experience under each

subtype. Since I tested for an equal number of self-evaluative and other task-related thoughts, it is difficult to conclude if the finding accurately depicts the types of intrusive thoughts that participants experienced.

This finding does, however, have one clearly defined implication for future research in the field. A number of researchers have contended that self-evaluative thoughts are essential to performance (Carver & Schier, 1981; Theise & Hudson, 1999). These thoughts enable athletes to intermittently evaluate their own performance in order to make the behavioral and strategic changes that will allow them to achieve positive results. While it is impossible to report what percentage of an athlete's cognitions consists of self-evaluative thoughts, it is clear that self-evaluative thoughts are essential to an athlete. Athletes reported having self-evaluative thoughts frequently. This suggests that future research should take into consideration the fact that experiencing these types of thoughts seems to be unavoidable by including them in future research designs.

The second finding was a trend in the data that revealed that losers experienced far more negative self-evaluative thoughts than winners. This trend is consistent with recent research, which has supported the merit of the self-regulatory model (Deffenbacher, 1980; Hembree, 1988; Pierce et al., 2002). Negative self-evaluative thoughts seem to have uniquely produced a decrease in performance, more so than any other sub-type of thought. The difference in the number of negative self-evaluative intrusive thoughts appears to have separated the winners from the losers. This directly supports the self-regulatory model and warrants the continuation of future research with a focus on the impact of self-evaluative thoughts.

Self-Efficacy

Although this research was not focused on the analysis of self-efficacy, as indicated by the single statement that was used to assess this variable, the data still produced results consonant with my hypotheses. As predicted, winners reported higher levels of self-efficacy than losers. An interesting aside to this finding was that while winners were more self-efficacious than losers, both winners and losers had relatively high scores on the self-efficacy scale. Both winners and losers had a mean score higher than the midpoint of the five-point self-efficacy scale, indicating that even losers did not feel as if they were incapable of winning the set. It was not the case that winners were characterized by their belief in themselves, while losers were characterized as having no confidence in their ability. Instead, both were relatively confident throughout the set, independent of whether they were winning or losing.

This finding could be due to the fact that none of the participants were novices, as all had at least two years of tennis experience. After playing a sport for many years, athletes generally gain experience dealing with many different competitive situations. It is likely each athlete has competed in a match he has won convincingly, one in which he has come from behind to win, and one in which the outcome was uncertain until the end. Research suggests that the more experience that people have with a situation, the more confident that they will be when they are in a similar situation again (Bandura, 1997). This could explain why even losers held the belief that they were capable of winning until the very end. The losers had all experienced victory before and, as a result, were confident that they were capable of producing similar results again. It would be useful for future research to examine self-efficacy in participants who were new to the sport of tennis.

Losers' self-efficacy levels also displayed variability as a result of their performance. While winners' self-efficacy remained stable over the course of all three assessments, losers' beliefs in their ability continually decreased at each of the three assessment points. This finding is all the more interesting given the fact that winners, for the most part, were winning at each of the three changeovers. Only six out of the thirty pairs of participants had a player who lost the first game and still won the set. It seems that as the players' performance decreased and they fell farther and farther behind their belief in themselves also decreased accordingly. It is somewhat surprising that winners' levels of self-efficacy did not increase as a result of their strong play. However, this finding could be explained by the ceiling effect. The winners started with such a strong belief in themselves that it might have been impossible for them to increase their self-efficacy.

Limitations

Despite the number of significant findings that resulted from this research, several limitations were present in the methodology and should be noted. One limitation that hindered the examination of my hypotheses occurred by chance. The feedback loop that I proposed to describe the short-term effects of cognitions on performance was based upon the idea that participants' thoughts and behaviors would be dynamic and ever changing. I proposed that as cognitions changed, performance would similarly change. However, despite my efforts to randomly assign participants into pairs, the participants displayed very little variability in their performance. One would predict that if participants were randomly paired up and asked to play a set of tennis, than the full range of possible outcomes would result so that some participants would win by a large margin,

some would lose by a large margin, and the remaining participants would have closely contested matches. Surprisingly, only six of the thirty eventual winners were behind after the first game. By the second assessment, only 2 of the thirty eventual winners were losing. This indicates that participants who won were, for the most part, ahead at each of the three assessment points throughout the set. The participants did not exhibit the changes in behavior that I had hoped to observe. This lack of dynamic change made it impossible for me to examine how changes in thoughts affect performance.

Additionally, the fact that winners were ahead throughout the set prevents any speculation about potential relationships between thoughts and behavior from taking place due to the possibility that another variable, skill, was influencing both cognitions and behavior. This difficulty is commonly referred to as the third variable problem. Participants could have performed at a high level because they were highly skilled. The positive performance outcomes that the participants experienced would then be a result of their skill, and not necessarily a result of the cognitions that they were experiencing. In the future, researchers might consider pairing up participants who were closely matched in skill level. This would hopefully allow the researchers to observe changes in performance and make it possible to examine the effects of thoughts on performance. Having participants' complete assessments throughout an entire match, as opposed to just one set, might also produce sufficient change.

The size of the population was another limitation of the present research. Although sixty participants were tested, in order to conduct statistical analyses, those sixty participants were treated as thirty pairs. Treating the subjects as pairs decreased the statistical power of the data set, and made observing statistical significance less likely.

Utilizing a larger pool of participants will almost certainly result in the reported trends becoming statistically significant.

Finally, a limitation that is present in all research on cognitions is the fact that we, as researchers, are unable to directly examine thoughts. Instead, we must rely on participants to report the thoughts that they have experienced. In trying to balance examining these thoughts as often as possible while still remaining unobtrusive, the difficulty becomes deciding how often to assess these thoughts. In the current research, assessments were taken after every two games, during a naturally occurring break in play. Assessments were only completed during stoppages in play with the hope that this would be the least intrusive means of collecting the data. However, the more often that participants report the thoughts that they are having, the closer the examination that researchers will be able to make into understanding the impact that thoughts have on behavior. In the future, researchers could increase the number of assessments, and perhaps even consider completing a point-by-point examination of athletes' thoughts.

Conclusion

In conclusion, the present research suggests that certain subtypes of thoughts uniquely and negatively impact performance. Future research seems warranted in both attempting to further disaggregate participants' thoughts as well in continuing to examine the interplay between cognitions and performance. An investigation of these subtypes of thoughts will allow researchers to come to a more complete understanding of the mechanisms through which performance is impaired, so that in the future we will be able to ensure that athletes' performances do not suffer as a result of these thoughts.

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Table 1. Mean Scores¹ for Winners and Losers for the CIQ Self-Evaluative and Other-Task Related Scales across the Three assessments points (at the conclusion of games 1, 3, and 5).

| | Winners | Losers |
|-----------------------------|---------------|----------------|
| Time 1 | | |
| Positive Self- Evaluative | 2.20 (.80) | 2.19 (.71) |
| Negative Self-Evaluative | 1.91 (.84) | 2.61 (1.04) |
| Positive Other Task-Related | 2.02 (.94) | 1.94 (.92) |
| Negative Other Task-Related | 1.69 (.71) | 1.89 (.79) |
| Time 2 | | |
| Positive Self- Evaluative | 2.22 (.81) | 2.30 (2.09) |
| Negative Self-Evaluative | 1.89 (.90) | 2.76 (1.00) |
| Positive Other Task-Related | 1.87 (.75) | 2.00 (1.00) |
| Negative Other Task-Related | 1.76 (.97) | 1.96 (.84) |
| Time 3 | | |
| Positive Self- Evaluative | 2.22 (.78) | 2.17 (.88) |
| Negative Self-Evaluative | 1.83 (.72) | 2.70 (1.19) |
| Positive Other Task-Related | 1.85 (.69) | 1.70 (.74) |
| Negative Other Task-Related | 1.65 (.62) | 2.00 (.84) |

¹ Standard deviations in parentheses.
Note: N = 60.

Table 2. Mean Scores¹ for Winners and Losers for the Self-Efficacy Scale at each of the Three Assessment Points.

| | Winners | Losers |
|--------|---------------|----------------|
| Time 1 | 4.19 (.68) | 3.78 (1.05) |
| Time 2 | 4.22 (.70) | 3.52 (1.05) |
| Time 3 | 4.15 (.99) | 3.07 (1.20) |

¹ Standard deviations in parentheses.
Note: N = 60.

Table 3. Mean Scores for Winners and Losers for the Positive and Negative Scales.

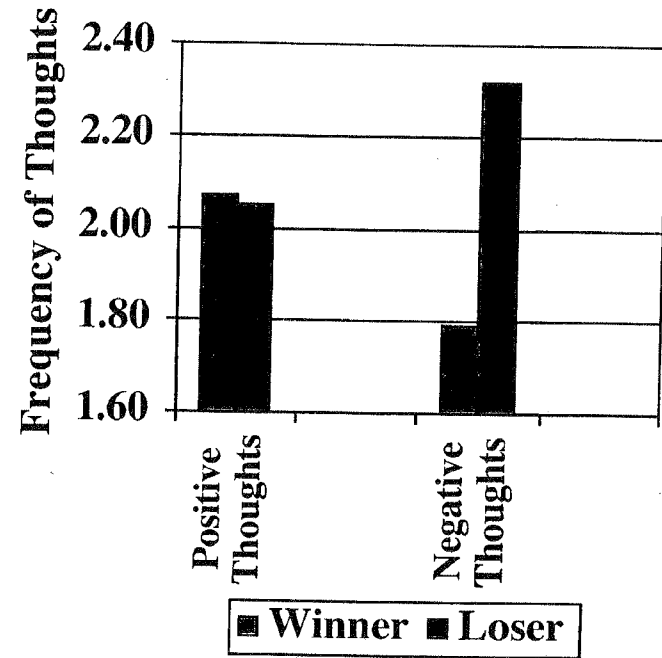
| | Winners | Losers |
|-------------------|---------|--------|
| Positive Thoughts | 2.07 | 2.05 |
| Negative Thoughts | 1.79 | 2.32 |

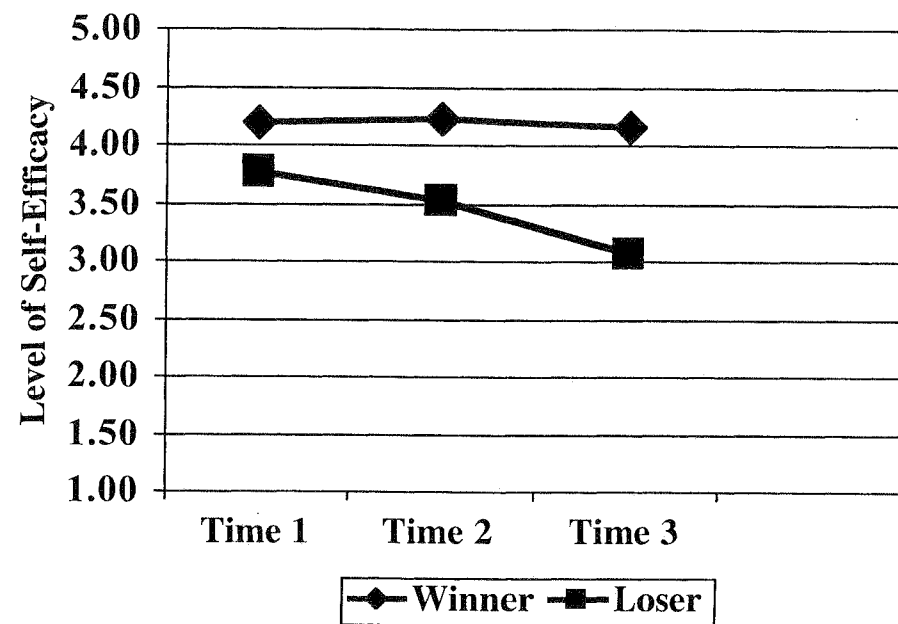
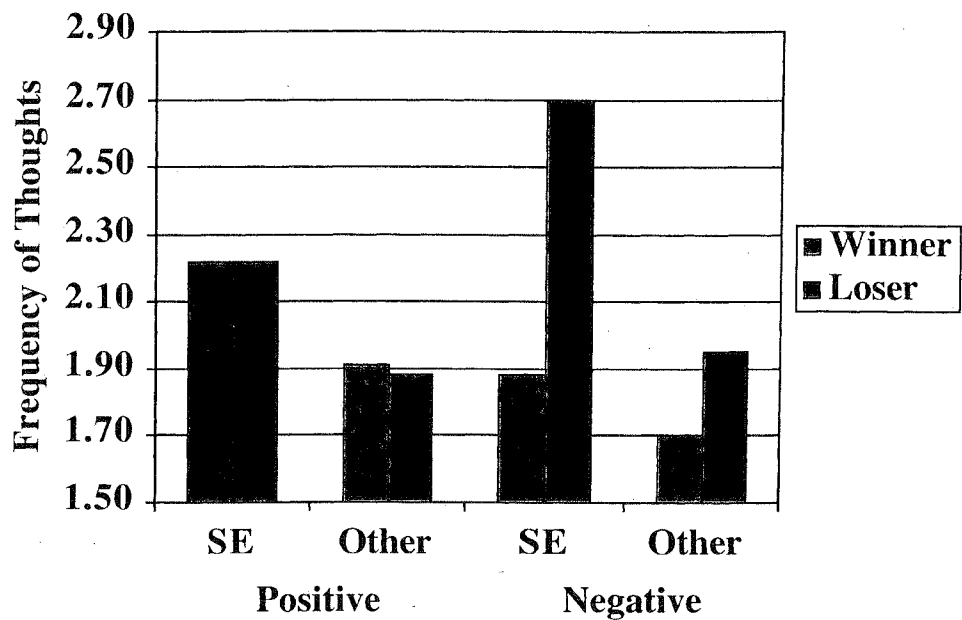
Figure Captions

Figure 1. The frequency with which Winners and Losers experienced Positive and Negative thoughts.

Figure 2. The frequency with which Winners and Losers experienced Self-Evaluative versus Other Task-Related thoughts.

Figure 3. Winners and Losers reported Self-Efficacy levels at each of the three assessments.





Appendix A

SID _____

Gender: M F

CIQ

Instructions: This questionnaire concerns the kinds of thoughts that go through people's heads at particular times, for example, while they are playing tennis. The following is a list of thoughts, some of which you might have had during the game(s) that you just completed. Please indicate approximately how often each thought occurred to you during the game(s) by circling the most appropriate letter beside each statement.

-A- -B- -C- -D- -E-
Never Once A few Often Very
 times

1. I thought about how well I was playing. ABCDE
2. I thought about how I was moving poorly on the court. ABCDE
3. I thought about how the court surface was in poor condition. ABCDE
4. I thought about how I was a better tennis player than my opponent. ABCDE
5. I thought about my opponent's weaknesses. ABCDE

6. I thought about how the condition of my racquet (e.g. strings, grip) was helping my play. ABCDE
7. I thought about how others would be disappointed by my performance. ABCDE
8. I thought about how I was comfortable with the number of games remaining in the set. ABCDE
9. I thought about how the behavior of my opponent was making the match enjoyable for me. ABCDE
10. I thought about how unlikely I was to win the match. ABCDE

11. I thought about how well I was hitting my forehand. ABCDE
12. I thought about how I felt uncomfortable in the conditions (e.g., temperature, lighting, etc.) that I was playing in. ABCDE
13. I thought about how the condition of my racquet (e.g. strings, grip) was hindering my play. ABCDE
14. I thought about how poorly I was playing. ABCDE
15. I thought about how others would be by impressed by my performance. ABCDE

16. I thought about how the court surface was in good condition. ABCDE
17. I thought about how likely I was to win the match. ABCDE
18. I thought about how I was uncomfortable with the number of games remaining in the set. ABCDE
19. I thought about my opponent's strengths. ABCDE
20. I thought about how poorly I was hitting my forehand. ABCDE

21. I thought about how the behavior of my opponent was annoying me. ABCDE
22. I thought about how I was moving well on the court. ABCDE
23. I thought about how I was a worse tennis player than my opponent. ABCDE
24. I thought about how I felt comfortable in the conditions (e.g., temperature, lighting, etc.) that I was playing in. ABCDE

Appendix B

SID _____

Self-Efficacy Scale

Instructions: Athletes have many thoughts as they approach athletic situations, and these thoughts may change during the course of play. We are interested in how you feel at this point in time. Please indicate how much you agree or disagree with the following statement by circling the letter above the most appropriate statement.

-A- -B- -C- -D- -E-
Strongly Disagree Not Sure Agree Strongly
Disagree

I currently believe that I have the tennis ability needed to win this set.