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**Ironic Processes of Mental Control of Action in Tennis**

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IRONIC PROCESSES OF MENTAL CONTROL OF ACTION IN TENNIS

By

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I would like to dedicate this manuscript to my wonderful parents who have always encouraged me to follow my dreams. You have raised me to be the person I am today and have been with me every step of the way. Thank you for all the unconditional love, guidance, and support that you have always given me, helping me to succeed and instilling in me the confidence that I am capable of doing anything I put my mind to.

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ABSTRACT

Wegner’s (1994) Ironic Processing Theory is proposed to account for the intentional and counter-intentional effects that result from efforts at mental control. It is predicted that when people try to implement their intentions under adverse conditions, they sometimes find themselves making errors that represent the ironic opposite of what they intended to do. The present study examined ironic effects of mental control of action in the sport environment, specifically with junior tennis players. The main intent of this study was to (a) determine whether certain instructions are more likely to induce mental control, thus affecting athlete performance, and (b) examine whether athletes are more likely to experience ironic effects under conditions of increased pressure. Participants were asked to complete a Pressure Rating Form, indicating on a scale from 1-10, the extent to which they feel pressure to perform. Participants were given four types of instructions before serving. These include the following: “hit the serve out wide,” “don’t miss the out wide serve,” “hit the serve down the t,” and “don’t miss the down the t serve.” Participants were also exposed to a low-pressure and high-pressure condition. Each participant hit a total of 160 serves toward a designated area of the service box. Eighty of these serves were performed under low-pressure, and 80 serves were performed under high-pressure. Of the 80 serves, 40 were first serves and 40 were second serves. For the first service, participants completed two blocks of five serves for each of the four instruction conditions, and did the same for the second service.

Results from this study indicated that participants missed more serves when instructed not to miss the serve in a specified location (e.g., “down the t”, “out wide”), than when they were told to hit the serve in a specified location. In addition, it was found that more service misses were observed under the high-pressure condition when participants were performing under the “don’t” instruction in comparison to the “do” instruction. This result provides support for ironic processing theory’s contention that trying not to perform some action under pressure can bring about those exact unwanted actions.
CHAPTER I
INTRODUCTION

Unwanted and intrusive thoughts seem to occur frequently in the lives of ordinary human beings. There are times when we want to relax, go to sleep, change a negative mood or thought, stop worrying, and even just concentrate on a task. Sometimes, however, our attempts at this mental control backfire with a resulting ironic increase in distracting thoughts. Rather than attaining our mental goal, we consequently end up failing, and are more likely to commit exactly what we intend not to do. This paradox has been coined as ironic processes of mental control (Wegner, 1994).

In addition to the normal occurrence of intrusive thoughts in everyday life, intrusive and negative thoughts are not unusual occurrences in the lives of athletes. The importance of self-talk has become increasingly evident in recent years. Van Raalte, Brewer, Rivera, and Petipas (1994) examined the self-talk of youth tennis players during competitive matches. They found that most of the tennis players reported negative self-talk during matches, and that this negative self-talk was associated with losing. Individual’s thoughts and self-talk are critical to cognitive and emotional processes (Bunker, Williams, & Zinsser, 1993; Lazarus, 1982 as cited in Hardy, 2006). The ability to control thought processes in sport is an integral component to successful performance because the contents of athletes’ thoughts affects their performance. Wegner, Ansfield, and Pilloff (1998) have argued that many errors of movement control may be due to an inability to manage thought processes effectively. Wegner’s (1994) theory of ironic processes of mental control may account for these failures of mental control by offering an explanation for occurrences of errors related to unwanted thoughts. Ironic processes may be operating when athletes feel, act, and think in ways that are opposite to the intended direction of emotion, behavior, and cognition (Wegner, 1994).

Research has expanded our understanding of ironic effects in the cognitive and verbal domain; however, there has been a scarcity of research conducted on behavioral ironies in the sport domain. Research in sport is needed so that researchers can understand how athletes’ thoughts specifically affect their actions (Janelle, 1999).

The aim of this study is to examine behavioral ironic effects in a sport skill, with ecological validity. First, literature on the theory of ironic processes of mental control (Wegner, 1994) is introduced, followed by research studies on ironic effects in the cognitive domain.
Finally, the focus of the paper turns to behavioral ironic effects in sport, an area that has scarcely been examined by researchers.
CHAPTER II
LITERATURE REVIEW
Ironic Processes of Mental Control

Intrusive thoughts are relatively ordinary for people going about their everyday lives. Some of our actions go as planned and others fall to error. There are times when we want to relax, go to sleep, distract ourselves from pain, or change a bad mood, but we find that our efforts to attain these desired states backfire. Our attempts at mental control fail, and we find the exact opposite of what we have intended occurring (Wegner, 1994). In order to better understand the effects of mental control, Wegner’s ironic processing theory is described. Next, literature examining ironic effects in the verbal and cognitive domain is discussed. Finally, the effects of mental control in the movement domain is examined, followed by a look at ironic processing in sport.

Ironic Processing Theory

Wegner’s (1994) theory of ironic processes of mental control is proposed to account for the intentional and counter-intentional effects that result from efforts at mental control (Wegner, 1994). Mental control, or self-control, is the influence individual’s exercise over their minds. Wegner described specific conditions under which the desire to control a mental state can produce the exact opposite of what is intended. The availability of mental capacity is the central variable dividing successful control from ironic effects. The normal operation of mental control is most times successful because there is sufficient mental capacity to achieve control. When mental capacity is reduced in some way (for example, by distraction, stress, or cognitive load), the exertion of mental control under these conditions can create ironic effects. Therefore, the act of mental control results in mental states that lead to the opposite outcome of what is desired. In the case of sleep, desired sleep would ironically lead to wakefulness; in the case of mood, desired happiness would ironically lead to sadness, and in the case of relaxing, desired relaxation ironically becomes anxiety (Wegner, 1994).

Operating and monitoring process. Wegner (1994) suggested that attempting to control one’s mental state occurs through two processes that work together simultaneously to produce some desired mental state. The first process is an intentional operating process that searches for mental contents that yield the desired state; it searches for mental contents consistent with the desired state of mind. Accompanying the operating process is the ironic monitoring process that
searches for mental contents that indicate a failure to attain the desired state. This second process is unconscious and less effortful compared to the conscious and effortful operating process. For example, when a person is trying to relax, the operating process could involve the conscious efforts to pursue this end such as thinking of relaxing thoughts, images, or sensations that go along with feeling relaxed. The ironic monitoring process, on the other hand, automatically searches for thoughts indicating a failure to relax, such as stressful, arousing thoughts, images, and sensations (Wegner, 1994).

As per the previous example, the intentional operating process and the ironic monitoring process operate simultaneously to produce a level of mental control that is desired. The operating process produces the desired change by filling the mind with thoughts that are pertinent to the desired mental state. The monitoring process searches for specific mental contents (i.e., presentations) that secures control, and thus regulates whether or not the operating process will be initiated. If the monitor finds signs of control failure, it reinitiates the operating process. It is watchful and sensitive to mental conditions signifying that mental control is failing. When the efficiency of mental capacity is reduced, and the operating process is limited, the monitor can renew its efforts. At the same time, however, under mental load, the monitoring process also has the effect of increasing the thoughts or sensations pertinent to failed control, thus inviting these thoughts into consciousness. Thus, mental load creates counter-intentional (i.e., ironic) effects by releasing the ironic monitoring process to activate the least desired thoughts, feelings, or actions. This ironic effect results in mental states that become the opposite of what is desired (Wegner, 1994).

Evidence of Ironic Effects in Non-Sport Domain

Evidence for ironic effects exists in several domains of mental control. Studies of ironic effects usually involve different mental control instructions with varying levels of mental load. Therefore, it is predicted that when people try to implement their intentions under adverse conditions, ironic effects are likely to occur.

Ironic effects of mental control have been found to exist in numerous studies in various research domains. Ironic effects have been found in the control of sleep (Ansfield, Wegner, & Bowser, 1996), in the control of anxiety (Koster, Rassin, Crombez, & Naring, 2003), when trying to relax under stress (Wegner, Broome, & Blumberg, 1997), and in mood control (Wegner, Erber, & Zanakos, 1993).
Ironic effects of relaxation under stress. Trying to relax is not an easy task when we feel stressed, anxious, or distracted. Sometimes our efforts at this relaxation seem to backfire and have just the opposite effect of what we have intended. In a study by Wegner et al. (1997), tests of ironic effects of relaxation were conducted in normal undergraduate students. In the first experiment, participants were either instructed to follow a progressive relaxation protocol or were not instructed to relax during a psychophysiological measurement period. At the same time, participants were then instructed to rehearse either a long or short number as a manipulation of cognitive load. For the high cognitive load, participants attempted to remember a 9-digit number, while for the low cognitive load, participants attempted to remember a 1-digit number. Results indicated that participants who were instructed to relax under the high mental load had higher SCL than those instructed to relax under low load, and tended to have higher SCL than participants under high load who were not instructed to relax.

In the second experiment, participants were instructed to relax or not to relax, but were given a more realistic manipulation of a stressful mental load. Some participants were given a series of questions to answer aloud which were described as measures of IQ, while other participants answered the same questions, but were just told that the questions were being evaluated. Results indicated that participants in the high load and stressful question situation who were instructed to relax had greater SCL than those participants not instructed to relax, and also than participants who were asked to relax in the low load situation.

Results from these two experiments provide support for the theory of ironic processes of mental control (Wegner, 1994). Intentional relaxation caused arousal in normal participants, as shown by electrodermal activity. The results suggest that intentional relaxation under cognitive load may not just yield failed control, but the opposite of the intended mental state.

Ironic effects of sleep urgency. There are times when we find ourselves lying in bed trying to fall asleep, but the combination of our urgent desire to sleep and some distressful thought or annoying event can keep us awake. It seems that the harder we try to fall asleep under these conditions, the more difficult it is to fall asleep. Ansfield et al. (1996) tested these ironic effects of sleep urgency in relation to the theory of ironic processes of mental control (Wegner, 1994).

In their study, Ansfield et al. (1996) had subjects take home a Sony walkman and listen to a cassette tape while they lay down to sleep at night. The cassette tape instructed them to either
fall asleep “as fast as you can” or to fall asleep “whenever you want.” While they fell asleep, half heard restful, sleep-conducive music (low mental load), while others heard John Philip Sousa band marches (high mental load).

The reports of time to fall asleep revealed both intentional and ironic effects. Under low load, subjects trying to fall asleep quickly did so faster than those attempting to fall asleep whenever they wanted. Under high load, however, and consistent with the ironic process theory of mental control (Wegner, 1994), sleep onset latency was greater for subjects attempting to fall asleep quickly than for those who were not attempting to fall asleep quickly.

These results support the ironic process theory of mental control in sleep urgency. There are conditions in which people’s purposeful attempts at falling asleep result in falling asleep more quickly than not trying at all. In this study, participants trying to fall asleep under low mental load did fall asleep more quickly than those not attempting to do so. There are also conditions in which people’s purposeful attempts at falling asleep can ironically lead to wakefulness. In this study, participants trying to fall asleep quickly under high mental load took longer to fall asleep than those not attempting to do so.

Ironic Processing in Sport

The theory of ironic processes of mental control (Wegner, 1989, 1994) is exhibited in the sport environment as well as everyday life. As Janelle (1999) explains in his paper, the demanding nature of sport may predispose athletes to be highly susceptible to ironic processes. The nature of sport is one in which to achieve excellence athletes must experience failure, setbacks from injuries, stress, and the ability to maintain a high degree of concentration in order to perform effectively, often under a high degree of mental load (Janelle, 1999).

Evidence of Ironic Effects in Sport

Although there are many experimental studies supporting Wegner’s (1994) theory, a limited amount of studies have been conducted on ironic processes in sport. Some evidence exists, however, in areas relevant to sport performance. These include ironic effects of pain control (Cioffi & Holloway, 1993), awareness of target images (umpires) (Dugdale & Eklund, 2002), intentional relaxation (Wegner et al., 1997), thought suppression (Wegner & Erber, 1992), mental control of action in golf putting performance and swinging a pendulum (Wegner et al., 1998), the effects of suppressive imagery on golf performance (Beilock, Afremow, Rabe, & Carr, 2001), and balance performance in expert dance performers (Dugdale & Eklund, 2003).
These studies have direct relevance to, and can be applied to the sport environment, however, are only the starting point in applying this theory to the domain of sport. Most importantly these findings suggest that trying not to think about something can result, ironically, in an increased awareness of the exact object that should be ignored (Janelle, 1999), and thus may be crucial to the competitive sport environment.

**Ironic effects of movement.** Wegner et al. (1998) in their study of golf putting performance and swinging a pendulum found evidence that ironic processes of mental control affect the quality of motor performance. Their study consisted of two experiments demonstrating the effects of specific thoughts on movement control. The two experiments examined the tendency of subjects to produce the exact opposite of what they intended in putting a golf ball and swinging a handheld pendulum.

In the first experiment, participants were putting a golf ball that they were specifically instructed not to hit past the target hole. When cognitive load was added, participants had an increased tendency to hit the ball past the target hole. In the second experiment involving the handheld pendulum, participants held the pendulum in front of a grid which specified the line of sway to be followed. Findings indicate that under cognitive load, participants who were instructed not to let the pendulum move along the axis were more likely to do so than those participants who were told to hold the pendulum steady. Essentially, more unwanted movements occurred when participants attempted to avoid movement under cognitive load (Wegner et al., 1998). This study provides evidence that trying not to perform some action under cognitive load can bring about those exact unwanted actions. Cognitive load can, and did, detrimentally affect motor control in this experiment, producing not only movement errors, but also the unwanted movement itself.

**Ironic effects in expert performers balance performance.** Dugdale and Eklund’s (2003) study is another example of behavioral ironies found in motor performance. Ironic effects of movement were investigated by examining the performance of expert performers in a static balance task. Ironic processes in expert performers were examined in order to demonstrate that even accomplished performers can experience ironic effects. As expected, more movements of the wobble board occurred when participants were instructed to “try not to wobble” than when asked to “hold the wobble board steady,” but this was evident only under the high cognitive load
condition, in which participants were asked to, in their head, count back from 1000 by sevens and report the lowest obtained figure to the researcher after each trial.

Dugdale and Eklund’s (2003) findings from their examination of a static balance task in expert performers provides further evidence that trying not to perform some action, even in accomplished performers, may result in ironic effects of movement control. Further, it provides support for Wegner’s theory of ironic processes of mental control and its applicability in sport settings as well as for those involved in applied sport psychology and research environments in sport.

*Ironc effects of pain control.* An important question for research dealing with how athletes cope with pain is, should pain be associated or dissociated? In other words, should pain be attended to, or should distraction techniques be used when painful sensations occur. Research on the effectiveness of these different mental control strategies indicates that, under some conditions, attention is more effective than distraction in reducing pain (Ahles, Blanchard, & Leventhal, 1983). In a meta-analysis by Cioffi (1993), he found that distraction works best when the pain is acute, however when pain is persistent, association is more effective in dealing with the pain.

According to the theory of ironic processes of mental control (Wegner, 1994), these findings make sense when considering the different ironic monitoring processes that are initiated by distraction and attention. When looking at acute pain, a person who attempts to dissociate the pain will do so by thinking about something other than the pain. This then initiates an ironic process to search for whatever items are not the chosen distracter, including the pain. This strategy works until the operating process deteriorates over tie, then, an ironic monitor would begin to reintroduce the pain to consciousness. Therefore, during highly intense periods of pain, a distraction strategy will be sufficient. However, during chronic pain, association strategies (i.e., focusing on the pain) will eventually result in ironic processes that search for anything but the pain.

The theory of ironic processes also suggests that the worst approach in dealing with pain is in suppressing it. Inhibiting painful thoughts or sensations leads to an ironic effect. This is because suppression yields ironic monitoring of only the pain, whereas distraction yields ironic monitoring of everything that is not the pain.
Imagery and ironic processes. The practice of mental imagery has been well established in facilitating performance and is widely used by athletes. Imagery is used in a variety of situations including, pre-game, onsite, and post-game implementation (Janelle, 1999). Athletes know all to well of situations where trying to forget a poor image only makes the image more prominent and less likely to go away. Beilock et al. (2001) examined the effects of suppressive imagery on golf putting performance using novice golfers. Utilizing the theory of ironic processes as a guideline the researchers hypothesized that (1) Attempting to suppress negative images will increase the probability of the occurrence of these negative images. (2) Attempting to suppress negative images related to performance will result in the appearance of these images behaviorally and therefore result in a decrement in golf putting performance. (3) Decrements in performance due to the attempted suppression of negative images may be eased by replacing these negative images, each time they occur, with a corrective image. (4) Increased frequency of trying to suppress negative images may worsen their impact. In order to test their hypotheses, the authors manipulated the imagery rehearsal frequency (before every putt, before every third putt) and type of imagery (positive, suppression, suppression-replacement) (Beilock et al., 2001).

Beilock et al. (2001) found that the suppression imagery groups had more frequent negative images than the groups receiving replacement imagery or positive imagery instructions. Therefore, the first hypothesis is supported; attempting to suppress negative images related to performance seems to increase the incidence of negative images. As for the second hypothesis, neither the imagery instruction, nor frequency of imaging produced a large, systematic impact on putting performance. When examining the third hypothesis concerning the effectiveness of corrective images, the results, however, contradicted the authors’ predictions. Findings indicated that attempting to replace negative images with corrective images more often harmed performance. This result suggests that replacing images with corrective, positive images is not always effective in getting rid of decrements in performance due to negative images. Finally, as for the last hypothesis, the accuracy of the positive imagery group improved across imaging blocks no matter the imagery frequency. For the suppression and suppression-replacement imagery groups, their accuracy in putting improved when imaging before every third putt, however, it declined when imaging before every putt. Beilock et al. (2001) suggest that frequent use of suppressive imagery hurts motor skill performance, and attempting to replace an incorrect image with a corrective one does not necessarily lessen the damage in performance.
Nature of Sport

Janelle (1999) proposed that the demanding nature of sport may predispose athletes to be particularly susceptible to movement control problems due to a lack of ability to successfully handle thought processes. Janelle (1999) further claimed that under the demanding conditions of the typical sport competition, by intentionally trying not to remain in an unwanted or negative emotional state, one’s thoughts, attention, and behaviors are unintentionally focused on the precise thing that ought to be ignored.

Athletes sometimes find themselves making errors in movement which are the exact opposite of what they intended to do. An athlete may say to themselves, “do not make another error,” only to make a few more; “do not listen to the crowd,” only to find that he or she is more distracted; “do not miss your serve,” only to go on and miss the next one. Possessing the ability to deal effectively with one’s thought processes, particularly when distracted or under stress, is an extremely important skill that enables athletes to perform successfully.

The belief that thoughts specifically influence actions in sport is of great interest to researchers and sport performers alike. One major reason that ironic effects occur in sport is that sport naturally occurs under conditions of mental load. Janelle (1999) supports this notion and states that “sport is abundant with roadblocks, failures, and injuries that must be overcome, often through a high degree of mental load” (p. 214). Athletes are faced with many obstacles that must be conquered. Examples include time constraints, stress, setbacks from injuries, anxiety experienced during competition, distraction, the need to concentrate on specific plans or performance strategies, the need to effectively deal with negative thoughts, and many others. These examples of mental load are show that the sport environment is an ideal setting for the production of ironic effects.

Pressure. As stated in the previous literature, there are various forms of mental load that can initiate ironic control processes. There have been many studies examining a variety of load-inducing procedures, including memory loads (word/digit lists) that are rehearsed while at the same time performing a specific task. Wegner (1989, 1994) suggested that there are other loads such as anger, stress, anxiety, time urgency, internal and external distractions, and many more that can increase the probability of ironic processes.

Pressure then, can be considered a form of mental load; a form of mental loading that is especially prominent among individuals taking part in athletic events. Pressure can be defined as
an aspect of the situation or combination of factors that increases the importance of doing well on a particular occasion (Baumeister, 1984). Individuals feel performance pressure to the extent that they care about the outcome of their performance and they perceive that their performance is instrumental for the attainment of the desired outcome (Baumeister, 1984).

In the context of the ironic processing theory, the tendency to experience ironic processes is most likely to occur in situations where mental load is high. Thus, the level of pressure an athlete experiences may increase the tendency to exhibit ironic effects, with a higher degree of pressure leading to more ironic processes than a lower degree of pressure. Pressure increases the task demand on individuals during performance leading to increased information-processing demands. When pressure is introduced it interferes with conscious level processing and consumes attentional resources that are being used by the operating process. The monitoring process then becomes increasingly significant and the individual attends to those thoughts or behaviors that are least desirable. As a result of this mental control backfiring, the individual becomes more susceptible to eliciting ironic effects.

Recommendations

As previously stated there are few experimental studies that directly examined ironic effects of movement in sport settings. Except for the study by Wegner et al. (1998), not much related to mental control of action in sport appears in the extant literature. There are many examples of episodic movement control problems experience by athletes as a result of a lack of ability to successfully handle thought processes (Janelle, 1999). Janelle (1999) stated, “Research in the sport environment is needed to clarify how and when these effects are most likely” (p. 214). The need to effectively regulate thoughts, behavior, and feelings in the athletic environment is critical. Further experimental studies on ironic effects of movement in sport are therefore needed to help not only athletes, but coaches and sport psychologists as well to recognize those situations in which ironic effects are most likely to occur.

With increased knowledge of the effects of ironic processing, coaches, sport psychologists, and athletes alike can be offered reasons for failures of mental control in the sport environment. Sport psychologists can implement programs to educate and help athletes interrupt ironic processes. In addition, athletes can learn what kind of self-talk works best for them and what kind of instruction works best from coaches to facilitate performance.
Purpose Statement and Hypotheses

Considering both the lack of empirical work devoted to the area of ironic effects of movement in sport situations, the purpose of this study, therefore, is to examine ironic effects of mental control of action in the sport environment, specifically tennis.

The main intent of this study is to examine if a behavioral ironic effect can be observed in a sport skill with ecological validity. Instructions given by coaches may significantly impact how athletes think and perform. Coaches may mistakenly induce conditions of mental control by instructing athletes not to do something, thus leading to an increased likelihood of ironic effects. Some examples of coaching instructions that may increase the athletes tendency to experience ironic effects include phrases such as, “don’t make another error” in baseball, “don’t miss the free throw” in basketball, “don’t hit the ball in the lake” in golf, and “don’t hit the ball in the net” in tennis. Therefore, one objective in this study is to determine whether certain instructions are more likely to induce mental control, thus affecting athlete performance. In addition, a second objective is to examine whether athletes are more likely to experience ironic effects under conditions of increased pressure. It is hypothesized that:

a) More service errors would occur when participants were instructed, “do not miss the out wide serve” or “do not miss the down the t serve” than when they were instructed to “hit the serve out wide” or “hit the serve down the t” when practicing their service game.

b) Service errors would be greater under a high-pressure condition compared to a low-pressure condition.
CHAPTER III
METHOD

Participants

Twelve junior tennis players from a public park tennis facility in the southeastern region of the United States participated in this investigation. All participants were taking private tennis lessons and had played in serious tennis competition, including the United States Tennis Association (USTA) sanctioned junior tennis tournaments and competitive middle school and high school competition. The sample consisted of participants ranging between the ages of 10 to 17 years, with a median age of 14 years, ($M = 13.92$, $SD = 2.47$). Participants included 8 males and 4 females. Years of playing experience of participants ranged from 2 to 6 years, with median playing experience of 4.25 years, ($M =4.21$, $SD =1.27$). Parental consent and participant assent was obtained from all participants in this study.

Instrumentation

Informed Consent. A consent form was used to gain written permission from the participants as well as their parents to participate in the study. The consent form included an explanation of the purpose and objectives of the study, as well as covering the responsibilities associated with participation. It also assured that the participants’ personal information and results of the study would remain confidential, and that their names would not be disclosed by the researcher. The participants were also informed of their right to withdraw from the study at any time without penalty.

Demographic Information. Participants were asked to indicate their age and gender, as well as years of playing experience.

Performance Errors. Performance errors on service placement were categorically determined by use of cones that outlined the two areas (wide, middle) of the service box that participants are serving to. Therefore, if the serve lands in the proper location of the service box within the cones, or has hit the cones after instructions have been issued, the participant has hit the proper service location. Service errors were determined by use of a video camera in which two judges examined where the serve has landed according to the instruction that has been issued.

Service Location. For purposes of these analyses, a ball that lands out wide in the doubles alley, when instructed to serve towards the wide area of the service box is the same as missing
when instructed to serve “down the t” and missing in the add service box. In addition, when instructed to serve “out wide” or “down the t” and the serve misses out of bounds, past the service line given based on the instruction; these are the considered the same types of misses. Although these misses appear to be different, they are equivalent because they are missing towards the same area, but are based on a different instruction. Finally, all serves that land in the correct area, despite different instructions are counted as in.

*Video Camera.* Ball landing location for all serves were recorded using a video camera. The video camera was aimed at the service box to which the participant was serving to record landing location. The videos were subsequently scrutinized to code whether or not the serves have been hit in the correct area of the service box. The location of serve was captured in all instances in this investigation.

*Radar Gun.* Service speed was assessed using the Speed Check Personal Sports Radar to ensure that participants were employing speeds appropriate for first and second serves. The radar gun was placed on the ground next to the net on the server’s side of the court on the midline. Ball speed in miles per hour for each serve was recorded. Although the radar gun was intended to measure the speed of every serve hit by the participants, it did not clock every one. This was a result of serves that were hit either too far away from the radar gun, those that fell into the bottom of the net, or second serves that were hit too lightly for the radar to register its speed. The means and standard deviations of service speeds provided subsequently, are therefore, based on incomplete data.

*Instruction Manipulation*

Participants were given four types of instructions. Instructions were presented consistently across all participants with a standardized script. Participants were specifically instructed that they are working on service placement. Before every serve, they received a specific instruction on whether to hit a first or second serve, and where to place the serve in the service box (out wide or down the middle; Appendix C).

On the first trial of each of the two blocks of the “hit the serve out wide” condition, the following instructions were given: “we are going to work on placement of our serves, and I would like you to hit the serve out wide in the service box.” In the following trials of the “hit the serve out wide” condition, participants were instructed to “hit the serve out wide” in the service box. On the first trial of each of the two blocks of the “hit the serve down the t” condition, the
following instructions were given: “we are going to work on placement of our serves, and I would like you to hit the serve down the t.” In the following trials of the “hit the serve down the t” condition, participants were instructed to “hit the serve down the t” of the service box.

On the first trial of each of the two blocks of the “do not miss the out wide serve” condition, the following instructions were given: “we are going to work on placement of our serves, but do not miss the out wide serve.” In the following trials of the “do not miss the out wide serve” condition, participants were instructed “do not miss the out wide serve.” On the first trial of each of the two blocks of the “do not miss the down the t serve” condition, the following instructions were given: “we are going to work on placement of our serves, but do not miss the down the t serve.” In the following trials of the “do not miss the down the t serve” condition, participants were instructed “do not miss the down the middle serve.” To secure participants’ collaboration they were asked to verbally repeat the instruction presented to them before performing on each trial. If a participant provided an incorrect verbalization of the instruction, the appropriate instructional script was repeated and the participant was again asked to verbalize the instruction.

To ensure that participants were focused on the relevant instruction for each manipulation, they were required to verbally repeat the instruction back to the researcher before performing on each trial.

*Pressure Manipulation*

An environmental manipulation was employed to produce high and low-pressure conditions for the participants. In the high-pressure condition, participants were informed that there is a coach coming to watch the tennis session. Participants were specifically told:

We have a USPTR/USPTA certified tennis professional coach here with us today and he is traveling around the Southeastern United States to look at the area’s junior talent. As you can tell this is a particularly important practice, for your performance is being evaluated. Today, Coach will be examining your service game, so make sure you’re focused and ready to perform.

In the low-pressure condition, participants were informed that they were working on placement of serves. Participants were specifically told:

Today we are working on the service game, specifically placement of first and second serves. I will be asking you to hit serves out wide in the service box and down the T.
Participants in both the high and low-pressure conditions had the placement of service landing recorded using a video camera. Service speeds were also recorded using a radar gun. It was emphasized to participants in the high-pressure condition, however, that their serves were being videotaped and the service speed was being recorded for later reviewing for the coach. In the low-pressure condition, participants were not informed that their serves were being videotaped or that the service speeds were being recorded. The camera and radar gun was placed in some location, but the participants’ attention was not drawn to the fact that their efforts were being recorded or subsequently scrutinized.

Research Design

A Latin Square (within-participants) design was employed to manage the order effects of conditions. All participants went through the same conditions; however, each participant started at a different place in the sequence. For both the first and second service, participants completed two blocks of five serves for each of the four instruction conditions. This resulted in a total of 40 first serves and 40 second serves, yielding a total of 80 serves performed in one day. Eighty serves were performed under a low-pressure condition day and eight serves were performed under a high-pressure condition day, yielding a total of 160 serves for each participant.

Procedure

All participants were tested individually. Prior to testing, each participant received a parental informed consent form that was read and signed by his or her parent/guardian, as well as a child assent form that was read and signed by the participant. Upon receiving consent, participants were instructed to fill out demographic information. Participants were then given instructions on how to complete the Pressure Rating form, and subsequently completed the form. Participants rated themselves on a scale from 1-10, indicating the extent to which they felt pressure to perform. Participants started the testing session individually. Participants were exposed to both a low-pressure and high-pressure condition. The low-pressure condition occurred on one day and the high-pressure condition occurred on a subsequent day.

Each participant hit a total of 160 serves in toward the designated area of the service box. Eighty of these serves were performed under low-pressure, and 80 serves were performed under high-pressure on separate days. Of the 80 serves on each of the days, 40 were first serves and 40 were second serves. For the first service, participants completed two blocks of five serves for each of the four instruction conditions, thus yielding 40 first serves. For the second service,
participants completed two blocks of five serves for each of the four instruction conditions, yielding 40 serves as well. Participants completed the same amount of serves on both the low and high-pressure condition days. This, therefore yielded a total of 160 serves.

Service placement was categorically determined by use of cones that outlined the two areas (wide, T) of the service box that participants were serving to. Therefore, if the serve landed in the proper location of the service box within the cones, or has hit the cones after instructions have been issued, the participant has hit the proper service location.

Data Analysis

Data analysis occurred in three phases. First, descriptive statistics were calculated for service misses and service speed. Second, a t-test was conducted on manipulation check data to ensure that the pressure manipulation worked as intended. Third, inferential analyses to evaluate the tenability of the investigative hypotheses were conducted using repeated measures analysis of variance (RM-ANOVA) procedures.

Eta-squared effect-size estimates were also calculated to evaluate the meaningfulness of the observed effects. The convention for interpretation of this effect size indicator is that eta-squared values of approximately: (a) .01 indicate a small effect, (b) .06 indicate a moderate effect, and (c) .14 indicates a large effect (Cohen, 1988). Cohen’s $d$ effect sizes were also calculated. An ES greater than .8 is large, an ES around .5 is moderate, and an ES less than .2 is small (Cohen, 1988).
CHAPTER IV
RESULTS

Descriptive statistics on service misses are presented first in this section. Next, descriptive statistics on the speed of serves are provided. The results of inferential analyses are presented subsequently. Finally, frequencies for location of service misses are presented.

Pressure Manipulation Check

The efficacy of the pressure manipulation was examined through analysis of the pressure to perform questionnaire. Results of the pressure manipulation indicate that under the high-pressure condition, participants reported perceiving more pressure to perform ($M = 7.08$, $SD = 1.73$) than when under the low-pressure condition ($M = 4.67$, $SD = 1.30$), $t(11) = 4.57$, $p < .001$. Figure 1 illustrates the significant effect of pressure manipulation. The pressure manipulation was therefore deemed effective.

![Figure 1: Mean pressure to perform for all participants under low- and high-pressure manipulation.](image)

Service Miss Descriptive Statistics

Means and standard deviations (SDs) for service misses by instruction, location, and pressure condition are presented in Table 1. Findings indicate that overall, participants missed about 6 ($M = 5.54$) out of 10 serves hit. Participants’ number of misses varied across conditions.
Examination of Table 1 indicates that descriptively more misses were observed for the “don’t” instruction condition ($M = 6.45$) than the “do” condition ($M = 4.63$) regardless of the pressure condition. When performing under the “don’t” high-pressure condition, participants descriptively missed more serves ($M = 6.54$) than when performing under the “do” high-pressure condition ($M = 4.33$).

Table 1
Descriptive statistics ($M$ and $SD$) for service misses by instruction, location, and pressure condition.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Location</th>
<th>Serve</th>
<th>Condition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Do</td>
<td>W</td>
<td>1st</td>
<td>4.42</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>4.00</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>1st</td>
<td>4.92</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>4.00</td>
<td>0.60</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>4.33</td>
<td>1.16</td>
</tr>
<tr>
<td>Don’t</td>
<td>W</td>
<td>1st</td>
<td>7.00</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>6.08</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>1st</td>
<td>6.75</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>6.33</td>
<td>1.23</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>6.54</td>
<td>1.15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>5.44</td>
<td>1.15</td>
</tr>
</tbody>
</table>

*Note. W = wide; T = down the middle*
Descriptive statistics for service speed are presented in Table 2. Findings indicate that overall, participants served faster when hitting a first serve ($M = 60.08$ mph) than when hitting a second serve ($M = 48.75$ mph). The speeds of serves that the radar gun did not register are not included in these analyses.

Table 2
_Service Speed (mph) Descriptive Statistics (M and SD) by instruction, location, and pressure condition_

<table>
<thead>
<tr>
<th>Condition</th>
<th>Location</th>
<th>Instruction</th>
<th>1st M</th>
<th>1st SD</th>
<th>2nd M</th>
<th>2nd SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>W</td>
<td>Do</td>
<td>59.80</td>
<td>7.86</td>
<td>48.58</td>
<td>7.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t</td>
<td>59.96</td>
<td>9.16</td>
<td>48.08</td>
<td>7.70</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>Do</td>
<td>62.08</td>
<td>10.25</td>
<td>49.10</td>
<td>7.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t</td>
<td>60.19</td>
<td>8.91</td>
<td>47.93</td>
<td>7.19</td>
</tr>
<tr>
<td>Low</td>
<td>W</td>
<td>Do</td>
<td>59.51</td>
<td>7.91</td>
<td>50.15</td>
<td>8.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t</td>
<td>57.98</td>
<td>8.34</td>
<td>48.44</td>
<td>8.79</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>Do</td>
<td>61.46</td>
<td>10.69</td>
<td>49.39</td>
<td>9.91</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t</td>
<td>59.67</td>
<td>9.65</td>
<td>48.35</td>
<td>9.47</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>60.08</td>
<td>9.11</td>
<td>48.75</td>
<td>8.33</td>
</tr>
</tbody>
</table>
Inferential Statistics

The RM-ANOVA results testing the study’s hypotheses are presented in Table 3. The results of the inferential analyses are reported by hypothesis.

**Hypothesis One.** A significant within-subjects main effect was observed for instruction, $F(1,11) = 62.26$, $p < .001$, $\eta^2 = .85$, with more misses occurring when participants were told not to miss a serve in a specified location ($M = 6.45$, $SD = 1.32$) than when they were told to hit the serve in a specified location ($M = 4.63$, $SD = 1.36$).

**Hypothesis Two.** The hypothesized interaction between instruction and condition was significant, $F(1,11) = 6.94$, $p < .05$, $\eta^2 = .39$. This interaction is presented in Figure 2. The effect sizes observed for the different instructions (“do,” “don’t”) under low pressure ($d = .98$) and high pressure ($d = 3.73$) were large to extremely large, whereas the effect sizes observed for the low pressure condition for “do” ($d = .45$) and “don’t” ($d = .14$) instructions were respectively moderate and trivial in magnitude. The number of misses across pressure conditions did not differ substantially for the “don’t” instructions, but fewer misses were observed under high compared to low pressure conditions for the “do” instructions.

![Figure 2: Mean values of service misses for Instruction by Pressure Condition.](image)

**Other significant effects.** A significant main effect for serve was observed, $F(1,11) = 9.89$, $p < .01$, $\eta^2 = .47$, with participants missing more on their first serve ($M = 5.85$) than their
second serve ($M = 5.22$). An unanticipated significant interaction between location and pressure condition was also observed, $F(1,11) = 5.12$, $p < .05$, $\eta^2 = .32$. This interaction is presented in Figure 3. The effect sizes observed for the different locations (“wide,” “t”) under low pressure ($d = 3.80$) and high pressure ($d = .03$) were extremely large and trivial in magnitude, whereas the effect sizes observed for the pressure conditions for “wide” ($d = .11$) and “t” ($d = .41$) were respectively trivial to moderate in magnitude. The number of misses across pressure conditions did not differ substantially for the “wide” location, but more misses were observed under low compared to high-pressure conditions for the “t” location.

![Figure 3](image.png)

*Figure 3*: Mean values of services misses for Location by Pressure Condition.
Table 3

*RM ANOVA effects for ball misses by instruction, service, location, and pressure condition*

<table>
<thead>
<tr>
<th>Effect</th>
<th>Wilks' $\lambda$</th>
<th>$F$</th>
<th>df</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction</td>
<td>0.15</td>
<td>62.26</td>
<td>1, 11</td>
<td>&gt;.001</td>
<td>.85</td>
</tr>
<tr>
<td>Location</td>
<td>0.78</td>
<td>3.18</td>
<td>1, 11</td>
<td>.10</td>
<td>.22</td>
</tr>
<tr>
<td>Serve</td>
<td>0.53</td>
<td>9.89</td>
<td>1, 11</td>
<td>.01</td>
<td>.47</td>
</tr>
<tr>
<td>Condition</td>
<td>0.95</td>
<td>0.53</td>
<td>1, 11</td>
<td>.48</td>
<td>.05</td>
</tr>
<tr>
<td>Instruction x Location</td>
<td>0.99</td>
<td>0.06</td>
<td>1, 11</td>
<td>.82</td>
<td>.01</td>
</tr>
<tr>
<td>Instruction x Serve</td>
<td>0.98</td>
<td>0.20</td>
<td>1, 11</td>
<td>.66</td>
<td>.02</td>
</tr>
<tr>
<td>Location x Serve</td>
<td>1.00</td>
<td>0.04</td>
<td>1, 11</td>
<td>.85</td>
<td>.00</td>
</tr>
<tr>
<td>Instruction x Location x Serve</td>
<td>0.82</td>
<td>2.37</td>
<td>1, 11</td>
<td>.15</td>
<td>.18</td>
</tr>
<tr>
<td>Instruction x Condition</td>
<td>0.61</td>
<td>6.94</td>
<td>1, 11</td>
<td>.02</td>
<td>.39</td>
</tr>
<tr>
<td>Location x Condition</td>
<td>0.68</td>
<td>5.11</td>
<td>1, 11</td>
<td>.05</td>
<td>.32</td>
</tr>
<tr>
<td>Instruction x Location x Cond.</td>
<td>0.89</td>
<td>1.39</td>
<td>1, 11</td>
<td>.26</td>
<td>.11</td>
</tr>
<tr>
<td>Serve x Condition</td>
<td>1.00</td>
<td>0.03</td>
<td>1, 11</td>
<td>.88</td>
<td>.00</td>
</tr>
<tr>
<td>Instruction x Serve x Condition</td>
<td>0.98</td>
<td>0.23</td>
<td>1, 11</td>
<td>.64</td>
<td>.02</td>
</tr>
<tr>
<td>Location x Serve x Condition</td>
<td>1.00</td>
<td>0.03</td>
<td>1, 11</td>
<td>.87</td>
<td>.00</td>
</tr>
<tr>
<td>Inst. x Loc x Serve x Cond.</td>
<td>0.99</td>
<td>0.15</td>
<td>1, 11</td>
<td>.71</td>
<td>.01</td>
</tr>
</tbody>
</table>
Frequency for Location of Service Landing

Frequencies for location of service misses are presented in Table 4. Overall, when instructed to hit the serve to a specific location in the service box, most participants hit their serves in the designated area \((k = 854)\). Furthermore, regardless of the instruction provided (e.g., “do,” “don’t”), most service misses occurred out of bounds in the “wide” location \((k = 321)\). The frequency of service misses by location and pressure condition and location by instruction are presented in Figures 4 and 5 respectively. The frequency of service misses for location by instruction under low pressure and high pressure conditions are presented in Figures 6 and 7 respectively.

Table 4

Frequencies for location of service landing by pressure condition and instruction

<table>
<thead>
<tr>
<th>Location</th>
<th>Pressure</th>
<th>No Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
<td>Do</td>
</tr>
<tr>
<td>In</td>
<td>268</td>
<td>170</td>
</tr>
<tr>
<td>Wide</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Deep</td>
<td>26</td>
<td>40</td>
</tr>
<tr>
<td>Center</td>
<td>45</td>
<td>63</td>
</tr>
<tr>
<td>Center</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Net</td>
<td>57</td>
<td>89</td>
</tr>
<tr>
<td>Total</td>
<td>480</td>
<td>480</td>
</tr>
</tbody>
</table>
Figure 4: Frequency for location of service landing by pressure condition.

Figure 5: Frequency of location of service landing by instruction.
Figure 6: Frequency for location of service landing under low pressure condition by instruction.

Figure 7: Frequency for location of service landing under high pressure condition by instruction.
CHAPTER V
DISCUSSION

Wegner’s (1994) theory of ironic processes of mental control is proposed to account for the intentional and counter-intentional effects that result from efforts at mental control. Mental control, or self-control, is the influence individual’s exercise over their minds. Wegner described specific conditions under which the desire to control a mental state can produce the exact opposite of what is intended. The availability of mental capacity is the central variable dividing successful control from ironic effects. The normal operation of mental control is most times successful because there is sufficient mental capacity to achieve control. When mental capacity is reduced in some way (for example, by distraction, stress, or cognitive load), the exertion of mental control under these conditions can create ironic effects. Therefore, the act of mental control results in mental states that lead to the opposite outcome of what is desired.

Research findings expanded the understanding of ironic effects in the cognitive and verbal domain; however, little research has been conducted on behavioral ironies in sport. Therefore, the purpose of this study was to examine if an ecologically valid behavioral ironic effect could be observed in the performance of a sport skill. Evidence for ironic effects exists in several domains of mental control (Ahles et al. 1983; Dugdale & Eklund, 2003; Ansfield et al., 1998; Beilock et al. 2001; Wegner et al., 1993; Wegner et al. 1997; Wegner et al., 1998). Studies of ironic effects usually involved different mental control instructions with varying levels of mental load. Therefore, it was predicted that when young tennis players try to implement their intentions under adverse conditions, ironic effects are likely to occur. Specifically, this study was conducted to determine (a) whether certain instructions are more likely to induce mental control, thus affecting athlete performance, and (b) to examine whether athletes are more likely to experience ironic effects under conditions of increased pressure.

In regard to the first hypothesis, when examining participants’ service errors by instruction condition, more misses occurred when participants were instructed not to miss the serve (“don’t” instruction) than when they were told to hit the serve (“do” instruction) towards a specified location of the service box. This significant difference between “do” and “don’t” instructions was also observed in the Dugdale and Eklund (2003) study. More unwanted movements occurred when participants were told to try not to wobble than when they were told to hold the wobble board steady.
In regard to the second hypothesis, cognitive load-inducing procedures have varied in previous studies of ironic processing theory hypotheses, including memory loads, such as word lists or number strings (Dugdale & Eklund, 2003; Wegner et al., 1998). In the present study, a certified tennis professional observed participants service performance in order to induce social evaluative stress load upon mental processing capacity. Participants reported increased pressure to perform in the presence of a certified tennis coach (high-pressure) than when no coach was present (low-pressure). Therefore, it was empirically substantiated that the tennis coach’s evaluative presence increased the importance of doing well on this particular occasion for participants. When examining the second hypothesis, the number of misses across pressure conditions did not differ substantially for the “don’t” instructions, but fewer misses (i.e., better performance) were observed under high compared to low-pressure conditions for the “do” instructions. More specifically, evaluative presence of the tennis coach resulted in enhanced performance in the “do” condition but not the “don’t” instruction condition. The increase in performance from high to low pressure conditions for the “do” instruction was an effect that was almost a half standard deviation in magnitude.

This result provides some support for ironic processing theory’s contention that trying not to perform some action under pressure may result in unwanted actions. This result is related to the Dugdale and Eklund (2003) study in which participants wobbled more under high cognitive load than low cognitive load, with this effect being most pronounced for the “don’t” instructions. Wegner et al.’s (1998) study also showed that trying not to perform simple actions under mental load can prompt the occurrence of those actions. Participants who attempted not to overshoot a golf putt or not to swing a pendulum in a certain direction committed that exact unwanted action, considerably more in the presence of mental load. In the present study, although no main effect for condition was observed, the interaction indicated that the effects of pressure differed for the two instructions. In particular, service performance was improved under “do” instructions, but did not improve under “don’t” instructions. Thus, pressure did not undermine performance as much as it facilitated performance under “do” compared to “don’t” instructions.

The results of the present study may not be entirely consistent with previous findings on ironic effects because the type of cognitive load was not similar to that employed in previous studies (e.g., word lists, number strings). In the present study, the manipulation used to affect available processing capacity in hopes of producing ironic effects was a socially evaluative
pressure, resulting from the presence of a certified tennis coach traveling the Southeastern United States looking at the area’s junior talent. In contrast, the Dugdale and Eklund (2003) study and the Wegner et al. (1998) study employed use of cognitive load, which is consistent with the extant literature. Thus, the socially evaluative pressure in this study may have produced the facilitation of performance under “do” but an ironic inability to perform better under “don’t” instructions, despite participants’ interest in performing well for the certified coach.

Finally, two other significant effects were observed. First, it was not anticipated, subjects were more likely to miss the serve “down the t” rather than “out wide” when performing under low compared to high-pressure conditions. There are no obvious explanations for why this result was observed. The serves do not inherently differ in difficulty and no apparent reason why pressure should differentially affect their performance. This is a matter that may merit further empirical investigation. Second, as expected, participants were more likely to miss more first serves than second serves. This main effect is unsurprising because, in tennis, a premium is placed upon getting the ball into play in second serves after having missed on the first serve attempt. In addition, first serves are hit with more speed than second serves, which may thus affect the accuracy of getting these serves in. In general, a first serve is a flat, fast serve with little margin for error, while a second serve is a slower spin serve with a higher margin for error.

Limitations

Although valuable data were obtained, there are several limitations to the present study. First, the overall sample size of 12 participants used in the study was relatively small, which may have resulted in diminished external validity. Thus, the relationships observed may not accurately reflect those present in the overall population of junior tennis players. Second, male participants outnumbered female participants in this investigation. As a result of the predominantly male sample the data collected in this study may be skewed towards reflecting male tennis players’ tendencies in regards to ironic processes of mental control. Furthermore, although participants in this study performed around the same level of ability, there was considerable variability in their ages. Therefore, the socially evaluative manipulation used to affect available processing capacity may affect younger and older participants differently. Finally, the type of cognitive load used in the present study represents a limitation. Because the type of cognitive load (socially evaluative pressure) was not consistent with previous studies
(Dugdale & Eklund, 2003; Wegner et al. 1998), the manipulation may have affected participants’ available processing capacity differently, thus giving rise to the difference in results.

As previously indicated, sample size was a considerable limitation of this study. Several issues arose during the course of the study that impeded the collection of data. First, many participants were not able to complete the second phase of the study, and therefore unable to provide additional data for the study. Second, some participants completed the second portion of the study weeks later than other participants, which may have induced some practice effects for the ones who had a longer period in between sessions. Finally, there were many cancellations by participants who were unable to attend the sessions.

Conclusion and Future Directions

The present study has provided an examination into the effects of mental control of action in the sport environment, specifically in tennis players. The results of this study indicate that instructions given by coaches or others working with athletes may significantly impact how athletes think and perform. Coaches may mistakenly induce conditions of mental control by instructing athletes not to do something, thus leading to an increased likelihood of ironic effects. Further research in this area should be focused on obtaining larger sample sizes to avoid some of the problems encountered within this study. In addition, few experimental studies directly examining the potential for ironic effects in sport settings have been carried out. The need to effectively regulate thoughts, behavior, and feelings in the athletic environment is critical. Further experimental studies on ironic effects of movement in sport are therefore needed to help not only athletes, but coaches and sport psychologists as well to recognize those situations in which ironic effects are most likely to occur. Finally, future research is needed to determine the specific manner in which different types of cognitive load induce ironic effects. It is possible that different types of load produce varying levels of ironic effects.

The current study has provided an adequate foundation for future studies examining ironic effects in sport. Further research is necessary, however, to increase our knowledge of these effects on performance and to facilitate our understanding of the phenomena. With increased knowledge of the effects of ironic processing, coaches, sport psychologists, and athletes alike can be offered reasons for failures of mental control in the sport environment. Sport psychologists can implement programs to educate and help athletes interrupt ironic processes. In addition,
athletes can learn what kind of self-talk works best for them and what kind of instruction works best from coaches to facilitate performance.
APPENDIX A

DEMOGRAPHIC INFORMATION

Please fill out the following information about yourself.

Age: __________

Gender: __________

Years of playing experience: __________
APPENDIX B

PRESSURE RATING FORM

Please rate on the scale from 1-10 to what extent you feel pressure to perform. 1 indicates you feel no pressure to perform, while 10 indicates that you feel extreme pressure to perform.

Performance pressure can be defined as an aspect of the situation or combination of factors that increases the importance of doing well on a particular occasion (Baumeister, 1984).

1 2 3 4 5 6 7 8 9 10

No Pressure               Moderate Pressure               Extreme Pressure
APPENDIX C

HUMAN SUBJECTS APPROVAL

Florida State University

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8833; FAX (850) 644-4392

REAPPROVAL MEMORANDUM

Date: 4/15/2008

To:
Jennifer LoRusso
2750 Old St. Augustine Rd., Apt. O62
Tallahassee, FL 32301

Dept.: EDUCATIONAL PSYCHOLOGY AND LEARNING SYSTEMS

From: Thomas L. Jacobson, Chair

Re: Reapproval of Use of Human subjects in Research: Ironic Processes of Mental Control of Action in Tennis

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by 4/9/2009 please request renewed approval.

You are reminded that a change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must report to the Chair promptly, and in writing, any unanticipated problems involving risks to subjects or others.

By copy of this memorandum, the Chairman of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols of such investigations as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

Cc: Robert Eklund
HSC No. 2008.0252-R
APPENDIX D

PARENTAL CONSENT FORM

Parental Consent Letter for Minors

Dear Parent:

I am a graduate student under the direction of Professor Dr. Robert Eklund in the Department of Educational Psychology and Learning Systems at Florida State University. I am conducting a research study to examine the effects of coaching instruction on service performance. This research study is entitled: Ironic Processes of Mental Control of Action in Tennis, and is being conducted as a part of a master’s thesis.

Your son or daughter’s participation will involve hitting a total of 160 serves over the course of two days. Eighty serves will be hit on the first day and eighty serves will be hit on the second day. The time to complete the total amount of serves (160) will take approximately 40 minutes.

Your participation, as well as that of your son or daughter, in this study is voluntary. If you, or your son or daughter, choose not to participate or to withdraw from the study at any time, there will be no penalty, (it will not affect your son or daughter’s treatment).

I understand that my son or daughter’s serves will be videotaped by the researcher. These tapes will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and they will be destroyed by August 1st, 2008.

The results of this research study will be confidential to the extent allowed by law. The results of this study may be published, but your son or daughter’s name will not be used.

Although there may be no direct benefit to your son or daughter, the possible benefit of your son or daughter’s participation is for researchers to gain a better understanding of the effects of coaching instruction on service performance. In addition, your son or daughter will gain a large amount of service practice.

If you have any questions concerning this research study or your son or daughter’s participation in the study, please call me, Jennifer LoRusso, at (631)384-6013 or at jel05@fsu.edu, or Dr. Robert Eklund, at (850)645-2909 or at Eklund@coe.fsu.edu.

Sincerely,

Jennifer LoRusso

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I give consent for my child ____________ to participate in the above study. I have read the above informed consent form. I understand that the placement of my child’s serves will be videotaped by the researcher. These tapes will be marked with an anonymous code and will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and that they will be


destroyed by August 1st, 2008. I understand I may withdraw my consent and discontinue my child’s participation at any time without penalty or loss of benefits to which my child may otherwise be entitled. In signing this consent form, I am not waiving any legal claims, rights or remedies. A copy of this consent form will be given to me.

Parent's Name: __________________________

Parent's Signature __________________________ (Date) __________________________

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.
APPENDIX E

CHILD ASSENT FORM

Child Assent

Dear Participant:

I am a graduate student under the direction of Professor Dr. Robert Eklund in the Department of Educational Psychology and Learning Systems at Florida State University. I am conducting a research study to examine the effects of coaching instruction on service performance.

Your participation will involve hitting a total of 160 serves over the course of two days. Eighty serves will be hit on the first day and eighty serves will be hit on the second day. The time to complete the total amount of serves (160) will take approximately 40 minutes.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty, (it will not affect your treatment). I understand that my serves will be videotaped by the researcher. These tapes will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and they will be destroyed by August 1st, 2008.

The results of this research study will be confidential to the extent allowed by law. The results of this study may be published, but your name will not be used.

There are no risks associated with this study. The possible benefits of your participation are for researchers to gain a better understanding of the effects of coaching instruction on service performance. In addition, you will gain a large amount of service practice.

If you have any questions concerning this research study or your participation in the study, please call me, Jennifer LoRusso, at (631) 384-6013 or ja at jflow@fsu.edu, or Dr. Robert Eklund, at (850) 645-2909 or at Eklund@coes.fsu.edu.

Sincerely,

Jennifer LoRusso

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I, __________________ have read the information in this assent form and I agree to participate in this study. I understand that there are no risks to participate in the study and that I may withdraw my participation from this study at any time.

Printed Name: __________________________

Signature __________________________ (Date) ____________
If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.
REFERENCES


BIOGRAPHICAL SKETCH

Jennifer earned her Bachelor of Arts degree in psychology from the University of Connecticut in 2005. While attending UConn, Jennifer was a member of the Women’s Tennis Team for four years. She entered Florida State University’s Sport and Exercise Psychology program in the fall of 2005. She will continue toward her M.S./Ed.S. degree in School Psychology at Florida State University.