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The relationship between psychosocial momentum, precipitating events, and tennis match outcome

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THE RELATIONSHIP BETWEEN PSYCHOLOGICAL MOMENTUM, PRECIPITATING EVENTS, AND TENNIS MATCH OUTCOME

by

Tracey M. Covassin

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ABSTRACT

The Relationship Between Psychological Momentum,

Precipitating Events, and Tennis Match Outcome

by

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The purpose of this experiment is to determine whether mood states, anxiety, self-confidence, precipitating events, and psychological momentum play a role in tennis match outcome. The following hypotheses were proposed: (a) tennis match outcome may be influenced by individual's pre-competition cognitive level, (b) tennis match outcome may be influenced by individual's pre-competition mood state, (c) a precipitating event or series of events may influence tennis match outcome, and (d) psychological momentum is present in tennis matches. Fifteen minutes prior to each match 24 NCAA division 1 male tennis players completed the Competitive State Anxiety Inventory-2 and the Profile of Mood States to assess their self-confidence level and mood states, respectively. Each participant was then videotaped and analyzed for precipitating events. Results indicated those athletes with high self-confidence, low anxiety, and low total mood disturbance were more successful. Results further indicated that positive and negative momentum were just as likely to occur in winning and losing players.

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DEDICATIONS

To my parents, who instilled the foundation for learning and hard work. Thanks for never giving up on me and believing in me through the hard times. You have taught me to strive for excellence and given me the confidence that I can achieve anything I set my mind to. Thanks for your never ending love and support.

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CHAPTER 1

INTRODUCTION

The concept of psychological momentum in sports is often referred to by athletes and coaches as streaks, slumps, "hot hands," choking or home court advantage. A positive or negative effect on the ability to perform sport specific tasks may result from an individual's mental state. Players who are evenly matched in physical skills often rely upon psychological skills to gain an advantage over their opponents. Adhler (1981) first described psychological momentum as a bi-directional concept, affecting either the probability of winning or the probability of losing an event. Adhler's definition of psychological momentum does not consider the influence of physiological arousal, changes in cognition, emotions or environmental factors. For an individual to exhibit positive momentum, resulting from a positive precipitating event, these psychological factors must be taken into account. According to Taylor and Demick, momentum is defined as "a positive or negative change in cognition, physiology, affect or behavior caused by a precipitating event or series of events that will result in a shift in performance and competitive outcome" (p. 54).

A positive shift in momentum is important to tennis players because it enables them to build their self-confidence while increasing their motivation which may potentially lead

to future success. A positive precipitating event will give psychological momentum to the winner, while simultaneously placing the loser at a psychological disadvantage (Iso-Ahola & Blanchard, 1986). There are currently three hypotheses that exist regarding precipitating events, momentum and immediate match outcome.

One possible hypothesis is that tennis match outcome depends on an individual's pre-competition cognitive level. As this study is in the sporting field, cognition can be thought of as self-confidence or as a player's belief in his ability to succeed and (Bandura, 1997) is fundamental to a competent performance (Bandura, 1981). For example, a tennis player with high self-confidence will have the perseverance and motivation to strive for his/her best performance, and thereby increase the likelihood of winning the match. In contrast, a tennis player with low self-confidence will lack the motivation and desire to strive for his best performance. In addition, home crowd can potentially influence self-confidence. Spectators influence performance by providing emotional support and encouragement for the home team. As a result, this positive atmosphere might enhance and motivate the athletes' performance.

A second hypothesis is that tennis match outcome depends on an individual's pre-competition mood state. When a tennis player displays high self-confidence, this may potentially result in a positive affect, which can be thought of as an individual's mood state. For example, a tennis player with high self-efficacy may display signs of happiness and enjoyment in his/her performance. In contrast, a player with low self-efficacy may potentially generate negative affect, such as frustration and disappointment in his performance.

The final hypotheses state that a precipitating event or series of events may influence tennis match outcome and that momentum exists in tennis matches. Positive momentum can be thought of as the ability to win the two points immediately following a positive precipitating event, while negative momentum can be demonstrated through losing the next two points immediately following a negative precipitating event. A negative precipitating event may result in decreased momentum and performance while simultaneously giving the opponent a psychological advantage. Therefore, a player who exhibits a positive shift in momentum resulting from a positive precipitating event or series of events is more likely to win.

The current study will analyze videotaped tennis matches through the observation and coding of changes in behavior and performance. Prior to each match the tennis players will complete two short inventories, the Profile of Mood State (POMS) and the Competitive State Anxiety Inventory (CSAI-2) to determine pre-match mood states and confidence/anxiety levels, respectively.

The purpose of this experiment is to determine whether mood states, anxiety, self-confidence, precipitating events, and psychological momentum play a role in tennis match outcome. If it is ascertained that there is a strong correlation between these variables we may then teach tennis players how to control the potential negative influences of these variables on the overall outcome of the tennis match. In addition, through the use of videotapes we can then show the athletes evidence of how the negative or positive variables affected their performance. This information may benefit these athletes during their entire tennis careers.

Limitations

1. The tennis players may not have answered all of the questions on the inventories honestly.
2. Foreign tennis players may not have understood all the terms correctly.
3. Environmental conditions such as wind and sun, may contribute to the performance of the players.

Definition of Terms

Affect: An individual's mood state.

Cognitive State Anxiety: Negative expectations and cognitive concerns about oneself, the situation at hand, and potential consequences.

Negative Momentum: The loss of the two points immediately following a negative precipitating event.

Positive Momentum: Winning the two points immediately following a positive precipitating event.

Self-confidence: A player's belief in his ability to succeed. In this study self-confidence and self-efficacy are used interchangeably.

Somatic State Anxiety: Concerned with moment-to-moment changes in perceived physiological activation. For example, heart rate and butterflies in the stomach.

Vigor: An athlete's energy or intensity going into the match.

CHAPTER 2

REVIEW OF LITERATURE

Psychological states play a key role in athletes' performance. More specifically, cognitive and somatic anxiety, mood disturbances, and self-efficacy have all been linked to athletic performance. Athletes exhibiting a positive precipitating event may potentially gain a psychological advantage over their opponent. Therefore, a tennis player who exhibits a positive shift in momentum resulting from a positive precipitating event or series of events is more likely to win.

Mood State

The well-known iceberg profile, characterized by scores on the domain of the POMS, is thought to predict athletic performance (Morgan, 1974; Morgan & Pollock, 1977). Morgan (1974) states that the "Iceberg Profile" is an indicator of an elite athlete's mental status. The iceberg profile is characterized by scores below the norm on tension, depression, anger, fatigue and confusion, and above the population norm on vigor. In 1985, Morgan proposed a mental health model that associates positive mood states in athletes with higher performance levels and lower performance levels with low positive mood states. The iceberg profile has been observed for athletes in a variety of sports

including wrestlers (Morgan, 1979), cyclists (Hagberg, Mullin, Bahrke & Limberg, 1979), swimmers (Furst & Hardman, 1988) and runners (Morgan & Pollock, 1979).

Empirical research by Morgan, Brown, Raglin, O'Connor & Ellickson (1987) investigated overtraining and staleness in swimmers. The POMS was administered to approximately 400 collegiate swimmers during 1975-1986. Results indicated that overtraining can cause a decrease in athletic performance. The researchers suggest this may be due to increased stress levels, hormonal and hypothalamic changes. These variables are associated with a reduction in functional capacity (i.e. reduced VO2 max), which may produce staleness. In addition, mood disturbance and improvement in athletic performance were directly related to the training load. An increase in training load produces an increase in mood disturbance while a decrease in training load decreases an athletes' mood disturbances.

Another study performed by Morgan and Johnson (1977) examined the role of mental health as measured by mood state in successful and unsuccessful wrestlers. Results indicated that lower anxiety and higher vigor scores favored the successful candidates. Results revealed that elite wrestlers also illustrate the iceberg profile. The researchers concluded that positive mental health plays an important role in governing on athlete's likelihood of success.

Morgan and Johnson (1978) investigated the psychological characteristics of successful and unsuccessful oarsmen by evaluating their psychological states and traits. The researchers administered the Minnesota Multiphasic Personality Inventory (MMPI) to 50 freshman oarsmen and examined their record four years later to identify successful and unsuccessful oarsmen. The second and final phase of the study consisted of 60

candidates for the 1974 U.S. Heavyweight Rowing Team and 16 finalists for the 1974 U.S. Lightweight Team, respectively. Each candidate completed several psychological inventories including the POMS. The results indicated that those oarsmen who earned berths on the 1974 team were less depressed, anxious, fatigued, angry, confused, and neurotic, and more extroverted and vigorous than those oarsmen who were cut from the team. The researchers found psychological differences exist between successful and unsuccessful oarsmen from the onset of their competitive careers. They concluded that the MMPI would not be as useful as more recently developed inventories designed to distinguish differences between psychological states and traits. The researchers suggest that other inventories such as the POMS, are more useful because these inventories predict psychological states as opposed to traits. Psychological states are more useful in predicting athletic performance.

Morgan, O'Connor, Ellickson and Bradley (1988) investigated psychological characteristics and performance in elite male distance runners. The researchers administered several psychological inventories including the POMS, and carried out a structured interview with each athlete. The taped interview lasted 45-minutes to 1-hour and addressed each athlete's motivation, race and cognitive strategies, staleness and pre-competitive arousal. The results of the questionnaires and interviews were consistent with previously mentioned iceberg profiles. In addition, the results support Morgan's (1985) concept that performance is associated with positive mental health.

Another study conducted by Morgan, Costill, Flynn, Raglin and O'Connor (1988) examined the effects of mood disturbances following increased training in male swimmers. Each swimmer completed a muscle soreness scale, the POMS and a 24 hour

history each morning prior to their first daily session. The results of the POMS indicated that it is possible to provoke mood disturbances within a period of 3 to 4 days following increased training; however, these results were not clinically significant. These swimmers experienced and increase in depression and an inability to tolerate increased training loads, however, the swimmers mean values fell within the normal range for college students. The researchers concluded that monitoring mood states during increased training sessions can be of potential value in the prevention of staleness.

Hassmen and Blomstead (1995) investigated soccer players' mood states by completing the POMS before, immediately after and two hours after each game during the season. The iceberg profile was observed as players demonstrated significantly lower tension, anger, confusion, and depression scores and high vigor scores when they won the games but not when they tied or lost. However, fatigue scores did not differ with regard to outcome. Hassmen and Blomstead suggested that the differences observed for the five POMS disciplines really reflect a difference in mood state that is not due to differences in the physical effort expended in the game. The researchers concluded the outcome of the games had a significant influence on the mood states of the athletes. In addition, POMS scores did not predict team performance.

Several other researchers have found contradicting results when utilizing the POMS test to predict athletic performance. Craighead, Privette, Vallianos, and Byrkit (1986) investigated whether significant differences exist between starters and non-starters in basketball players. The researchers examined personality characteristics between high school and university basketball teams. The results of the POMS test indicated that there were no significant differences between starters and non-starters, as well as no

differences between winning and losing teams. The results also indicated a difference between university and high school players with regard to anger and tension. The results revealed high school players scored higher on both variables when compared to university players. Craighead et al. concluded that these findings cannot be generalized without replication.

Thomas, Zebas, Bahrke, Araujo, and Etheridge (1983) examined the psychological and physiological variables that may be used to predict successful track and field performance. Collegiate track and field athletes completed several psychological inventories including the POMS to assess both psychological traits and states. Athletes displayed exceptional mental health on the assessed psychological variables, which supports Morgan's (1979) mental health model. In other words, highly successful power athletes and distance runners exhibited positive mood states. However, there was no significant relationship between POMS profile and performance.

An athlete's mood is influenced to a large extent by his/her performance and game outcome (McAuley, 1985; Robinson & Howe, 1987). Robinson and Howe (1987) examined mood state relationships of soccer players for team outcome and personal performance. The researchers investigated which causal dimensions (locus, controllability and stability) were most closely related to affective responses. Male collegiate soccer players completed the POMS on the evenings prior to the day of three play-off games. In addition, players completed the Causal Dimension Scale (CDS), POMS, and a personal evaluation of their performance on the morning following the day of the game. Successful soccer players exhibited positive pre and post-game mood states, while the unsuccessful group exhibited post-game mood disturbances. Results revealed

team performance profiles were positive for both win1 and win 2; however, mood disturbances were evident for the loss in the final play-off game. The researchers suggest mood disturbances were evident for loss 1 and not win 1 and win 2 because a win was required in all games to advance to the final rounds of the Canadian Inter-University Athletic Union. Athletes displayed lower scores on aggression, frustration, confusion, vigor and total mood disturbances. Correlations were found between the causal dimensions and affective states. The researcher found controllability to be the dimension most clearly related to emotional reactions for performance and outcome of game.

Friend and LeUnes (1990) investigated psychological and physical predictors of baseball players. Coaches rated players physical abilities (pitching, hitting, fielding) to predict performance. Each baseball player completed the POMS and Locus of Control (LOC) inventories prior to the start of the season. Results provided partial evidence that psychological measures enhance the prediction process for baseball players. LOC did not predict performance, however, tension and anger subscales of the POMS were the two strongest psychological predictors of performance.

Self-Confidence

Self-efficacy is one of the most frequently cited psychological factors thought to affect sport performance and is a primary focus of research conducted by sport psychologists (Feltz, 1992). Bandura's (1982) social cognitive theory suggests an individuals' degree of self-efficacy influences performance both directly and indirectly via emotions and cognitions. Successes enhance perceived self-efficacy while repeated failures lower it, especially if failures occur early in the course of events and do not reflect adverse external circumstances or lack of effort (Bandura, 1982). Bandura suggests the higher

the level of self-efficacy, the higher the performance accomplishments and the lower the emotional arousal. Several studies have shown successful elite athletes to have lower pre-competition anxiety than less successful athletes (Ussher & Hardy, 1986; Mahoney & Avener, 1977; Weinberg & Genuchi, 1981; Highlen and Bennett, 1979).

Mahoney and Avener (1977) investigated psychological factors of 13 male gymnasts competing for the 1976 US Olympic team. Forty-eight hours prior to the competition athletes were given several inventories. Results indicated the gymnasts that made the 1976 Olympic team had a higher self-confidence than the gymnasts who did not make the team. Successful gymnasts were able to control their anxiety during competition better than less successful gymnasts. The researchers suggest athletes could be trained not to "fight" anxiety but to capitalize on it to improve performance.

Highlen and Bennet (1979) examined wrestlers competing for positions on three Canadian National Teams by assessing psychological factors affecting the athletes' training and competition. Wrestlers were classified as either qualifiers or non-qualifiers. The researchers found that qualifiers reported being closer to reaching their maximum potential and were more confident than nonqualifiers. In addition, qualifiers exhibited less stress and anxiety prior to and during the competition.

Krane and Williams (1987) examined self-confidence, cognitive and somatic anxiety in high school gymnasts' and collegiate golfers to determine which variable was the best predictor of performance. The CSAI-2 was completed by each gymnast and golfer 24 hours, 1 hour, and 10 minutes prior to competition. Results indicated collegiate golfers have lower somatic cognitive anxiety and higher self-confidence than gymnasts who were subjectively scored. Gymnasts cognitive anxiety increased prior to competition

while golfers cognitive anxiety decreased as the competition approached. In addition, gymnasts' somatic anxiety increased up to the start of competition. Gymnasts' self-confidence decreased slightly from 24 hours to one hour prior to competition then increased slightly ten minutes prior to competition. Golfers self-confidence increased consistently 24 hours, one hour and ten minutes prior to competition. The researchers concluded that none of the three subscales was able to predict collegiate golf and high school gymnastic performance.

Lox (1992) hypothesized greater perceived uncertainty and importance of personal performance and outcome would be correlated with higher self-confidence prior to competition. Collegiate volleyball players completed two short questionnaires on self-efficacy and perceived threat, as well as the CSAI-2. Results indicated that perceived threat of game outcome and personal performance were correlated with self-confidence. Cognitive anxiety was correlated with uncertainty regarding personal performance, while somatic anxiety was correlated with perception of importance of personal performance and outcome.

Treasure, Monson and Lox (1996) hypothesized that self-efficacy of wrestlers would be associated with higher levels of positive affect and lower levels of negative affect, somatic and cognitive anxiety. In addition, they examined the relationship between pre-competition self-efficacy and different measures of performance and match outcome. Treasure et al. argued that a point scoring system in wrestling will provide a higher degree of precision and sensitivity than a win-loss measure. Each athlete completed the CSAI-2, positive and negative affective schedule (PANAS) and a questionnaire on self-efficacy 15 minutes prior to the commencement of his match. Results indicated that self-

efficacy was positively correlated with positive affect and somatic and cognitive anxiety prior to competition. Results also showed that the higher the pre-competitive level of self-efficacy, the better the wrestlers performed. The findings suggest that a point system used for measuring performance provides a higher degree of precision and sensitivity than a simple win-loss measure.

Scanlan, Lewthwaite and Jackson (1984) examined psychological predictors of win-loss outcomes for children who were novice wrestlers. The researchers investigated pre-match competitive stress or state anxiety, competitive experience and pre-match performance expectancies, and pre-competitive cognition and their performance outcomes. Each child completed several questionnaires before the first and second rounds of tournament competition. In addition, win-loss records were recorded for each. Results revealed that if the participants' competitive wrestling experience was considered, then the prematch cognition factor (worries about failure) and prematch performance expectancies were influential predictors of performance outcomes in round 1 and 2.

Miller, Carlyle and Pease (1995) hypothesized that when self-efficacy was elevated, motivation would increase, and when self-efficacy was reduced, motivation would decrease in swimmers, ice hockey and basketball players. Athletes completed a self-report scale prior to their event. Results revealed that swimmers and basketball players with high self-efficacy had considerably lower motivation. These findings may be due to the fact that in most situations when perceived self-efficacy was extremely high, there was little challenge, resulting in reduced motivation. The results did not provide

conclusive support that there is a positive linear relationship between self-efficacy and motivation.

Swain and Jones (1992) hypothesized that highly competitive male athletes competing in track and field would exhibit higher levels of state self-confidence and lower levels of competitive state anxiety than low competitive athletes. Each athlete competed the CSAI-2 one week, two days, one day, two hours, and 30 minutes prior to the start of the track and field competition. An athletes temporal pattern includes scores from the three subcomponents of the CSAI-2. In addition, athletes completed the Sport Orientation Questionnaire (SOQ) to determine if the subscales emerged as significant predictors of the CSAI-2 subscale score. Results revealed that for somatic anxiety, an earlier elevation in the somatic response occurred for the low competitive group. The low competitive group showed a progressive increase in cognitive anxiety as the competition neared, while the high competitive group showed no change across time. The high competitive group had significantly higher self-confidence than the low competitive group. However, self-confidence decreased on the day of the competition for the high competitive group. These results suggest that temporal patterning did differ for somatic and cognitive anxiety as a function of competitiveness.

According to Jackson and Roberts (1992) peak performance is characterized by optimal sport performances, resulting in personal best and astounding achievement. The researchers hypothesized that athletes who are confident in their ability experience flow more often than athletes who are low in perceived ability. They also hypothesized that athletes are in a state of flow during peak performance. Cskszentmihalyi (1975) describes flow as a perceived balance between activity and one's ability to meet the

demands of a task. However, if there is an imbalance between perceived demand and ability to respond, it may be manifested as stress or anxiety. Collegiate athletes completed a questionnaire that assessed competitive goal orientations and mastery, experience in best and worst competitive performances, perceived ability and flow. Competitive orientation was often associated with an athlete's worst performances and a mastery orientation with an athlete's best performances. In addition, athletes who are high in mastery orientations experienced flow more frequently than athletes low in mastery. The study also concluded that athletes experienced high levels of flow during their best performances and with high levels of perceived ability. A competitive orientation was associated with poor performance.

Momentum and Precipitating Events

In the early 1980s, Adhler (1980) generated the first theoretical exploration of momentum as a social phenomenon. According to Adhler, psychological momentum is the tendency of an effect to be followed by a similar effect. A positive shift in momentum results in increased self-efficacy and motivation, which in turn results in enhanced performance and possibly future success. A negative shift in momentum results in decreased self-efficacy and performance, which may lead to defeat. Adhler (1981) presented a model involving five fundamental components: (1) focus on a specific goal; (2) motivation initiating the effort of goal attainment; (3) emotional feelings attached to motivation toward the goal; (4) increased arousal associated with the activity; and (5) enhanced performance due to the above factors. Adhler's model of psychological momentum does not take into account the factors of physiological arousal, emotions,

cognition or environment. In addition, Adhler's model did not empirically test psychological momentum.

The first attempt to test empirically the concept of psychological momentum in sport was made by Iso-Ahola and Mobily (1980). According to Iso-Ahola and Mobily, psychological momentum was defined as "added or gained psychological power which changes interpersonal perceptions and influences an individual's mental and physical performance" (p.392). The researchers analyzed the role of psychological momentum on performance in an open racquetball tournament. Their results supported their hypothesis that psychological momentum predicted second game and match outcome when players won the first game. However, psychological momentum did not predict match outcome when games were split. They concluded that when two people compete against each other, the competitor who has psychological momentum is more likely to win.

A follow-up study done by Iso-Ahola and Blanchard (1986) supports the hypothesis that early success gives psychological momentum to the winner while simultaneously placing the loser at a psychological disadvantage. Iso-Ahola and Blanchard administered a questionnaire to competitive racquetball players during a two-minute break between the first and second game of a racquetball tournament. Players were asked to rate their personal ability in relation to the opponent's, their confidence in their ability and experience to win the second game, and their perceived likelihood of winning the second game. The results indicated that the winners more often rated themselves as players of better ability than did losers; winners were significantly more confident than losers in their ability and experience to win the second game; and the perceived likelihood for winning was significantly greater for winners than losers. The researchers also

concluded positive psychological momentum enhances an athlete's performance, which in turn increases the likelihood of winning the entire match.

The concept of psychological momentum has been a popular research topic in the realm of tennis. For example, research by Weinberg, Richardson and Jackson (1981) and Weinberg and Jackson (1989) investigated gender differences in tennis players' ability to win 2 out of 3 sets in a match after losing the first set. Results indicated that males were more likely to come from behind and win after losing the first set than females. Weinberg et al. (1981, 1989), Iso-Ahola and Mobily (1980) and Iso-Ahola and Blanchard (1986) all inferred that psychological momentum was responsible for the results.

Silva, Hardy and Crace (1988) attempted to evaluate the existence of psychological momentum in female and male collegiate tennis matches by examining three seasons of Division 1 competition. Results indicated that singles match outcome predicted doubles match outcome. Results revealed that positive momentum occurred 74.6 % of the time. In other words, doubles performance is related to singles performance. In addition, winning set 1 in singles predicted set 2 outcome and match outcome. However, when players split sets psychological momentum disappeared. The results of the tie-breaker indicated that in straight set situations, winning the tie-breaker in set 1 predicted set 2 outcome and match outcome. However, tie-break outcome did not predict match outcome in the split set situation. The researchers indicated that if superior ability causes a player to win the first set, that same superior ability, rather than the influence of psychological momentum, most likely produced the win in the second set.

Another study by Richardson, Adhler and Hankes (1988) supported Silva et al.'s (1988) interpretation of psychological momentum in tennis players. Richardson et al.

investigated if winning a specific game in a tennis match would predict success in the match and if psychological momentum was influenced by ability level of the players. Results indicated that winning any of the first eight games in the first and/or second set was a predictor of tennis match success. Games 8, 10, and 11 in the first set were significant predictors of winning the match, while only Game 4 of the second set predicted the probability of match victory (Richardson et al, 1988). They indicated that when ability was controlled, psychological momentum was not evident.

One study with results not supporting the theory that momentum leads to success was that of Gilovich, Vallone and Tversky (1985), on the "hot-hand phenomenon" in basketball. Basketball players and fans tend to believe that a player's chance of hitting a shot are greater following a hit than following a miss on the previous shot. Gilovich et al. surveyed basketball fans' beliefs regarding streak shooting, as well as recorded field goal and free-throw data from players in the NBA. Gilovich et al.'s results indicated that there was no statistical evidence to support players' and fans' belief in "the hot hand phenomenon." However, they did indicate that two factors may contribute to their findings. First, a player's selection of shots may vary due to his previous record of hits or misses. A player may become more confident and attempt more difficult shots; after missing a shot, a player may get conservative and take only high-percentage shots. Second, once a player has made two or three shots in a row, the opposing team's defense may intensify pressure on that player and "take away" his good shot.

Gilovich et al. conducted two more studies on basketball shooting that are uncontaminated by shot selection or defensive pressure. First, they collected data for all pairs of free throws by Boston Celtics players during the 1980-1981 season. Again, their

results provided no statistical evidence that the outcome of the second free throw is influenced by the outcome of the first free throw. Second, a controlled shooting experiment with the varsity players of Cornell University led to the same conclusions. Gilovich et al. determined a distance for each player from which his or her shooting percentage was roughly 50%. The players were required to move along the arc between shots so that consecutive shots were never taken from the same spot. Again, no significant correlation between shots was found. Gilovich et al. concluded that these results might be due to a "powerful and widely shared cognitive illusion" (p.313). Players may assume a "hot hand" because if long sequences of hits (or misses) are more memorable than alternating sequences, then the observer is likely to overestimate the correlation between successive shots.

Vallerand, Colavecchio, and Pelletier (1988) were the first to introduce momentum in their antecedents-consequences model of psychological momentum. According to their model, "psychological momentum refers to a perception that the actor is progressing toward his/her goal" (p.94). The model emphasizes that psychological momentum must be distinguished from its antecedents (momentum starters) and performance consequences by dividing it into three distinct parts. First, the model postulates that perceptions of psychological momentum are produced by the interplay between situational and personal variables. For example, situational variables may be so important that most individuals will perceive psychological momentum in that given situation. Personal variables refer to schemas, experience and the need for control. The second phase of Vallerand et al.'s ancedent-consequences model deals with perceptions and feelings of psychological momentum. Several studies indicated that winning the first

set may enhance psychological momentum perceptions, which in turn resulted in victory (Iso-Ahola & Mobily,1980; Iso-Ahola & Blanchard, 1986; Weinberg, Richardson & Jackson 1981; Weinberg & Jackson 1989). The final phase of the model pertains to consequences, such as crowd, game importance, skill level and need for achievement.

The study tested hypotheses derived from the model with respect to the impact of antecedent variables on perceptions of psychological momentum. In addition, it attempted to ascertain the link between psychological momentum perceptions and performance inferences. Vallerand et al. hypothesized that the player coming from behind to win four games in a row and tie the score at five all in the first set would have greater perceptions of psychological momentum than the players alternating in winning games up to five all. A second hypothesis was that subjects with high levels of tennis experience would perceive more psychological momentum than subjects with less experience. In addition, it was also hypothesized that both variables would lead to enhanced performance inferences. Vallerand et al.'s results indicated that coming from behind to tie the match had a strong influence on perceptions of momentum. Second, there was no main effect or interaction involving tennis experience on perceptions of psychological momentum. Finally, score configuration and level of experience led to inferences that the player having psychological momentum should win the first set.

Miller and Weinberg (1991) produced similar findings related to critical situations and skill level on perceptions of momentum in volleyball matches. Miller and Weinberg based their study on Vallerand et al.'s (1988) model, and hypothesized that momentum teams would have a performance advantage over nonmomentum teams in terms of scoring the next few points as well as winning the match. Several different scenarios

were provided in which critical situations and perceived momentum were manipulated. Subjects responded to scenarios in which one volleyball team came back from three points down to tie the game. Each situation was analyzed to determine the outcome of the next five serves, five points, and the game at critical and noncritical situations. Results indicated that teams with positive momentum have a significant psychological advantage over their opponents, especially in critical situations. Second, low-skill subjects predicted the momentum team would have a performance advantage in critical situations for the subsequent point and game. In contrast, high-skill subjects did not perceive any advantage. Finally, results indicated momentum had minimal influence on subsequent performance in actual game situations.

Taylor and Demick (1994) have presented another model of psychological momentum. They formulated a multidimensional model of momentum in sports, which ties together the evidence and theoretical concepts from several previous studies. According to Taylor and Demick, the use of the term "psychological momentum" is inappropriate because it does not take into account the important role that physiological, behavioral, emotional, social, and environmental factors play in the development of momentum. Therefore, they defined momentum as "a positive or negative change in cognition, affect, physiology, and behavior caused by an event or series of events that will result in a commensurate shift in performance and competitive outcome" (p. 54).

The researchers' model consists of six elements, termed the "momentum chain," that result in the development of momentum: (A) a precipitating event or series of events; (B) a change in cognition, physiology and affect; (C) a change in behavior; (D) an increase or

decrease in performance consistent with the above changes; (E) opponent factors for sports with head-to-head competition; (F) a change in immediate outcome.

The first step in the development of momentum is the emergence of a precipitating event or series of events (Richardson, Adhler, & Hankes, 1988). A precipitating event may trigger the momentum chain for one athlete but not for another athlete. The second element in the development of momentum is a change in cognition, physiology and affect which may emerge due to an event or series of events. By this stage, alterations in observable behavior will be evident through changes in general activity level, pace, and body language. A negative or positive change in behavior results from the previous phases of the momentum chain. The changes that have occurred so far in the momentum chain will produce the change in performance. A positive momentum chain will result in an increase in individual performance, while a negative momentum chain will manifest as a decrease in an individual's performance. Another element in the development of momentum pertains to opponent factors. For momentum to have a significant impact on competitive outcome, a positive momentum chain would have to occur for one athlete, while simultaneously producing a negative momentum chain for the opposing athlete.

Taylor and Demick conducted two studies on tennis players and basketball teams to test the multidimensional model of momentum in sports. The results indicated that winning tennis players displayed significantly more positive precipitating events and fewer negative precipitating events than losing players. In contrast, there was no significant difference in the number of positive and negative precipitating events that winning and losing basketball teams experienced. In addition, basketball teams and tennis players had only a proportion of the precipitating events result in a change in

immediate outcome. Taylor and Demick's results offer supportive, though not conclusive, evidence that winning basketball teams displayed a significantly greater number of changes in immediate outcome following precipitating events than when no precipitating event occurred. However, tennis players did not exhibit significant evidence, that a greater number of changes in immediate outcome resulted following precipitating events than when no precipitating event occurred. Taylor and Demick concluded that the relationship between a precipitating event and changes in immediate outcome provided partial evidence in support of the model.

As considerable debate still exists regarding the impact of psychological factors and momentum on tennis match outcome, this study is designed to clarify the relationship between these factors. Based on Taylor and Demick's multidimensional model of momentum in sports, this study is designed to investigate whether self-confidence, somatic and cognitive anxiety, and total mood state have an impact on tennis match outcome. In addition, this study will try and determine whether there is a relationship between positive precipitating events, positive momentum, and tennis match outcome.

CHAPTER 3

METHODS

Participants

Twenty four division I NCAA male tennis players volunteered to participate in the present study. Participants were naive to the theoretical question of the study and signed informed consent forms (Appendix A) prior to participation.

Instrumentation

The Profile of Mood State (POMS) was developed by McNair, Lorr, and Droppleman in 1971 to measure fluctuating affective states in diverse situations. The POMS test consists of 65 adjectives describing mood, rated on a five-point Likert scale. The POMS is divided into 6 factors describing six mood dimensions that include: tension-anxiety, depression-dejection, anger-hostility, fatigue-inertia, confusion-bewilderment, and vigor-activity. The first five factors tend to be positively correlated while vigor activity tends to be negatively correlated with the other factors. The POMS test allows for the deviation of a meaningful total mood disturbance score by adding up the first five factors and subtracting the vigor score (Weckowicz, 1978). This method is to ensure in Total Mood Disturbance (TMD) score consistency with collegiate athletes normative data. Reliability coefficients reported for each subscale were: depression (0.74), tension (0.70),

anger (0.71), confusion (0.68), fatigue (0.66), vigor (0.65) (McNair et al., 1971). Internal consistency of factors were between 0.90 or above and validity has been well established (McNair et al., 1971).

Researchers use the Competitive State Anxiety Inventory-2 (CSAI-2) to measure self-confidence and somatic and cognitive anxiety in sport situations. In the CSAI-2, self-confidence is viewed as a separate subscale of anxiety in addition to somatic and cognitive anxiety (Feltz, 1988). Somatic state anxiety is considered to be a reflexive response to various environmental stimuli, associated with the onset of an evaluative event (Martens et al., 1983). Somatic state anxiety is reflected in such response as rapid heart rate, butterflies in the stomach and nausea. Cognitive state anxiety is defined as "negative expectations and cognitive concerns about oneself, the situation at hand, and potential consequences" (Morris, Davis, & Hutchings, 1981, p. 541). Cognitive state anxiety is manifested in negative concerns, thoughts, and expectations about ones' performance and opponent ability. The CSAI-2 is comprised of 27 4-point Likert-type scale items. Cronbach's alpha coefficients range from .79 to .90, demonstrating a high degree of internal consistency for each of the CSAI-2 subscales (Martens et al., 1983). The concurrent validity of the CSAI-2 was examined by investigating eight selected A-state and A-trait inventories and comparing the relationship to the CSAI-2 subscales. The concurrent validity of the CSAI-2 is highly congruent with hypothesized relationships among the scales of the related constructs and the CSAI-2 subscales (Martens et al., 1983).

Procedure

The participants included players from the 1998 NCAA Regional (VII) Team Tennis Tournament. Three singles matches were randomly selected from each of the team's top six singles players. These matches included two teams competing in the quarterfinals, four teams competing in the semifinals, and two teams competing in the finals. All teams had similar competition experience to minimize the effects of ability on match outcome. By this time in the tournament due to the single elimination format, athletes are more evenly matched in ability as weak athletes have already been defeated. Prior to the start of their tennis match participants completed the POMS and CSAI-2 questionnaires. The inventories were administered 15 minutes prior to competition to minimize changes between the time of psychological testing and start of performance. After the questionnaires were completed, participants were videotaped for future analysis of precipitating events.

Three trained observers then watched each match, and, using a specially designed assessment form (Appendix B), recorded every occurrence of the following precipitating events and subsequent scoring pattern: (A) Dramatic shot; (e.g. drop shot, overhead smash); (B) Ace; (C) Double fault; (D) Making an unforced error; (E) Break of serve; (F) Not converting a break point; (G) Pumped fist; (H) Body language; (e.g. slouched shoulders, head down, dragging feet, ball and racquet abuse); (I) Winners. These precipitating events were similar to those identified by Richardson, Adhler and Hankes, (1988). The next two points after a precipitating event were used to calculate the subsequent scoring pattern and were used as a measure for positive or negative momentum.

Data Analysis

Independent t-tests will be conducted to determine if pre-competition total mood disturbance differs between winners and losers of the tennis matches. Independent t-tests will be conducted to evaluate whether there is a significant difference between pre-competition anxiety levels (both somatic and cognitive) and the winners and losers of the tennis matches. Independent t-tests will be utilized to determine if there is a difference between pre-competition self-confidence levels and overall tennis match outcome. Chi square analyses will be conducted to evaluate the relationship between precipitating events, psychological momentum, and tennis match outcome. Conditional probabilities will be calculated to examine the relationship between precipitating events and psychological momentum.

CHAPTER 4

RESULTS

Competitive State Anxiety Inventory-2 (CSAI-2)

The CSAI-2 was used to measure pre-competitive cognitive anxiety, somatic anxiety, and self-confidence. Results revealed winning tennis players displayed significantly higher self-confidence ($M=29.42$) than losing players ($M=21.83$, $t = 7.21$, $(p<0.05)$. Results suggest that athletes who have a higher self-confidence entering competition are more likely to be successful (Appendix E).

Results revealed winning tennis players exhibited significantly lower cognitive anxiety ($M=14.67$) than losing players ($M=20.5$, $t = -5.21$, $(p<0.05)$. Athletes who manifested greater negative expectations about performance and opponent ability were more likely to lose the match (Appendix F).

Results indicated winning players displayed significantly lower somatic anxiety ($M=13.33$) when compared to losing players ($M=19.58$, $t = -4.68$, $(p<0.05)$. Winning tennis players began their matches with significantly lower anxiety levels than losing tennis players (Appendix G).

Profile of Mood States (POMS)

The POMS was used to obtain measures of mood disturbances 15 minutes prior to the match. Raw POMS data for winning and losing players were converted to T scores using the T values provided in the POMS manual for collegiate-aged males (Table 1).

Table 1

POMS T Values

POMS	Norm	Win	Loss
Tension	50	38.65	49.00
Depression	50	40.17	49.75
Anger	50	44.83	60.25
Vigor	50	65.25	52.08
Fatigue	50	35.67	40.58
Confusion	50	34.00	44.17
Total Mood Disturbance	43	-7.67	39.67

Winning athletes scored above the mean T score (M = 50.00) on vigor and below the mean T score on tension, depression, anger, fatigue and confusion. Losing athletes scored above the mean T score on anger and vigor. Winning athletes scored lower on tension, depression, anger, fatigue and confusion, when compared to losing athletes. Winning athletes had a higher vigor score, when compared to losing athletes. Winning athletes scored considerably lower on total mood disturbance than losing and collegiate athletes. Winning tennis players had a negative total mood disturbance because they had a considerably large vigor score.

Total Precipitating Events

The 24 tennis players exhibited an average of 91.6 precipitating events per match. The most common type of precipitating event was an unforced error (28.7 %), followed by winners (15.5 %), pumped fist (10.8 %), and overall negative body language (10.6 %) (Table 2).

Table 2

Percentage of Precipitating Events

Precipitating Event	Percentage
Unforced Error	28.7 %
Winners	15.5 %
Pumped Fist	10.8 %
Negative Body Language	10.6 %
Head Down	8.3 %
Break Point	6.7 %
Ace	5.8 %
Double Fault	5.2 %
Drop Shot	4.1 %
Slouched Shoulders	2.5 %
Overhead	1.8 %

Table 3 illustrates the total number of precipitating events for winning tennis players. Results revealed winning players experienced a significantly greater proportion of positive precipitating events (65.2 %) and a significantly smaller proportion of negative precipitating events (34.8 %, $t = 9.24$, $p<0.05$).

Table 3

Precipitating Events for Winners

Positive Precipitating Events	Negative Precipitating Events
61.2 %	38.8 %
57.3 %	42.7 %
70.0 %	30.0 %
76.1 %	23.9 %
61.5 %	38.5 %
72.0 %	28.0 %
54.4 %	45.6 %
58.3 %	41.7 %
58.5 %	41.5 %
71.9 %	28.1 %
69.2 %	30.8 %
71.7 %	28.3 %
TOTAL 65.2%	34.8%

As shown in Table 4, results indicate that losing players experienced a significantly greater proportion of negative precipitating events (58.2 %) and a smaller proportion of positive precipitating events (41.9 %, $t = 2.69$, $p<0.05$). The differences between total number of precipitating events for winning and losing players was not statistically significant.

Table 4

Precipitating Events for Losers

Positive Precipitating Events	Negative Precipitating Events
44.6 %	55.4 %
42.6 %	57.4 %
38.5 %	61.5 %
39.2 %	60.8 %
33.6 %	66.4 %
47.2 %	52.8 %
30.7 %	69.3 %
48.2 %	51.8 %
60.0 %	40.0 %
36.2 %	63.8 %
42.7 %	57.3 %
40.0 %	60.0 %
TOTAL 41.9%	58.1%

Conditional Probabilities

Table 5 displays conditional probabilities for the 12 winning tennis players during the 1999 NCAA Regional Tennis Tournament. Conditional probabilities suggest that positive momentum occurred 67.5 % of the time following a positive precipitating event for winning players. Winning players also demonstrated negative momentum 72.67 % of the time following a negative precipitating event.

Table 5

Conditional Probabilities for Winners

Positive Momentum	Negative Momentum
74.2 %	71.4 %
65.6 %	76.2 %
67.5 %	58.3 %
58.3 %	73.9 %
72.7 %	70.0 %
71.0 %	53.8 %
73.7 %	75.0 %
76.4 %	66.7 %
62.1 %	65.3 %
72.4 %	88.2 %
55.6 %	90.9 %
61.0 %	81.8 %
TOTAL 67.5%	72.6%

Table 6 illustrates conditional probabilities for the 12 losing tennis players. Conditional probabilities indicate that positive momentum occurred 66.0 % of the time following a positive precipitating event for losing players. While, conditional probabilities indicated that negative momentum occurred 74.3 % of the time following a negative precipitating event for losing players.

Table 6

Conditional Probabilities for Losers

	Positive Momentum	Negative Momentum
	83.3 %	91.4 %
	66.7 %	66.7 %
	43.3 %	32.1 %
	50.0 %	87.5 %
	41.1 %	87.5 %
	56.5 %	72.9 %
	75.0 %	93.8 %
	100 %	84.2 %
	60.0 %	76.1 %
	80.9 %	79.4 %
	85.7 %	58.3 %
	50.0 %	62.0 %
TOTAL	66.0%	74.3%

A series of Chi-square analyses were conducted to examine the relationship between positive and negative precipitating events and subsequent positive and negative momentum. Across the 24 matches, 22 were found to show a significant relationship between precipitating events and psychological momentum (92%).

A series of chi-square analyses were also conducted to elaborate on the relationship between negative and positive precipitating events and the next point. Across the 24 matches, 17 matches demonstrated a significant difference between positive and negative precipitating event and the next point (71%).

CHAPTER 5

DISCUSSION

This study examined the relationship between mood states, anxiety, self-confidence, precipitating events, psychological momentum and tennis match outcome. The first hypothesis suggests that self-confidence level is a major factor in determining tennis match outcome. Results of the CSAI-2 indicated winning tennis players exhibited significantly higher levels of self-confidence than losing players. These results support the study conducted by Treasure et. al. (1996) on wrestlers which concluded that the higher the level of self-confidence, the better the wrestler performed. Confident athletes believe in their ability to perform well and win. In addition, they are more able to overcome the effects of negative precipitating events. CSAI-2 results revealed that winning players demonstrated significantly lower levels of somatic and cognitive anxiety. This finding supports the numerous studies that have shown that winning athletes have lower pre-competitive anxiety levels than losing athletes (Ussher & Hardy, 1986; Mahoney & Avener, 1977; Weinberg & Genuchi, 1981; Highlen & Bennett, 1979). Winning athletes manifested fewer negative expectations and concerns about performance than losing players. Losing athletes exhibited higher arousal and anxiety level that in turn may have influenced their performance. Athletes have an optimal level of arousal and when an athlete reaches this optimal level, his/her performance will reach

a peak level. When an athlete surpasses this optimal level of arousal, his/her performance will decrease as a result of this high anxiety level. Athletes who displayed high self-confidence and low anxiety levels were potentially able to remain calm and relaxed under pressure and were not as affected by negative precipitating events. Winning tennis players were also able to produce positive momentum or reverse negative momentum, hence decreasing the impact of momentum on tennis match outcome.

The second hypothesis suggests an individual's pre-competition mood state may play a significant role in the outcome of the tennis match. Results revealed winning tennis players in this study scored above the mean T Score (M= 50.00) on vigor and below the mean on tension, depression, confusion, anger, and fatigue when compared to college-age norms and unsuccessful athletes. These findings replicate Morgan and Johnson (1977) study that revealed that successful wrestlers demonstrated lower anxiety and higher vigor when compared to unsuccessful wrestlers. Losing tennis players demonstrated higher scores on anger-hostility when compared to college-age norms and winning tennis players. Losing tennis players showed high feelings of intensity, overt anger, "grouchy" and "Bad-temperament". These emotions already existed prior to the match, therefore, these negative emotions might have played a role in their decreased performance and subsequent loss.

Winning tennis players exhibited higher vigor scores than losing tennis players. Winning tennis players illustrated high energy levels, cheerfulness, and carefree vigorous attitudes. These factors might have played a role in their performance and match outcome in that they were able to maintain a positive attitude and self confidence in the face of adversity. Winning and losing tennis players showed considerably lower scores

on fatigue when compared to college-age norms. Therefore, it appears that fatigue did not play a role in overall match outcome. These results are consistent with the findings of Hassmen et.al.(1995) who concluded that fatigue did not play a role in soccer players game outcome.

A total mood disturbance score was calculated to obtain a single global estimate of affective state. Results revealed that total mood disturbance score was substantially lower for losing tennis players when compared to winning tennis players and college-age norms. Athletes who enter a match with low total mood disturbance states are more relaxed and might be capable of controlling their negative emotions so they don't play a key role in their match.

Winning tennis players demonstrated Morgan's (1980) iceberg profile. The iceberg profile results when athletes score below the mean T Score (M=50.00) on tension, anger, fatigue, confusion, and depression, and above the mean T Score on vigor. Tennis players in this study exhibited the iceberg profile which is consistent with additional studies conducted on athletes in other sports (Morgan, 1979; Hagberg et al. 1979; Furst et al. 1988; & Morgan et al. 1979).

Tennis players in this study exhibited an average of 91.6 precipitating events per match. Winning players demonstrated a significantly greater proportion of positive precipitating events (65.2%) and a significantly smaller proportion of negative precipitating events (34.8%) than losing players. These results would be expected for tennis players to win the match. Winning tennis players would be able to act on the positive events and restrict the influence of the negative events. These findings replicate the Taylor et al. study on the multidimensional model of momentum in sport. In addition,

losing tennis players demonstrated a greater proportion of negative events (58.2%) and a smaller proportion of positive events (41.9%) than winning players, yet this difference was not statistically significant. This occurrence may be due to several close matches where losing players exhibited slightly higher negative precipitating events. Furthermore, one athlete demonstrated more positive precipitating events than negative precipitating events, however, still lost the match. One possible explanation for this occurrence may have been due to his extremely high total mood state going into the match. This particular athlete demonstrated considerably higher scores on tension, depression, and anger as compared to his opponent. His pre-competition mood state may have contributed to his poor performance on big points, which in turn may have resulted in his losing the match.

Results revealed that conditional probabilities for positive and negative momentum were both present when comparing winning tennis players to losing tennis players. These findings suggest that positive and negative momentum were just as likely to occur in both winning and losing players. There are two possible explanations for these findings. First, winning players were able to overcome negative momentum and win the match while losing players were not able to overcome negative momentum. Second, athletes who demonstrate high self-confidence and low anxiety might find momentum is not as crucial, as these two psychological factors help moderate the effects of momentum. However, it is important to note that due to the fact that winning tennis players exhibited a significantly greater number of positive precipitating events than negative precipitating events, positive momentum was more prevalent in the tennis match. Therefore, psychological momentum alone is not the best predictor of tennis match outcome.

However, these results suggest that an athletes pre-competition mood state, anxiety and confidence levels are more accurate predictors of who is able to control psychological momentum during the match and overall tennis match outcome.

When a series of chi-squares were conducted to look at the relationship between precipitating events and momentum, significant differences were found in 22 out of the 24 matches (92%). This illustrates that psychological momentum is present in tennis matches and is influenced by whether you have a positive or negative precipitating event. Athletes who utilize positive momentum to their advantage and overcome negative momentum are more likely to win the match.

Results revealed that 17 out of 24 matches displayed significant differences between precipitating events and the next point (71%). Winning players showed more points won following a positive precipitating event then losing players. Losing tennis players lost more points following a negative precipitating event as compared to winning tennis players. This demonstrates that winning players were more likely to string together two points in a row then losing players. These results suggest that momentum can be manifested after precipitating events and that it can influence tennis match outcome.

The primary focus of this study was to determine whether mood states, anxiety, self-confidence, precipitating events, and psychological momentum play a role in tennis match outcome. This study illustrates how a precipitating event may influence performance and match outcome similar to the multidimensional model of sport proposed by Taylor et al. This study replicated the findings that winning players demonstrated significantly more positive precipitating events and fewer negative precipitating events.

This study demonstrates a relationship between positive precipitating events and positive tennis match outcome. It appears that high self-confidence, low anxiety, and fewer negative precipitating events are crucial to increasing performance and increasing the probability of a positive match outcome. A profile of winning tennis players would include low total mood disturbance, high self-confidence, low somatic and cognitive anxiety, and a greater number of positive precipitating events leading to a prevalence of positive psychological momentum. A profile of losing tennis players would include high total mood disturbance, low self-confidence, high somatic and cognitive anxiety, greater number of negative precipitating events leading to a prevalence of negative psychological momentum. Therefore, it appears that confidence, mood, and anxiety act as moderator variables for psychological momentum, precipitating events and tennis match outcome. In conclusion, the results of this study partially support the idea that psychological momentum plays a crucial role in tennis match outcome and that psychological factors such as mood state, confidence, and anxiety may be more valuable or accurate as predictors of tennis match outcome.

Directions for Future Research

Further study is needed on positive and negative momentum and how it influences match outcome. An approach would be to break down each game and look to see if positive momentum was present in a winning game. You could then compare game outcome to see if momentum played a role.

Another approach would be to interview or have the athletes fill out inventories after the match to recount post hoc cognitions and emotions. This could be done by having the

athletes watch a videotape of themselves while commenting on their performance. Finally, you could compare team sports to individual sports to see if there is a shift in momentum.

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APPENDIX A

CONSENT FORM

CONSENT TO PARTICIPATE IN A RESEARCH STUDY AT THE UNIVERSITY OF NEVADA LAS VEGAS SPORT INJURY RESEARCH CENTER

Principal investigator: Tracey Covassin
UNLV affiliation: Graduate Student, Department of Kinesiology

TITLE OF THE STUDY
The Relationship Between Positive Momentum, Precipitating Events, and Tennis Match Outcome

PURPOSE
The purpose of this experiment is to study whether an event or a series of events can cause a change in behavior or mood which in turn results in a change in the outcome of the tennis match.

PROCEDURE
Prior to three matches the UNLV tennis players will complete two short inventories including the Profile of Mood States and the Competitive State Anxiety Inventory-2 to determine pre-match confidence and emotional state. Each participant will then have their tennis match videotaped and analyzed for significant events.

RISKS
There are few potential risks for this study. The athletes may become distracted from their normal precompetition routines through the completion of the written tests prior to competition or due to the fact that they are not routinely videotaped.

BENEFITS
The most important outcome of this study may be in determining the relationship between significant events and match outcome. If it is determined that there is a strong relationship between these variables we may then teach tennis players how to control the potential negative influences of these variables on the overall outcome of the tennis match.

CONFIDENTIALITY
All test results, and any personal data, will be coded and kept confidential. If the study is published, no participants will be identified by name.

RIGHT TO REFUSE OR WITHDRAW
You may refuse to participate. You may withdraw consent and discontinue participation in the study at any time.

QUESTIONS
If you have any questions, please feel free to ask the investigators. Should any questions arise at a later date, feel free to call Suzanne Pero at (702) 895-0938. For questions concerning the rights of research subjects, you may contact the UNLV Office of Sponsored Programs at 895-1357. You will be given a signed and dated copy of this form for your personal records.

YOUR SIGNATURE BELOW CERTIFIES THAT YOU UNDERSTAND THE TEST PROCEDURE AND HAVE DECIDED TO VOLUNTEER AS A RESEARCH PARTICIPANT. YOU HAVE READ THE PROVIDED INFORMATION AND ALL QUESTIONS REGARDING THE EXPERIMENT HAVE BEEN ANSWERED TO YOUR SATISFACTION.

Participants signature	Participants printed name	Date
Witness' signature	Witness' printed name	Date

APPENDIX B

PERMISSION FROM INTERNAL REVIEW BOARD

UNLV

DATE: September 29, 1998

TO: Tracey Covassin ((KIN-3034)

FROM: Dr. Fred Preston
Chair, Social/Behavioral Committee
of the Institutional Review Board

RE: Status of Human Subject Protocol entitled:
"The Relationship Between Positive Momentum, Precipitating Events, and Tennis Match Outcome"

OSP #504s0398-233s

This memorandum is official notification that the protocol for the project referenced above has been approved by the Social/Behavioral Committee of the Institutional Review Board. This approval is approved for a period of one year from the date of this notification, and work on the project may proceed.

Should the use of human subjects described in this protocol continue beyond a year from the date of this notification, it will be necessary to request an extension.

If you have any questions or require any assistance, please contact Marsha Green at 895-1357.

cc: [redacted] (KIN-3034)
OSP File

Office of Sponsored Programs
4505 Maryland Parkway • Box 451037 • Las Vegas, Nevada 89154-1037
(702) 895-1357 • FAX (702) 895-4242

APPENDIX C

RAW DATA FOR POMS: WINNERS

RAW DATA FOR POMS: WINNERS

	T	D	A	V	F	C	TMD
	4	0	4	23	4	4	-7
	7	0	1	27	0	0	-19
	5	2	3	28	0	2	-16
	13	7	11	22	4	1	14
	6	3	5	31	0	2	-15
	6	0	6	18	7	4	-5
	0	0	6	26	0	2	-18
	7	6	17	30	4	3	7
	10	3	6	28	0	5	-4
	8	0	5	22	1	3	-5
	0	4	4	25	0	1	-16
	2	1	2	23	0	0	-18
MEAN	**5.67**	**2.17**	**5.83**	**25.25**	**1.67**	**2.25**	**-7.67**
S	**3.85**	**2.48**	**6.42**	**3.79**	**2.42**	**1.60**	**11.28**
T SCORE	**38.65**	**40.17**	**44.83**	**65.25**	**35.67**	**34**	

APPENDIX D

RAW DATA FOR POMS: LOSERS

RAW DATA FOR POMS: LOSERS

	T	D	A	V	F	C	TMD
	11	8	21	18	0	7	29
	18	11	20	18	8	7	46
	16	17	20	19	4	10	48
	15	21	20	20	6	9	51
	10	8	13	17	1	8	23
	9	8	12	18	4	9	52
	14	18	21	12	2	9	52
	14	12	19	18	6	10	43
	12	18	15	12	13	9	55
	16	14	18	18	5	10	45
MEAN	**13**	**13.75**	**17.25**	**17.08**	**4.58**	**8.17**	**39.7**
S	**2.95**	**4.41**	**3.49**	**3.42**	**3.48**	**1.99**	**11.83**
T SCORE	**49**	**49.75**	**60.25**	**52.08**	**40.58**	**44.17**	

APPENDIX E

RAW DATA FOR CSAI-2: SELF-CONFIDENCE

RAW DATA FOR CSAI-2: SELF-CONFIDENCE

	Winning Players	Losing Players
	29	19
	32	23
	33	22
	25	17
	32	20
	32	24
	32	20
	27	23
	30	22
	28	25
	27	23
	26	24
Mean	**29.42**	**21.83**
Standard Deviation	**2.78**	**2.36**

APPENDIX F

RAW DATA FOR CSAI-2: COGNITIVE ANXIETY

RAW DATA FOR CSAI-2: COGNITIVE ANXIETY

	Winning Players	Losing Players
	13	18
	16	19
	14	20
	19	27
	17	25
	13	22
	11	19
	18	21
	14	20
	12	17
	14	21
	15	17
Mean	**14.67**	**20.50**
Standard Deviation	**2.42**	**3.03**

APPENDIX G

RAW DATA FOR CSAI-2: SOMATIC ANXIETY

RAW DATA FOR CSAI-2: SOMATIC ANXIETY

	Winning Players	Losing Players
	11	17
	10	19
	13	20
	19	26
	12	20
	10	20
	16	21
	19	24
	14	21
	11	18
	12	15
	13	14
Mean	**13.40**	**19.58**
Standard Deviation	**3.14**	**3.39**

APPENDIX H

EXPLANATIONS FOR CALCULATIONS FOR RAW DATA

Explanation for Calculations of Raw Data

1. Conditional probabilities for positive momentum were calculated by taking the positive momentum following a positive precipitating event (27) and dividing it by the total positive momentum following either a positive or negative precipitating event (38).

Conditional Probabilities for Positive Momentum = 27 / 38

= 71%

Conditional Probabilities for Negative Momentum = 14 / 26

= 53.8 %

Precipitating Events

Momentum		Positive	Negative
	Positive	27 E=23.1	11 E=14.8
	Negative	12 E=15.8	14 E=10.1

2. Total positive precipitating events were calculated by adding up all the positive precipitating events and dividing by the total precipitating events. Some precipitating events occurred at the end of a game or set, therefore, were not calculated in the box that containing the next point.

APPENDIX I

RAW DATA FOR EACH MATCH

PEPPERDINE vs. NEW MEXICO # 1
PEPPERDINE Won 7-5, 7-5

Precipitating Events

Momentum	-	Positive	Negative
	Positive	27 E=23.1	11 E=14.8
	Negative	12 E=15.8	14 E=10.1

Total = 64
$\chi^2 = 0.64 + 1.0 + 1.46 + 0.94$
$\chi^2 = 4.04$

Conditional Probabilities for Positive Momentum = 27 / 38
= 71 %

Conditional Probabilities for Negative Momentum = 14 / 26
= 53.8 %

Precipitating Events

Next Point		Positive	Negative
	Positive	37 E=30.4	17 E=23.5
	Negative	16 E=22.6	24 E=17.4

Total = 94
$\chi^2 = 5.9 + 1.43 + 1.9 + 2.46$
$\chi^2 = 11.69$

Total Positive Precipitating Events = 64 / 104
= 61.5 %

Total Negative Precipitating Events = 40 / 104
= 38.5 %

PEPPERDINE vs. NEW MEXICO # 1
NEW MEXICO Lost 7-5, 7-5

Precipitating Events

Momentum		Positive	Negative
	Positive	13 E=8.8	23 E=14.2
	Negative	10 E=14.2	27 E=22.8

Total = 60
$\chi^2 = 1.23 + 1.98 + 1.23 + 0.77$
$\chi^2 = 5.21$

Conditional Probabilities for Positive Momentum = 13 / 23
= 56.5 %

Conditional Probabilities for Negative Momentum = 27 / 37
= 72.9 %

Precipitating Events

Next Point		Positive	Negative
	Positive	31 E=24.1	21 E=27.8
	Negative	21 E=27.8	39 E=32.1

Total = 112
$\chi^2 = 1.69 + 1.95 + 1.69 + 1.46$
$\chi^2 = 6.79$

Total Positive Precipitating Events = 45 / 134
= 33.6 %

Total Negative Precipitating Events = 89 / 134
= 66.4 %

PEPPERDINE vs. NEW MEXICO # 5
PEPPERDINE Won 6-3, 6- 2

Precipitating Events

Momentum		Positive	Negative
	Positive	21 E=15.7	11 E=16.3
	Negative	5 E=10.3	16 E=10.7

Total = 53
$\chi^2 = 1.79 + 1.74 + 2.73 + 2.63$
$\chi^2 = 8.89$

Conditional Probabilities for Positive Momentum = 21 / 32
= 65.6 %

Conditional Probabilities for Negative Momentum = 16 / 21
= 76.2 %

Precipitating Events

Next Point		Positive	Negative
	Positive	35 E=30.2	15 E=19.7
	Negative	17 E=21.7	19 E=14.2

Total = 86
$\chi^2 = 0.75 + 1.15 + 1.6 + 1.05$
$\chi^2 = 4.55$

Total Positive Precipitating Events = 55 / 94
= 58.5 %

Total Negative Precipitating Events = 39 / 94
= 41.5 %

PEPPERDINE vs. NEW MEXICO # 5
NEW MEXICO Lost 6-3,6-2

Precipitating Events

Momentum		Positive	Negative
	Positive	12 E=8.3	6 E=9.8
	Negative	10 E=13.8	20 E=16.3

Total = 48
$\chi^2 = 1.44 + 1.7 + 1.02 + 0.86$
$\chi^2 = 5.02$

Conditional Probabilities for Positive Momentum = 12 / 18
= 66.7 %

Conditional Probabilities for Negative Momentum = 10 / 30
= 66.7 %

Precipitating Events

Next Point		Positive	Negative
	Positive	18 E=12.7	11 E=16.3
	Negative	13 E=18.3	29 E=23.7

Total = 71
$\chi^2 = 3.84 + 1.74 + 1.56 + 1.21$
$\chi^2 = 8.35$

Total Positive Precipitating Events = 42 / 70
= 60 %

Total Negative Precipitating Events = 28 / 70
= 40 %

PEPPERDINE vs. NEW MEXICO # 6
PEPPERDINE Won 6-3, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	**20** E=16	**16** E=19.9
	Negative	**1** E=4.9	**10** E=6.08

Total = 47
$\chi^2 = 0.96 + .077 + 2.52 + 3.1$
$\chi^2 = 7.37$

Conditional Probabilities for Positive Momentum = 20 / 36
= 55.6%

Conditional Probabilities for Negative Momentum = 10 / 11
= 90.9%

Precipitating Events

Next Point		Positive	Negative
	Positive	**41** E=39.2	**22** E=23.8
	Negative	**15** E=16.5	**12** E=10.2

Total = 90

$\chi^2 = 0.08 + 0.14 + 0.32 + 0.19$
$\chi^2 = 0.73$

Total Positive Precipitating Events = 72 / 104
= 69.2 %

Total Negative Precipitating Events = 32 / 104
= 30.1 %

PEPPERDINE vs. NEW MEXICO # 6
NEW MEXICO Lost 6-3, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	6 E=3.6	1 E=3.38
	Negative	10 E=12.3	14 E=11.6

Total = 31
$\chi^2 = 1.58 + 1.68 + 0.49 + 0.46$
$\chi^2 = 4.21$

Conditional Probabilities for Positive Momentum = 6 / 7
= 85.7 %

Conditional Probabilities for Negative Momentum = 14 / 24
= 58.3 %

Precipitating Events

Next Point		Positive	Negative
	Positive	17 E=14	16 E=18.9
	Negative	21 E=23.9	35 E=32

Total = 89
$\chi^2 = 0.6 + 0.45 + 0.26 + 0.35$
$\chi^2 = 1.66$

Total Positive Precipitating Events = 38 / 89
= 42.7 %

Total Negative Precipitating Events = 51 / 89
= 57.3

PEPPERDINE vs. UNLV # 1
PEPPERDINE Lost 7-6, 7-5

Precipitating Events

Momentum		Positive	Negative
	Positive	**13** E=16.5	**17** E=13.4
	Negative	**19** E=15.4	**9** E=12.5

Total = 58
$\chi^2 = 0.76 + 0.94 + 0.82 + 1.01$
$\chi^2 = 3.53$

Conditional Probabilities for Positive Momentum = 13 / 30
= 43.3 %

Conditional Probabilities for Negative Momentum = 9 / 28
= 32.1 %

Precipitating Events

Next Point		Positive	Negative
	Positive	**22** E=26	**30** E=26
	Negative	**34** E=30	**26** E=30

Total = 112
$\chi^2 = 0.62 + 0.62 + 0.62 + 0.62$
$\chi^2 = 2.48$

Total Positive Precipitating Events = 52 / 108
= 48.2 %

Total Negative Precipitating Events = 56 / 108
= 51.8 %

PEPPERDINE vs. UNLV # 1
UNLV W on 7-6, 7-5

Precipitating Events

Momentum		Positive	Negative
	Positive	27 E=24.6	13 E=15.4
	Negative	5 E=7.4	7 E=4.6

Total = 52
$\chi^2 = 0.23 + 0.37 + 0.78 + 1.2$
$\chi^2 = 2.58$

Conditional Probabilities for Positive Momentum = 27 / 40
= 67.5 %

Conditional Probabilities for Negative Momentum = 7 / 12
= 58.3 %

Precipitating Events

Next Point		Positive	Negative
	Positive	49 E=42	30 E=37
	Negative	10 E=17	22 E=15

Total = 111
$\chi^2 = 2.88 + 3.27 + 1.16 + 1.32$
$\chi^2 = 8.63$

Total Positive Precipitating Events = 74 / 127
= 77 %

Total Negative Precipitating Events = 53 / 127
= 41.7 %

PEPPERDINE vs. UNLV # 5
UNLV Lost 6-3, 7-5

Precipitating Events

Momentum		Positive	Negative
	Positive	7 E=3.7	7 E=10.3
	Negative	3 E=6.32	21 E=17.7

Total = 38
$\chi^2 = 2.98 + 1.07 + 0.62 + 1.74$
$\chi^2 = 6.41$

Conditional Probabilities for Positive Momentum = 7 / 7
= 100 %

Conditional Probabilities for Negative Momentum = 21 / 24
= 87.5 %

Precipitating Events

Next Point		Positive	Negative
	Positive	14 E=10.4	9 E=12.5
	Negative	21 E=24.5	33 E=29.4

Total = 77
$\chi^2 = 1.2 + 1.0 + 0.43 + 0.51$
$\chi^2 = 3.14$

Total Positive Precipitating Events = 23 / 75
= 30.7 %

Total Negative Precipitating Events = 52 / 75
= 69.3 %

PEPPERDINE vs. UNLV # 5
PEPPERDINE Won 6-3, 7-5

Precipitating Events

Momentum		Positive	Negative
	Positive	14 E=10.2	10 E=13.8
	Negative	6 E=9.8	17 E=13.2

Total = 47
$\chi^2 = 1.41 + 1.04 + 1.08 + 1.47$
$\chi^2 = 5.00$

Conditional Probabilities for Positive Momentum = 14 / 24
= 58.3 %

Conditional Probabilities for Negative Momentum = 17 / 23
= 73.9 %

Precipitating Events

Next Point		Positive	Negative
	Positive	23 E=21.7	21 E=22.2
	Negative	14 E=15.2	17 E=15.7

Total = 75
$\chi^2 = 0.077 + 0.75 + 0.11 + 1.47$
$\chi^2 = 0.37$

Total Positive Precipitating Events = 49 / 90
= 54.4 %

Total Negative Precipitating Events = 41 / 90
= 45.6 %

Negative Behavior Followed by a Negative Precipitating Event = 12 / 16
= 75 %

PEPPERDINE vs. UNLV # 6
PEPPERDINE Won 6-3, 6-3

Precipitating Events

Momentum	Positive	Negative
Positive	**26** E=23.3	**9** E=11.7
Negative	**2** E=4.6	**5** E=2.3

Total = 42
$\chi^2 = 0.31 + 0.61 + 3.1 + 1.5$
$\chi^2 = 5.53$

Conditional Probabilities for Positive Momentum = 26 / 35
= 74.3 %

Conditional Probabilities for Negative Momentum = 5 / 7
= 71.4 %

Precipitating Events

Next Point	Positive	Negative
Positive	**44** E=39	**11** E=15.9
Negative	**10** E=14.9	**11** E=6.1

Total = 76
$\chi^2 = 0.62 + 1.52 + 3.9 + 1.6$
$\chi^2 = 7.66$

Total Positive Precipitating Events = 69 / 96
= 71.9 %

Total Negative Precipitating Events = 27 / 96
= 28.1 %

PEPPERDINE vs. UNLV # 6
UNLV Lost 6-3, 6-3

Precipitating Events

Momentum		Positive	Negative
	Positive	10 E=3.3	2 E=8.6
	Negative	3 E=9.6	2 E=25.3

Total = 47
$\chi^2 = 13.5 + 1.76 + 5.2 + 4.6$
$\chi^2 = 25.1$

Conditional Probabilities for Positive Momentum = 10 / 12
= 83.3 %

Conditional Probabilities for Negative Momentum = 32 / 35
= 91.4 %

Precipitating Events

Next Point		Positive	Negative
	Positive	19 E=8.3	5 E=15.6
	Negative	5 E=15.6	40 E=29.3

Total = 69
$\chi^2 = 13.7 + 7.2 + 7.2 + 3.8$
$\chi^2 = 31.9$

Total Positive Precipitating Events = 29 / 80
= 36.2 %

Total Negative Precipitating Events = 51 / 80
= 63.8 %

NEW MEXICO vs. SAN DIEGO # 1
SAN DIEGO Lost 6-3, 6-4

Precipitating Events

Momentum	Positive	Negative
Positive	**17** E=9.2	**4** E=11.8
Negative	**7** E=14.8	**27** E=19.1

Total = 55
$\chi^2 = 6.7 + 5.2 + 3.2 + 4.1$
$\chi^2 = 19.2$

Conditional Probabilities for Positive Momentum = 17 / 21
= 80.9 %

Conditional Probabilities for Negative Momentum = 27 / 34
= 79.4 %

Precipitating Events

Next Point	Positive	Negative
Positive	**21** E=12.6	**10** E=18.3
Negative	**10** E=18.3	**35** E= 26.6

Total = 76
$\chi^2 = 5.5 + 0.38 + 2.6 + 3.8$
$\chi^2 = 12.29$

Total Positive Precipitating Events = 33 / 74
= 44.6 %

Total Negative Precipitating Events = 41 / 74
= 55.4 %

NEW MEXICO vs. SAN DIEGO # 1
NEW MEXICO Won 6-3, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	21 E=14.5	8 E=20.8
	Negative	2 E=8.5	15 E=12.2

Total = 46
$\chi^2 = 2.9 + 2.9 + 4.9 + 4.9$
$\chi^2 = 15.7$

Conditional Probabilities for Positive Momentum = 21 / 29
= 72.4 %

Conditional Probabilities for Negative Momentum = 15 / 17
= 88.2 %

Precipitating Events

Next Point		Positive	Negative
	Positive	24 E=36	16 E=24
	Negative	11 E=21	24 E= 14

Total = 95
$\chi^2 = 2.77 + 4.17 + 7.14 + 4.7$
$\chi^2 = 18.8$

Total Positive Precipitating Events = 60 / 98
= 61.2 %

Total Negative Precipitating Events = 38 / 98
= 38.8 %

SAN DIEGO vs. NEW MEXICO # 5
SAN DIEGO WON 6-4, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	13 E=3.1	4 E=8.1
	Negative	7 E=11.1	14 E=9.9

Total = 38
χ^2 =1.84 + 2.04 + 1.65 + 1.48
χ^2 = 7.01

Conditional Probabilities for Positive Momentum = 13 / 17
= 76.5 %

Conditional Probabilities for Negative Momentum = 14 / 21
= 66.7 %

Precipitating Events

Next Point		Positive	Negative
	Positive	25 E=23.7	18 E=19.3
	Negative	13 E=14.3	13 E= 11.7

Total = 69
χ^2 = 0.74 + 0.9 + 0.15 + 0.12
χ^2 = 1.91

Total Positive Precipitating Events = 56 / 80
= 70 %

Total Negative Precipitating Events = 24 / 80
= 30 %

SAN DIEGO vs. NEW MEXICO # 5
NEW MEXICO Lost 6-4, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	3 E=0.82	0 E=2.2
	Negative	3 E=5.2	16 E=13.8

Total = 22
$\chi^2 = 5.82 + 2.18 + 0.34 + 0.92$
$\chi^2 = 9.26$

Conditional Probabilities for Positive Momentum = 3 / 3
= 100 %

Conditional Probabilities for Negative Momentum = 14 / 21
= 66.7 %

Precipitating Events

Next Point		Positive	Negative
	Positive	10 E=5.1	1 E=5.9
	Negative	9 E=13.9	21 E= 16.1

Total = 41
$\chi^2 = 4.07 + 1.49 + 1.72 + 4.72$
$\chi^2 = 12.00$

Total Positive Precipitating Events = 20 / 52
= 38.5 %

Total Negative Precipitating Events = 32 / 52
= 61.5 %

NEW MEXICO vs. SAN DIEGO # 6
NEW MEXICO Lost 6-4, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	9 E=5.8	6 E=9.2
	Negative	5 E=8.2	16 E=12.8

Total = 36
$\chi^2 = 1.72 + 1.09 + 1.23 + 0.78$
$\chi^2 = 4.82$

Conditional Probabilities for Positive Momentum = 9 / 15
= 60 %

Conditional Probabilities for Negative Momentum = 16 / 21
= 76.2 %

Precipitating Events

Next Point		Positive	Negative
	Positive	15 E=10.5	10 E=14.5
	Negative	11 E=15.5	26 E= 21.5

Total = 62
$\chi^2 = 1.95 + 1.41 + 0.95 + 1.31$
$\chi^2 = 5.62$

Total Positive Precipitating Events = 26 / 61
= 42.6 %

Total Negative Precipitating Events = 35 / 61
= 57.4 %

NEW MEXICO vs. SAN DIEGO # 6
SAN DIEGO Won 6-4, 6-4

Precipitating Events

Momentum		Positive	Negative
	Positive	23 E=18.8	14 E=18.2
	Negative	9 E=13.2	17 E=12.8

Total = 63
$\chi^2 = 0.97 + 1.38 + 1.34 + 0.95$
$\chi^2 = 4.64$

Conditional Probabilities for Positive Momentum = 23 / 37
= 62.2 %

Conditional Probabilities for Negative Momentum = 17 / 26
= 65.4 %

Precipitating Events

Next Point		Positive	Negative
	Positive	33 E=26.3	25 E=31.7
	Negative	10 E=16.7	27 E= 20.3

Total = 95
$\chi^2 = 1.44 + 2.25 + 2.62 + 1.74$
$\chi^2 = 8.05$

Total Positive Precipitating Events = 67 / 117
= 57.3 %

Total Negative Precipitating Events = 50 / 117
= 42.7 %

FRESNO vs. UNLV # 1
FRESNO Lost 6-3, 6-3

Precipitating Events

Momentum		Positive	Negative
	Positive	9 E=3.0	3 E=9.0
	Negative	2 E=8.0	30 E=24

Total = 44
$\chi^2 = 12 + 4 + 1.5 + 4.5$
$\chi^2 = 22$

Conditional Probabilities for Positive Momentum = 9 / 12
= 75 %
Conditional Probabilities for Negative Momentum = 30 / 32
= 93.8 %

Precipitating Events

Next Point		Positive	Negative
	Positive	23 E=10.1	4 E=16.8
	Negative	4 E=16.8	41 E=28

Total = 72
$\chi^2 = 16.4 + 10 + 10 + 6$
$\chi^2 = 42.4$

Total Positive Precipitating Events = 31 / 79
= 39.2%

Total Negative Precipitating Events = 48 / 79
= 60.8%

FRESNO vs. UNLV # 1
UNLV Won 6-3, 6-3

Precipitating Events

Momentum		Positive	Negative
	Positive	28 E=24.7	10 E=13.2
	Negative	2 E=5.2	6 E=2.8

Total = 46
$\chi^2 = 0.42 + 0.78 + 3.7 + 1.99$
$\chi^2 = 6.89$

Conditional Probabilities for Positive Momentum = 28 / 38
= 73.7 %

Conditional Probabilities for Negative Momentum = 6 / 8
= 75 %

Precipitating Events

Next Point		Positive	Negative
	Positive	43 E=38.3	7 E=11.7
	Negative	6 E=10.7	8 E= 3.3

Total = 64
$\chi^2 = 0.58 + 1.9 + 6.7 + 2.1$
$\chi^2 = 11.28$

Total Positive Precipitating Events = 51 / 67
= 76.1 %

Total Negative Precipitating Events = 16 / 67
= 23.9 %

FRESNO vs. UNLV # 5
FRESNO Won 5-7, 6-2, 6-2

Precipitating Events

Momentum	Positive	Negative
Positive	**16** E=10.57	**6** E=11.4
Negative	**9** E=14.4	**21** E=15.6

Total = 52
$\chi^2 = 2.79 + 2.56 + 2.03 + 1.89$
$\chi^2 = 9.26$

Conditional Probabilities for Positive Momentum = 16 / 22
= 72.7 %

Conditional Probabilities for Negative Momentum = 21 / 30
= 70 %

Precipitating Events

Next Point	Positive	Negative
Positive	**32** E=23.3	**17** E=25.7
Negative	**17** E=25.7	**37** E=28.3

Total = 103

$\chi^2 = 3.24 + 2.94 + 2.94 + 2.67$
$\chi^2 = 11.79$

Total Positive Precipitating Events = 81 / 112
= 72 .0 %

Total Negative Precipitating Events = 31 / 112
= 28.0 %

FRESNO vs. UNLV # 5
UNLV Lost 5-7, 6-2, 6-2

Precipitating Events

Momentum		Positive	Negative
	Positive	7 E=3.8	10 E=13.2
	Negative	4 E=7.2	28 E=24.8

Total = 49
$\chi^2 = 2.65 + 0.77 + 1.41 + 0.41$
$\chi^2 = 5.24$

Conditional Probabilities for Positive Momentum = 7 / 17
= 41.1 %

Conditional Probabilities for Negative Momentum = 28 / 32
= 87.5 %

Precipitating Events

Next Point		Positive	Negative
	Positive	20 E=12.6	21 E=28.4
	Negative	13 E=20.4	53 E=45.6

Total = 107

$\chi^2 = 4.29 + 1.91 + 1.19 + 2.66$
$\chi^2 = 10.05$

Total Positive Precipitating Events = 52 / 110
= 47.2 %

Total Negative Precipitating Events = 58 / 110
= 52.8 %

FRESNO vs. UNLV # 6
FRESNO Lost 6-2, 6-4

Precipitating Events

Momentum	Positive	Negative
Positive	**3** E=2.4	**3** E=3.6
Negative	**11** E=11.6	**18** E=17.4

Total = 35
$\chi^2 = 0.15 + 0.1 + 0.02 + 0.03$
$\chi^2 = 0.03$

Conditional Probabilities for Positive Momentum = 18 / 29
= 62%

Conditional Probabilities for Negative Momentum = 3 / 6
= 50%

Precipitating Events

Next Point	Positive	Negative
Positive	**11** E=16	**16** E=18
Negative	**14** E=16	**34** E=32

Total = 75
$\chi^2 = .44 + 0.22 + 0.125 + 0.25$
$\chi^2 = 1.035$

Total Positive Precipitating Events = 34 / 85
= 60%

Total Negative Precipitating Events = 51 / 85
= 60.0%

FRESNO vs. UNLV # 6
UNLV Won 6-2, 6-4

Precipitating Events

Momentum	Positive	Negative
Positive	**13** E=9.8	**9** E=11.8
Negative	**2** E=5.1	**9** E=6.1

Total = 32
$\chi^2 = 1.04 + 0.67 + 1.30 + 1.95$
$\chi^2 = 4.9$

Conditional Probabilities for Positive Momentum = 13 / 21
= 61.0%

Conditional Probabilities for Negative Momentum = 9 / 11
= 81.8%

Precipitating Events

Next Point	Positive	Negative
Positive	**38** E=33.85	**12** E=11.8
Negative	**2** E=5.1	**9** E= 6.1

Total = 80
$\chi^2 = 0.54 + 1.1 + 1.85 + 0.89$
$\chi^2 = 4.38$

Total Positive Precipitating Events = 66 / 92
= 72.0%

Total Negative Precipitating Events = 26 / 92
= 28.0%

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