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TERI J. HEPLER

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Deborah L. Feltz
Major Professor's Signature

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DECISION-MAKING IN SPORT: AN EXAMINATION OF THE TAKE THE FIRST HEURISTIC AND SELF-EFFICACY THEORY

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Teri J. Hepler

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ABSTRACT

DECISION-MAKING IN SPORT: AN EXAMINATION OF THE TAKE THE FIRST HEURISTIC AND SELF-EFFICACY THEORY

By

Teri J. Hepler

The purpose of this study was to explore the role of self-efficacy and the Take the First (TTF) heuristic in option-generation and decision-making performance in a simulated sports task. Participants ($N = 72$) performed a basketball video-based decision-making task. The option-generation task asked participants to generate options regarding what move the player with the ball should make next and subsequently decide which option represented the optimal move. In addition, participants' decision-making self-efficacy was assessed using a 10-item questionnaire comprising various aspects of decision-making in basketball. Similarly, the decision-making performance task required participants to watch video situations and make a decision as fast as possible. Participants rated their degree of confidence, from 0 (not at all confident) to 10 (extremely confident), to perform various tasks related to decision-making. Specific hypotheses investigated whether: participants used the TTF heuristic, option quality decreased with serial position, participants who use TTF make decisions that are faster and/or better, and self-efficacy influenced any of these relationships. Results of the study supported many of the tenets of the TTF heuristic, such that people used the heuristic on a majority of the trials (70%) and earlier generated options were better than later ones. Mixed results were found on dynamic inconsistency and decision confidence as each relates to the number of options generated. Results did not support the notion performance would have been

better, on average, by generating only one option. Exploratory questions indicated that while using TTF did not produce higher quality decision, it was associated with faster decisions and greater confidence in one's decisions. Self-efficacy was also shown to be significantly related to the TTF heuristic. Participants with higher self-efficacy beliefs used TTF more frequently and they generated fewer options than those with low self-efficacy. Likewise, self-efficacy was also related to several aspects of option-generation and decision-making. After controlling for basketball knowledge and competitive basketball playing experience, self-efficacy was significantly related to decision confidence on both tasks and decision quality on the option-generation task. However, efficacy beliefs were not significantly related to decision quality on the decision-making performance task or decision speed on either of the tasks.

DEDICATION

To my mom, whose love and strength inspire me everyday and who showed me what it means to be an extraordinary woman.

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CHAPTER 1

INTRODUCTION

Nature of the Problem

The 1993 National Collegiate Athletic Association Men's Basketball Championship was the stage for one of the most unforgettable moments in the history of college sports. The Michigan Wolverines and the North Carolina Tar Heels battled back and forth all game. However, North Carolina surged to a 3 point lead with 46 seconds left in the game, forcing Steve Fischer's Wolverines to call their final time-out. As the players headed back onto the court to resume play, Coach Fischer reminded his players that they were out of time-outs. With 20 seconds on the clock and his team down by 2 points, Michigan's super sophomore Chris Webber came up with a crucial rebound. Following some confusion in the backcourt, and a missed traveling call by the referees, Webber frantically brought the ball upcourt. As he dribbled to the right sideline, two Tar Heel defenders trapped him as he picked up his dribble. Sensing he was in trouble and the clock winding down, Webber had only a split-second to make a decision about what to do next. Immediately, Webber called a time-out. There was only one problem: Michigan was out of time-outs. The play resulted in a technical foul against Michigan and effectively sealed the national championship for the North Carolina Tar Heels. This incident, dubbed as the "time-out that never was", is so infamous that it ranks 11th on ESPN's list of the "biggest chokes in the last 25 years." (http://sports.espn.go.com/espn/espn25/story?page=listranker/25biggestchokes).

As can be seen from this example, performance in sport is determined not only by physical skill execution, but also by the quality of decisions made throughout the competition. One decision could mean the difference between victory and defeat. The purpose of this dissertation was to explore the process of decision-making in sport. Specifically, it examined the different options athletes generated for an upcoming move, the rules they used to choose among those options, and the role that self-efficacy played in these processes. This chapter briefly summarizes the decision-making research in sport, introduces heuristics, and concludes with discussion of the tenets and limitations of the Take the First heuristic – a particular heuristic for making quick decisions.

Decision-making, which is defined as a process by which an individual selects one action from among a set of alternatives in a given situation, has been studied extensively in the sport psychology literature (Tenenbaum, 2004). In fact, journals such as the *International Journal of Sport and Exercise Psychology* and the *Psychology of Sport & Exercise* have devoted entire issues to the topic. However, most of the research on decision-making in sport has been rooted in the expert-novice paradigm. Accordingly, this line of research explores differences in the perceptual systems and information processing mechanisms of expert and novice performers. Results of this research suggests that, compared with novices, experts make faster, more accurate decisions, recall game structured information better, detect game-related signals faster, and predict events from advanced cues better (Starkes & Ericsson, 2003)

While this line of research has yielded valuable information regarding the decision-making of experts and novices, it has not provided further insight into the process of decision-making. However, one area that might help shed light on the cognitive processes involved in decision-making is the study of heuristics. Practically speaking, a heuristic is a rule of thumb that a person uses to make a decision. While there are many different heuristics that people use in different environments, fast and frugal heuristics (FFH) are particularly relevant to sport (Gigerenzer, Todd, & ABC Research Group, 1999). FFH are especially useful in fast-paced, dynamic sports because they rely on limited information to make quick decisions.

While there are many different heuristics in the fast and frugal family, this dissertation explored the FFH known as the Take the First (TTF) heuristic. This rule of thumb, which was proposed by Johnson and Raab in 2003, suggests that for familiar, yet ill-defined tasks, a person should simply choose one of first options that comes to mind, instead of generating and evaluating all possible options. One of the appeals of TTF is that it describes the processes of option-generation and decision choice. These processes are important in situations requiring people to generate potential options, rather than choose from a set of predefined choices, and then quickly determine which option is best. There are many real-life situations when people are presented with specific, predefined options. For instance, a person who walks into a grocery store to buy a box of breakfast cereal will find many different kinds of cereal on the shelf from which to choose. However, many other real-world circumstances do not present people with these clear, explicit options. Sport is one such environment, as athletes must freely generate options for each situation that arises. A major assumption of this heuristic is that options are generated in a sequential, meaningful way based on option similarity, experience, strategy, and environmental factors. Based on the sequential order of option-generation, earlier options represent better decisions than later ones. Thus, a person should choose the first option generated because it likely represents the best decision.

As TTF is a relatively new heuristic, there have only been two published studies on the topic (Johnson & Raab, 2003; Raab & Johnson, 2007). Both of these studies required team handball players to watch offensive attack situations in handball, cite potential moves the player with the ball could perform (e.g., shoot at the goal), and then choose the best decision among the generated options. Results of these studies support the main predictions of TTF. In both studies, the first option was chosen approximately 60% of the time across all participants. Moreover, the first options generated were, on average, of higher quality than later options (Johnson & Raab, 2003; Raab & Johnson, 2007).

Statement of the Problem

While these early studies have provided support for the use of the TTF heuristic in sport decision-making, there are many limitations and knowledge gaps. For instance, a major assumption of these studies is that participants actually verbalized their first, intuitive options. However, there was no manipulation, such as time pressure, to ensure that participants stated their first inclination. Rather, participants may have contemplated several options and only indicated the one they felt was the best. This potential confound would explain why the first option was of such high quality and why participants selected that option as the best decision in a majority of the cases.

Another major knowledge gap in this area of research is how various psychosocial factors influence a person's tendency to use TTF in sport. One psychosocial factor that has been linked to heuristics and decision-making is self-efficacy. Self-efficacy represents people's beliefs in their capabilities to successfully perform a task (Bandura, 1997). Research has found that efficacy beliefs are positively related to decision-making performance in various settings, including business (Bandura & Wood, 1989; Wood & Bandura, 1989) and sport (Hepler & Feltz, 2008; Tenenbaum, Levy-Kolker, Slade, Lieberman, & Lidor, 1996). According to Bandura (1997), self-efficacy is related to heuristics in that it influences the options a person considers, what information is collected, how information is interpreted, and how information is used to make a decision. This relationship between self-efficacy and heuristics was discussed in a concept paper by Wood, Atkins, and Tabernero (2000). The authors suggest that the influence of self-efficacy on the performance of complex tasks is mediated by the use of judgmental heuristics. In particular, Wood et al. (2000) posit that people with low perceptions of self-efficacy are more vulnerable to the biases of heuristics than are high efficacious people. For example, people with low self-efficacy beliefs may be more susceptible to the availability bias because they limit their external search and rely more on memory. The proposed link between efficacy beliefs and heuristics is supported by the findings of a study on entrepreneurial decision-making (Bryant, 2007). Using a mixed-method design, Bryant (2007) found that self-regulatory factors, including self-efficacy, were related to the use of various decision-making heuristics by entrepreneurs. For instance, results indicated that self-efficacy was positively related to participants' use of the "strategic fit" heuristic. In this study, the "strategic fit" heuristic was used to determine whether or not an entrepreneurial opportunity was worth exploring and also how the opportunity fit in with the overall vision of the company.

While self-efficacy may be related to heuristics in general, it is also likely that efficacy beliefs influence the use of the specific TTF heuristic. According to Bandura's theory, self-efficacy influences cognitive functioning. Specifically, self-efficacy influences people's perceptions of a situation, as well as the quality of their analytic thinking. People with high efficacy beliefs tend to perceive situations as realistic challenges, visualize success, and exhibit efficient analytic thinking. Conversely, those who doubt their capabilities typically dwell on the risk of failure, visualize failure, and display inefficient analytic thinking (Bandura, 1997). It is likely that people with low efficacy who constantly envision failure will doubt the first option that comes to mind and attempt to cognitively process several other options. On the other hand, a strong belief in one's abilities may make it quite easy to simply trust one's instincts and accept the first option. In fact, there are a few research findings that provide indirect support for the link between self-efficacy and the TTF heuristic. For instance, Bouffard-Bouchard and colleagues (1991) found that when matched on ability, students with high self-efficacy were less likely to prematurely reject correct solutions than were students with low self-efficacy. In terms of TTF, this would translate into a positive relationship between self-efficacy and choosing the first option, assuming it was an acceptable option. Similarly, another study on entrepreneurial decision risk-taking found that people with high self-efficacy beliefs perceived situations as presenting more opportunities and fewer threats than did those with low ability beliefs. In turn, high self-efficacy participants took more risks when making decisions than did participants with low self-efficacy. Many would consider choosing the first option, with little or no consideration of alternatives, to be an example of very risky decision behavior.

In addition, sport success is often determined by an athlete's ability to use early predictive cues in order to guide their own actions. For instance, a baseball batter must predict where the pitch will cross the plate before deciding whether or not to swing.

Likewise, a football quarterback must anticipate where the defense will go before deciding which receiver to throw the ball to. Expert-novice research has indicated that experienced players are more efficient and accurate at utilizing advanced cues than are inexperienced athletes (Starkes & Ericsson, 2003). Furthermore, experts are more confident in their predictions than are novices (Tenenbaum et al., 1996). Thus, Bandura concluded that "the cognitive side of athleticism is not just matter of gaining predictive knowledge but of gaining the self-assurance to act on it unhesitatingly (Bandura, 1997, pp. 375). The TTF heuristic epitomizes action without hesitation, as it suggests that when facing a familiar situation, a person should simply go with their first inclination. The importance of having confidence in one's instinctive decision-making capabilities can be seen in the aforementioned example involving Chris Webber. During the entire play, Webber seemed to be very confused and indecisive about what to do with the ball. After grabbing the rebound, his instinctive decision was to pass the ball to a guard, but he second-guessed that decision, causing him to travel. Webber's self-doubts regarding his ability to make good decisions may have also contributed to his calling the infamous time-out. Perhaps he did not feel capable of making a decision that could help lead his team to victory and called the time-out to transfer the decision-making responsibility to his coach.

Purpose of the Study

The purpose of this study was to explore the role of self-efficacy and the TTF heuristic in option-generation and decision-making performance on a simulated sports task. As TTF is a relatively new heuristic, it is important to provide further evidence that this heuristic is in fact used by athletes and to explore how using the heuristic relates to decision-making performance. Moreover, this dissertation expands on previous research by examining how self-efficacy influences option-generation and decision-making performance using the framework of the TTF heuristic.

This study investigated several hypotheses and research questions. Many of the predictions were based on the tenets of the TTF heuristic, as well as previous research findings on TTF (Johnson & Raab, 2003; Raab & Johnson, 2007). Additionally, several hypotheses were based on self-efficacy theory and research (Bandura, 1997; Bandura & Wood, 1989; Hepler & Feltz, 2008; Wood & Bandura, 1989). In addition, this dissertation examined several research questions that are rooted in theory, but have not yet been empirically tested.

Option-Generation Hypotheses

1. Participants will choose the first option generated as the best decision in more than half of the trials.
2. Option quality will be negatively related to serial position.
3. As the number of generated options increases, the likelihood that the first option will be chosen decreases.
4. Confidence in final decision will be negatively related to the number of options generated.
5. On average, participants would make better choices if they only generated one option.
6. Decision-making self-efficacy will be positively related to final decision quality, after controlling for basketball knowledge and competitive basketball playing experience.

7. Decision-making self-efficacy will be negatively related to option-generation speed, in which higher efficacy beliefs will predict faster generation speeds, after controlling for basketball knowledge and competitive basketball playing experience.
8. Decision-making self-efficacy will predict the confidence in final decision, after controlling for basketball knowledge and competitive basketball playing experience.

Option-Generation Research Questions

1. Does self-efficacy predict the use of TTF heuristic, after controlling for basketball knowledge and competitive basketball playing experience?
2. Does self-efficacy influence the number of options generated, after controlling for basketball knowledge and competitive basketball playing experience?

Decision-Making Performance Hypotheses

9. Decision-making self-efficacy will be positively related to decision-making quality, after controlling for basketball knowledge and competitive basketball playing experience.
10. Self-efficacy will be positively related to decision-making speed, after controlling for basketball knowledge and competitive basketball playing experience.
11. Self-efficacy will be positively related to decision confidence on the decision-making performance task, after controlling for basketball knowledge and competitive basketball playing experience.

Decision-Making Performance Research Questions

3. Do participants who have a high tendency to use TTF make better decisions than those who have a low tendency to use TTF?
4. Do participants who have a high tendency to use TTF make faster decisions than those who have a low tendency to use TTF?
5. Are participants who have a high tendency to use TTF more confident in their decisions than are those who have a low tendency to use TTF?

Delimitations

The findings are limited to a population of undergraduate and graduate students who have previous experience or knowledge of basketball. These results may not generalize to youth sport participants or athletes in sports other than basketball. Likewise, the findings may not be applicable to closed or independent sports and situations. Finally, as the decision-making tasks utilize video situations, these results may not apply to decision-making during actual game play.

Definitions

1. *Basketball knowledge test score*: participants' score on the 10-item basketball knowledge test.
2. *Decision confidence*: average confidence in final decision on the 13 task trials.
3. *Decision-making*: a process by which an individual selects one course of action from among a set of two or more alternatives in a specific situation.
4. *Decision-making performance task*: experimental task requiring participants to watch 13 video clips and make a decision regarding the best move in each situation.

5. *Decision-making self-efficacy*: participants' confidence in their ability to make decisions on the basketball video test.
6. *Decision quality*: average decision quality (0-4) of all 13 final decisions in each task.
7. *Decision response time (or speed)*: average response time, in seconds rounded to the nearest hundredth) on the 13 trials in each task.
8. *Dynamic inconsistency*: switch in preference from first option to a different final decision.
9. *Ecological rationality*: the ability of a heuristic to exploit the structure of information in the environment.
10. *Fast and frugal heuristics (FFH):* a subset of heuristics which allow people to make adaptive decisions in the real world by minimizing the amount of time, knowledge, and computation necessary to make decisions.
11. *Heuristic*: a rule of thumb; a mental device that can solve a class of problems in situations with limited knowledge and time.
12. *Option-generation*: process of generating alternatives from scratch.
13. *Option-generation task*: experimental task requiring participants to watch 13 video clips, generate potential moves for each clip, and choose one option as the best decision for each situation.
14. *Self-efficacy:* people's judgments of their capabilities to organize and execute courses of action needed to achieve designated types of performance.
15. *Take the first (TTF) heuristic:* a heuristic that suggests that in familiar, yet ill-defined tasks, a person should choose one of the initial options generated, rather

than exhaustively generating all possible options and subsequently processing them deliberately.

16. *Take the first score*: number of times (out of 13) that participants chose the first option on the option-generation task.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to provide a review of literature that is relevant to the variables and procedures used in this study. Specifically, the chapter introduces decision-making in sport, summarizes the relevant research on decision-making in sport, and examines the influence of self-efficacy on decision-making. Next, the chapter focuses on heuristics by providing a general overview of heuristics, outlining the TTF heuristic, and discussing some of the limitations of previous research on TTF.

Decision-Making in Sport

"Success in athletic competition requires more than physical skills. It is now widely recognized that cognitive factors play an influential role in athletic development and functioning" (Bandura, 1997, pp. 369). Accordingly, one of the key cognitive components of athletic performance is decision-making (Chamberlain & Coelho, 1993; Thomas, 1994). Decision-making is a process by which an individual selects one action from among a set of two or more alternatives in a specific situation (Tenenbaum, 2004). Specifically, a decision represents the course of action an athlete chooses to pursue and when to execute that action. The importance of decision-making in sport is highlighted by the fact that every voluntary action is preceded by a decision to perform that action (Grehaigne, Godbout, & Bouthier, 2001). For example, a soccer match could involve over 2,500 touches, with a tactical decision preceding each touch (Morris, 1981). Decision-making is especially important in complex in open, interdependent sports such as football, basketball, hockey, volleyball, and soccer because the environment and game conditions are constantly changing. In these types of sports, an athlete must assess a rapidly changing situation, make a decision about what action to take, and then execute that action. All of these things must occur within a matter of seconds, or even less, as the dynamic nature of these sports imposes a strict time constraint.

As decision-making is such a critical component of sport performance, a great deal of research has been conducted on the topic. The majority of this research has focused on the differences between expert and novice performers. This research has used a number of approaches, such as examining differences in perceptual systems, knowledge, signal detection, information recall, and speed and accuracy of tactical decisions. The earliest line of research investigated the hardware hypothesis (Clark & Warren, 1935; Olson, 1956; Starkes & Deakin, 1984). The hardware hypothesis suggests that experts have more highly developed perceptual systems than do novices, which contribute to superior decision-making capabilities. These studies compared various sensory and perceptual systems such as depth perception, visual acuity, and reaction time of experts and novices. For instance, one study investigated the eye movements of expert and novice baseball players. In this study, participants were shown videos of different pitches and the task was to identify the type of pitch (i.e., fastball or curveball) as fast as possible. Phototransistors were used to determine participants' eye movement reaction time, defined as the amount of time it took for the eyes to move once the pitcher had released the ball. Results indicated that there were no differences in eye reaction time between experienced and non-experienced players. Another study by Starkes (1987) investigated several "hardware" aspects of female field hockey players from three competitive levels. There were no differences in dynamic visual acuity or coincident anticipation timing between the national, varsity, and novice players. Interestingly, national-level players (i.e., experts) had slower simple visual reaction time than did varsity and novice players. The findings of these studies, and many others, have yielded equivocal results that provide no solid link between hardware and expertise (Shank & Haywood, 1987).

Another framework that has been used to investigate expert-novice differences in decision-making is the software hypothesis (Starkes & Ericsson, 2003). The software hypothesis posits that, when compared to novice performers, experts are better decision-makers because they have a more extensive knowledge base and use their knowledge more efficiently. Studies based on the software hypothesis have examined differences between experts and novices in visual search patterns, advanced cue utilization, signal detection, and information recall. For example, while the previously mentioned study of baseball batters found no expert-novice differences in eye movement reaction time, results did suggest that the two groups differed in their visual search patterns. Experts had a tendency to fixate on the point of release and to only attend to the oncoming ball. Meanwhile, novices had a more active visual search pattern, as their gaze often shifted to non-relevant cues, such as the pitcher's head, just before the ball was released. Consequently, the experienced players were better able to identify the type of pitch that was thrown. This suggests that experts perform better because they attend to more relevant cues (Shank & Haywood, 1987). Support for differences in cue utilization can also be evidenced by studies by Abernethy and Russell (1987). These studies utilized temporal and spatial occlusion to investigate advanced cue utilization in experienced and inexperienced racket sport players. The task was to predict the landing point of different badminton shots presented in a video clip. According to the results, the racket arm side provided the most pertinent cues and experts were able to extract relevant information from earlier events than were novices.

Signal detection and information recall studies are also common methods to investigate the issue of expert-novice software. One study involved expert and novice volleyball players who were shown slides of structured and unstructured volleyball situations. Structured activities were defined as game situations while unstructured situations represented non-game activities, such as warm-ups and time-outs. As a signal detection study, the objective was to determine, as quickly as possible, whether or not a volleyball appeared in the picture. The volleyball players responded more quickly than non-players to both the structured and unstructured scenes. However, there were no differences between the two groups on the accuracy of signal detection (Allard & Starkes, 1980). Another project assessed the information recall capabilities of expert and novice basketball players. Participants were shown slides of both structured and unstructured situations in a basketball game. After viewing the scenes, they were asked to diagram the positioning of the players depicted in the slide. The researchers found that experts more accurately recalled structured situations than did novices. However, there were no differences in the recall of unstructured scenarios (Allard, Graham, & Paarsalu, 1980).

Another area of research on decision-making in sport has investigated the role of expertise in determining the speed and accuracy of tactical decisions. These studies have typically used slides, diagrams, or videos to present participants with tactical decision-making situations. For instance, Tenenbaum and colleagues (1993) presented team handball players with slides of various handball situations. Participants in this study were asked to indicate what move the highlighted player should make. Decision-making performance was defined as the accuracy of decision, which was rated by handball experts. According to the results, experience was positively related to decision-making performance (Tenenbaum, Yuval, Elbaz, Bar-Eli & Weinberg, 1993). In another study, Starkes (1987) examined the speed and accuracy of decisions made by female field hockey players. The elite-level players made more accurate decisions than did varsity or novice athletes. There were no significant differences between the groups on decision-making speed. Helsen and Pauwels (1988) investigated decision-making in soccer. In this study, the researchers used special lenses to project life-size video images of soccer situations on a large screen. Participants stood 7 m in front of the screen with a soccer ball directly in front of them. One moment in each clip depicted the ball being kicked back towards the participant. At that moment, participants executed their tactical decision by kicking the ball to the desired target (e.g., shoot at the goal, pass to a teammate). Across all of the trials, experience did not predict speed or accuracy of decisions. However, when examining only the correct decisions, experienced players made faster decisions than did inexperienced players.

Overall, research on decision-making in sport has found support for some consistent differences between experts and novices. Experts tend to have greater recall for structured game information, detect game-related signals faster, are better able to predict events from advanced cues, and make faster, more accurate decisions than do novice performers. It is important to understand that expert-novice differences only pertain to the specific context in which the person has expertise. For example, an expert soccer player may have a decision-making advantage in soccer, but that advantage does not generalize to other sports or non-soccer situations (Chamberlain & Coelho, 1993).

Decision-Making and Self-Efficacy

Despite the fact that there has been extensive research focusing on the relationship between experience and decision-making in sport, there has been little examination of the role of self-perceptions in decision-making. For instance, one self-perception that has been linked to both cognitive and physical performance is self-efficacy. Self-efficacy refers to people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1977). According to Bandura and Wood (1989), self-efficacy beliefs can be especially influential on decision-making in complex, dynamic environments. In a series of studies investigating managerial decision-making in a simulated business organization, these researchers found that self-efficacy was positively related to decision-making quality. The results of these studies led Bandura to conclude that: "... people who believe strongly in their problem-solving capabilities remain highly efficient in their analytic thinking in complex decision-making situations. Quality of analytic thinking, in turn, fosters performance accomplishments" (Bandura, 1997, pp. 452).

While there has been evidence linking self-efficacy and decision-making in organizational settings, there have only been a handful of studies that have explored self-efficacy beliefs and decision-making in sport. Tenenbaum and colleagues conducted a study involving expert, intermediate, and novice tennis players. Participants in this study viewed video footage of various tennis strokes. There were different experimental conditions where the video was occluded at various points prior to, during, or after the racket made contact with the ball. The task was to judge the final landing spot of each stroke. After deciding where the ball would land, participants rated how confident they were in their decisions. The researchers found that experts were significantly more confident in their decisions than were intermediate players or novices on shots where the video was occluded shortly after contact (Tenenbaum et al., 1996). While this study did measure confidence, it did not investigate how self-efficacy influences decision-making performance. Two studies by Hepler and colleagues have investigated this relationship. In the first study, Hepler and Chase (2008) examined the relationship between task self-efficacy, decision-making self-efficacy, and decision-making performance on a video test involving softball situations. While the results indicated that decision-making self-efficacy was related to physical performance, there was no significant relationship between self-efficacy and decision-making performance. However, the authors cited several methodological limitations that may have influenced the results. Thus, Hepler and Feltz (2008) conducted a follow-up study utilizing improved methodology. In this research, participants had to decide which base to throw the ball to in 10 video simulations of defensive baseball situations. Decision-making performance was defined as the product of the decision speed and accuracy, as determined by baseball experts. Results of this study indicated that self-efficacy was a positive and significant predictor of decision-making performance on a simulated sport task.

Bounded Rationality and Heuristics

Despite the considerable amount of research on decision-making in sport, there has been little emphasis on examining the mechanisms through which athletes make these decisions. One area which could be useful is the study of heuristics. A heuristic, commonly called a rule of thumb, can be defined as a simple "mental device that can solve a class of problems in situations with limited knowledge and time" (Raab &

Gigerenzer, 2005, p.188). These simple rules of thumb can be particularly useful is decision research because they describe the actual process of problem-solving, not just the outcome (Gigerenzer, 2004). Heuristics are rooted in Simon's (1957) notion of bounded rationality. According to bounded rationality, adaptive behavior can only be understood by jointly considering the limited capacities of the human mind and the structure of the environment. Simon has likened these two factors (i.e. cognition, environment) to blades on a scissors (Simon, 1990, p. 7). In this manner, it would not be possible to understand how a scissors works by simply examining only one blade of the tool. However, inspecting both blades, and observing the interaction between them, provides all of the information needed to understand the cutting mechanism of a scissors. In this manner, intelligent behavior can best be understood by considering people's cognitive capabilities in the context of the task environment. Overall, bounded rationality seeks to explain human behavior in real world conditions, which typically involve limited time, knowledge, and computational capacity (Gigerenzer, 2004).

Simon's view of bounded rationality is in direct opposition to the classical, normative theory of unbounded rationality. The perspective of unbounded rationality assumes that people have unlimited resources (i.e. knowledge, time, processing capabilities) which can be used to make optimal, rational decisions. However, in order to perform these infinitely complex calculations, humans would have to possess some form of superintelligence. An example of cognition based on unbounded rationality is the expected utility theory. Use of the expected utility theory requires a person to identify every possible consequence associated with an action, assign a numerical utility value to each consequence, and multiply that utility value by the probability that the consequence will occur. As a result of this process, the option with the highest expected utility value would represent the optimal, rational choice (Gigerenzer, Todd, et al., 1999). Conversely, methods associated with bounded rationality suggest that either an optimal solution does not exist or that it is not feasible to calculate the optimal choice. Instead, people often choose a "satisficing" strategy (Simon, 1956). Satisficing is a heuristic in which a person chooses among a set of alternatives by selecting the first option which exceeds a specified aspirational level (Simon, 1990). For instance, a person may decide that he or she wants to eat a hamburger for lunch. Using a satisficing strategy, the person would drive past Taco Bell and Kentucky Fried Chicken, but stop at the very first restaurant, such as McDonald's, that served hamburgers.

According to Gigerenzer, Todd, and colleagues (1999), satisficing and other heuristics are tools that are contained within the adaptive toolbox of the mind (Gigerenzer, Todd, et al., 1999). Specifically, the adaptive toolbox refers to the "collection of specialized cognitive mechanisms that evolution has built into the human mind for specific domains of inference and reasoning" (Gigerenzer, Todd, et al., 1999, pp. 30). This toolbox is adaptive because people can choose which tool to use in order to meet the demands of the environment, they can identify situations in which a tool is effective or ineffective, and they can revise and create new tools when needed. Tools in the adaptive toolbox are domain-specific (i.e. specialized, not generalized), they work within cognitive limitations, and they are only useful if they match the environment (i.e. ecologically rational) (Martignon & Schmitt, 1999).

In order to operate within the constraints of the mind and the environment, the toolbox utilizes resources from three different layers. The first level contains evolved capacities such as depth perception or face recognition. These evolved capacities are used to form the basis of the second layer, known as building blocks. These building blocks, which are discussed in detail below, comprise rules regarding search, stopping, and decisions. Finally, these building blocks are used to construct heuristics, or tools, which comprise the last layer in the adaptive toolbox. In keeping with the toolbox metaphor, the evolved capacities serve as the metal which is molded into various nuts and bolts, or building blocks. Subsequently, these nuts and bolts (i.e., building blocks) are assembled together to create the tools of heuristics (Gigerenzer, 2007). Moreover, new tools can be fashioned out of existing heuristics or nested within other tools. One family of tools in the adaptive toolbox that might be particularly useful in the study of decision-making in sport is fast and frugal heuristics (FFH).

Fast and Frugal Heuristics (FFH)

FFH are a subset of heuristics which allow people to make adaptive decisions in the real world by minimizing the amount of time, knowledge, and computation necessary to make decisions. Before providing a more detailed description of FFH, a few examples of these tools are presented first. One commonly cited example of FFH is the recognition heuristic (Goldstein & Gigerenzer, 2002). The recognition heuristic can be used to infer which alternative has the higher value on a particular criterion. Specifically, this tool states that when one alternative is recognized and the other is not, then it can be inferred that the recognized alternative has the higher value on the specified criterion. For example, research has demonstrated the power of this heuristic in an inference task requiring participants to decide which city is more populous. In one study, students from Germany and the United States were asked to determine which U.S. city had the larger population: San Diego or San Antonio. While two-thirds of the students from the U.S. answered the question correctly, an astounding 100% of the German students correctly selected San Diego as the larger city. The recognition heuristic can help to explain this result. According to the researchers, the German students reported that they recognized San Diego, but had never heard of San Antonio. Based on the fact that they recognized one city, but not the other, they simply inferred that the city they recognized, San Diego, was more populous. Conversely, students in the United States were at least somewhat familiar with both cities, therefore they could not rely on the recognition heuristic (Goldstein & Gigerenzer 2002). Thus, recognition heuristic is only ecologically rational in situations where a person is ignorant of one or more alternatives.

While the American students in this study had too much knowledge to use the recognition heuristic, they could have relied on another FFH, known as the Take the Best (TTB). The TTB heuristic posits that when choosing between two alternatives, a person will search cues in order of their cue validity (i.e., correlation with criterion), from highest to lowest, until they find a cue that discriminates between the choices. Subsequently, they will choose the alternative that has the highest value on the discriminating cue (Gigerenzer & Goldstein, 1996). In the aforementioned study, two cues that most likely would have been searched first, as they are typically highly correlated with population, are the city's status as a state capital and the presence of a professional football team. In this example, the state capital cue would not distinguish between the two cities, as neither San Diego nor San Antonio is a state capital. Thus, students would extend their search to the next cue, which is whether or not the city has a professional football team. Using this cue would successfully discriminate between the cities, as only San Diego has an NFL team. Thus, San Diego would be selected as the largest city because it has the highest value on the cue that discriminates between the two options.

The recognition heuristic and TTB heuristic demonstrate two key aspects of FFH: speed and frugality. These heuristics are fast because they use simple rules which do not attempt to optimize through the weighting and integration of information. Likewise, these rules are frugal because they use very limited information to make decisions. Thus, FFH are especially useful for making decisions in dynamic environments involving time pressure (e.g., sports). A heuristic can be considered fast and frugal if it displays four central characteristics (Bennis & Pachur, 2006; Gigerenzer, 2004). The first aspect of FFH is that they exploit evolved capacities. These capacities can be biologically evolved (e.g., depth perception), culturally evolved (e.g., technological savvy), or the result of learning (e.g., pattern recognition). For instance, the recognition heuristic utilizes the evolved capacity of recognition memory. A second characteristic of FFH is that they exploit the structure of the environment. This is the notion of ecological rationality, in that the effectiveness (i.e., rationality) of a heuristic depends on how well it matches the environment. In this manner, a rational heuristic fits the environment, whereas an irrational one does not match the structure of the environment. As a result, FFH seek to define the environments in which a heuristic would be effective, as well as those where it would be ineffective. For instance, the recognition heuristic is proposed to be effective in situations where the decision-maker is ignorant of one or more of the alternatives, but is not effective when a person recognizes (or fails to recognize) all of the options.

Search rules, stopping rules, and decision rules, collectively known as process rules, are another vital aspect of FFH. These rules represent the building blocks, or ABCs of FFH (Gigerenzer, Todd, et al., 1999). Search rules define what information or cues will be searched and in what order that search will be conducted. Stopping rules dictate when the search for new information will be terminated. Likewise, decision rules denote how decisions will be made based on the available information. It is easy to illustrate these rules in the TTB heuristic. In TTB, search rules dictate that the cues should be searched in decreasing order of validity, stopping rules terminate the search once a single discriminating cue has been found, and the decision rule states that the option with the highest value on the last cue should be selected. One final characteristic of FFH is that they are simple. The simplicity of FFH is reflected by the fact that these heuristics do not attempt to optimize through the weighting and integration of information. Moreover, the clearly defined process rules which govern FFH allow these simple rules to be computationally modeled. As such, the decision processes of FFH are highly transparent and the algorithms are easily testable (Gigerenzer, Todd, et al., 1999).

As FFH are simple rules based on limited information, many people might question the accuracy of these heuristics. The accuracy of heuristics is typically evaluated by comparing their performance with that of computationally complex models that take into account all of the available information. Overall, research has found that FFH perform as well as most normative methods, such as multiple regression. In their book *Simple Heuristics that Make Us Smart*, Gigerenzer, Todd, and colleagues (1999) devote a great deal of attention addressing the accuracy of FFH. In fact, an entire chapter is dedicated to reporting tests comparing the performance of two FFH, TTB and minimalist (same as TTB, but with a random search order) with that of two linear strategies, multiple regression and Dawes' rule. Each of these four methods was used to predict which of two alternatives would score higher on the criterion. The data represented 20 different environments in various disciplines such as psychology, economics, and transportation. Some of the specific tasks required the various techniques to predict differences in mortality, housing prices, attractiveness, and high school drop-out rate. The findings showed that the FFH were indeed fast and frugal, as the minimalist and TTB heuristics searched for 2.2 and 2.4 cues, respectively. On the other hand, the linear methods used all of the available information, with a mean of 7.7 cues over the 20 tasks. Additionally, the authors reported that the benefit of speed and frugality did not cost much in terms of accuracy. While the multiple regression technique was the most accurate, predicting the correct answer 77% of the time, TTB performed almost as well with an accuracy rate of 75%. Meanwhile, the predictions of Dawes' rule and the minimalist heuristic were correct 73% and 69% of time, respectively (Gigerenzer, Todd, et al., 1999). Additional research also supports the notion that FFH can simultaneously be fast, frugal, and accurate (Gigerenzer, Czerlinski & Martignon, 1999; Gigerenzer & Goldstein, 1996).

Previous research has examined a few FFH in a sporting context. For instance, the gaze heuristic has been cited as a tool to help judge and catch fly balls in sports such as baseball (Gigerenzer, 2004). Judging a fly ball can be a difficult task, as the flight path is influenced by several factors such as trajectory, wind resistance, and velocity of the ball. In order to investigate how athletes perform this difficult task, McLeod & Dienes (1996) conducted two experiments involving skilled ball catchers. Results of the study indicated that athletes did not perform complicated calculations (e.g., trajectory, wind resistance) to properly position themselves to catch a fly ball, but rather they used a very simple rule: keep the angle of the gaze constant. While the study was not an examination of heuristics, other researchers have subsequently referred to the findings of the study as the "gaze heuristic" (Gigerenzer, 2004). Thus, the gaze heuristic states that the perceptual component of catching a fly ball simply requires an athlete to adjust his or her running speed so that the angle of gaze does not change. Consequently, this strategy allows players to intercept the ball at the appropriate time and place without conducting complex mental computations. However, one must also consider the types of environments or tasks on which this heuristic would be useful. Accordingly, the gaze heuristic is only ecologically rational in environments in which the ball is high up in the air, on its descent, and in front of the athlete. For example, a fielder who used the gaze heuristic to judge a ball that is still on an upward trajectory would end up over-running the ball. Likewise, a shortstop would not want to use the gaze heuristic to try to field a ground ball (Gigerenzer, 2004).

Furthermore, the recognition heuristic discussed above has also been applied to the sport setting. For example, Snook and Cullen (2006) examined the recognition heuristic on a task where participants were presented with a pair of professional hockey players and asked to decide which player scored more points in his career. Additionally, participants were asked to indicate whether or not they recognized the players. In the event that participants recognized a specific athlete, they were instructed to write down what they knew about the athlete. Based on these responses, the researchers created three different categories of recognition: not recognized, merely recognized, and recognized with additional knowledge. According to the results, when faced with a choice between a merely recognized player and an unrecognized player, participants chose the recognized athlete 95% of the time. This answer was correct on 81% of the trials. Similarly, in pairs where one player was recognized with additional knowledge and the other athlete was not recognized, the athlete recognized with additional knowledge was selected as the high scorer in 98% of the occasions. This response was accurate 94% of the time (Snook & Cullen, 2006). Likewise, the recognition heuristic has also been explored in tasks requiring participants to predict which team or athlete would win a particular competition. One such study examined participants' predictions regarding professional tennis matches. Participants who recognized only one of the players in a match predicted that the recognized player would win the match in 90% of the cases (Serwe & Frings, 2006).

Take the First Heuristic

While these examples illustrate how heuristics can be used in the sport domain, they fail to explain how athletes generate options and choose among them. This is the specific aim of the Take the First (TTF) heuristic (Johnson & Raab, 2003; Raab & Johnson, 2007). According to TTF, information and concepts can be represented by nodes. Nodes are interconnected and the strength of these connections is determined by the degree of similarity between the nodes. Accordingly, the more similar a node is to another, the stronger the connection between the two will be. When a node is activated, spreading activation stimulates other similar nodes. Spreading activation is sequential in that only one node is activated at a time, and it operates in order of decreasing similarity (i.e., highest to lowest). In the context of TTF, the rules governing the spreading activation are determined by strategy. The strategy a person uses depends on his or her goals, task constraints, and other environmental factors that are specific to the particular domain of functioning. For example, Johnson and Raab (2003) proposed that handball players use functional and spatial strategies. Functional strategies focus on the functional result (e.g., pass, shoot); whereas, spatial strategies refer to spatial orientation (e.g., left, right). These strategies influence spreading activation by defining node similarity. For instance, a spatial strategy in basketball would closely link "pass to the left elbow" to "pass to the left baseline" but not to "shoot". Consequently, "pass to the left baseline" would be strongly activated, whereas "shoot" would only be slightly activated or it may not be stimulated at all. In this manner, strategy determines the order in which options are generated. Likewise, the repetitive activation of a node, such as through practice in sports, strengthens its association in the associative network. When faced with a similar situation, the links with the strongest connections, which should represent high quality decisions, will be retrieved first. Consequently, a person should simply choose the initial option generated, as that should represent an appropriate decision.

Simply put, the TTF heuristic states that when making a decision in a familiar, ill-defined task, a person should choose one of the first options that springs to mind. The basic underlying principle of this heuristic suggests that options are not generated in random order, but rather that they are meaningfully generated, with better options coming first. Specifically, high quality options are generated first simply because they have the strongest connections within the associative network, which is where a person searches for options.

Earlier in this chapter, the four central characteristics of FFH were discussed. These factors suggested that FFH exploit evolved capacities as well as the environment, they involve process rules, and they are simple. Thus, it is important to understand how TTF satisfies these qualities. First, TTF exploits the evolved capacities of the associative memory network, as well as the ability to recognize patterns. Moreover, the heuristic is proposed to be effective in environments with which the performer is familiar. TTF also uses process rules. Specifically, search through the associative network occurs in order of similarity, from highest to lowest, to the initial option stemming from the stimuli. The stopping rule suggests that search should be terminated after only a few options have been generated. Finally, the decision rule dictates that the first option should be taken. Furthermore, the TTF heuristic also conforms to the simplicity aspect of FFH, as it makes no effort to deliberately process, weight, or integrate any of the information.

To date, only two published studies have empirically investigated the TTF heuristic in sport (Johnson & Raab, 2003; Raab & Johnson, 2007). The first study involved 85 male handball players representing six club teams from Germany and Brazil (Johnson & Raab, 2003). All of the participants were between the ages of 13 and 18. Participants in this study performed a simulated sports decision-making task in which the objective was to generate options regarding what course of action the player with the ball should take and subsequently decide which option was the best one in that situation. The simulated sports task involved 31 videotaped offensive attack situations in handball. Approximately 10 s into each clip, the video was frozen while a player in the middle of the court had possession of the ball. At that time, participants were asked to pretend that they were the player with the ball and to give three verbal responses. First, they were to name, as quickly as possible, the first option that intuitively came to mind. Next, they were asked to give other appropriate options that the player could perform. Finally, participants had to choose which course of action they felt was the best decision in that situation. The quality of each of the options that was generated by study participants was evaluated by handball experts. The experts rated the choices on a 5-point Likert scale ranging from 0 (inappropriate) to 4 (best possible solution). Option-generation strategy was evaluated by a computer program that examined all consecutive pairs of options to detect patterns supporting either a functional or spatial strategy. The number of consecutive pairs reflecting a specific strategy was summed across all trials for each participant. Subsequently, a participant's strategy score was calculated by subtracting the number of strategy pairs from functional pairs. Based on this score, a median split was used to categorize participants as using a spatial or functional strategy of option-generation. As was mentioned previously, a person using a functional strategy focused on the action, such as passing or shooting, whereas participants who used a spatial strategy were primarily concerned with the direction of the action (i.e., left, right, middle).

Results of the study provided support for TTF. First, the findings demonstrated that participants did in fact use the TTF heuristic, as they selected the first option on 60% of the trials. Moreover, Johnson and Raab (2003) found that the serial position of an option was negatively related to the quality of the option. In other words, earlier options were of higher quality than were later ones. It is interesting to note that participants generated relatively few options (M = 2.3) for each trial. Moreover, option-generation strategy was found to influence the number and quality of options that were generated. Specifically, participants who exhibited a functional strategy generated more options and resulted in poorer final decisions than did the spatial strategy (Johnson & Raab, 2003).

A follow up study conducted by Raab and Johnson (2007) provided a further exploration of TTF. In particular, this study focused on two aspects that were not directly addressed in the first study: search strategy and expertise. This longitudinal study involved 69 adolescent male and female handball players who were classified as expert, near expert, or non-expert. The study was conducted over a period of 2 years with measures taken on 4 occasions spaced 6 months apart. Participants in this study performed a video decision-making task that was adopted from the original study by Johnson and Raab (2003). Unlike the original study, the authors sought to get direct, formal measures of search strategy and expertise. Eye-tracking data were used to classify participants into spatial or functional search strategy groups. According to the researchers, a spatial search strategy was characterized by eye fixations in one area of the screen; whereas, attending to the entire screen was indicative of a functional strategy. This direct measurement is in contrast to the first study, which inferred search strategy based on the pattern of options that were generated. Moreover, the researchers also used a tactical questionnaire to measure tactical expertise for attack situations. Many of the results in this study replicate the findings of Johnson and Raab (2003) thereby supporting the TTF heuristic. Results revealed that people had a tendency to choose the first option, that earlier generated options were of higher quality than were later generated ones, and people did come up with very many options (M = 3.3).

As a new heuristic, there has been limited research on TTF. Thus, there are many limitations and knowledge gaps regarding the role of TTF in option-generation and decision-making. A major limitation of the research that has been conducted on TTF is the failure to take measures to ensure that participants cite their first inclination. Johnson and Raab (2003) state that they did not utilize time pressure in their experimental task because they wanted to foster creative option generation. However, the same study found that slower-generated first options were of higher quality than were initial options that were generated quicker. This finding could simply be an illustration of the speed-accuracy tradeoff, but it could also reflect that participants were evaluating some options before giving their first response. Thus, in order to get an accurate evaluation of the TTF heuristic, it is important that researchers implement measures, such as time pressure, to try to ensure that participants honestly name the first intuitive option.

As mentioned previously, this line of research has not attempted to identify psychosocial factors, such as self-efficacy, that might influence a person's use of TTF. Previous research has suggested that individual differences, such as intelligence (Bröder, 2002), personality and happiness (Schwartz, Ward, Monterosso, Lyubomirsky, White, & Lehman, 2002), and expertise and knowledge (Johnson & Raab, 2002; Raab & Johnson, 2007) influence the use of heuristics. In order to advance our understanding of decision-making and TTF, it is important to identify the various psychosocial factors that influence a person's tendency to use this specific heuristic. Related to this concern, previous studies have not examined TTF in varying game conditions. Research has found that quality of decision-making decreases during the final, critical moments of competition (Bar-Eli & Tractinsky, 2000). However, the studies conducted by Johnson and Raab did not vary the game conditions to determine if participants used TTF during pressure situations.

Another limitation is that previous research has required participants to verbally state all of their options. However, these options were not written down or recorded for participants to review. Consequently, the final decision of participants may reflect biased recall of the generated options, such as occurs in the recency and primacy effects. The scoring system is also a weakness of the two previous studies on TTF. In most situations in sport, there are many decisions which would be considered at least minimally acceptable. For instance, in basketball, almost any decision that doesn't result in a turnover could be considered appropriate. However, many of these options vary in the quality of the decision, ranging from the best decision to one that is simply adequate. Despite employing a rating system ranging from 0 to 4, the previous studies have evaluated decisions by counting only the best decision or by tallying the frequency of all appropriate decisions. Neither of these methods accurately reflects the varying quality of different decisions.

This dissertation addressed several of the limitations of the previous research. In particular, the current study used time pressure to encourage participants to give their first intuitive response, investigated the influence of self-efficacy on TTF, required participants to write down the potential options, varied game conditions to include pressure-filled, end-of-the-game situations, and utilized a more comprehensive scoring system to evaluate decision quality. These facets could help advance the current knowledge and understanding of decision-making in sport.

Summary

Decision-making is an important determinant of performance in sport. Previous research has mainly focused on understanding decision-making differences between expert and novice performers. However, self-efficacy has also been found to be an influential factor in determining the speed and accuracy of decisions. Likewise, there has been little research examining the rules, or heuristics, that people use to make decisions in sport. The TTF heuristic is a promising tool to help explain the process of option-generation and decision-making in familiar, dynamic environments. The aim of the present study was to examine the TTF heuristic in sport, as well as how self-efficacy influences TTF, option-generation, and decision-making.

CHAPTER 3

METHOD

In order to investigate the TTF heuristic, self-efficacy, and decision-making, a sport-specific study was devised. This study utilized a video-based decision-making task in the sport of basketball. This chapter begins by identifying the participants and instruments involved in the study. Next, the specific study procedures are detailed. Finally, the chapter concludes by discussing the treatment of the data and how the data will be analyzed.

Participants

One hundred and five undergraduate and graduate students were recruited for the study. However, only 72 met the criterion of 1 year of competitive basketball playing experience in which competitive experience was defined as membership on a team that had a coach and where records and/or standings kept. This criterion was used because familiarity with a task is a basic tenet of TTF. All participants between the ages of 18 and 30 (M = 21.23, SD = 2.32) participated in the study. Participants were recruited from various classes offered in the Kinesiology department. Based on the conceptual framework self-efficacy theory, participants were required to have requisite incentive to perform well on the task. Thus, in order to be included in the final data analysis, participants were required to indicate that it was at least moderately important for them to do well in the basketball decision-making test. Importance ratings were pertinent because, according to self-efficacy theory, self-efficacy influences performance only when the performer has requisite incentive to do well. Similar to the inclusion criteria of other studies, participants who selected an importance rating below 5 (as described below) were not included in the final data analysis (Chase, 2001; George, 1994; Hepler & Chase, 2008). Consequently, data from two participants was excluded from the final analysis. Therefore, the results reported in this study are based on the final sample size of 70 (34 males, 36 females).

Self-Report Questionnaires

Demographic and importance questionnaire. A demographic questionnaire was used to collect background information from the participants. Specific items included age, gender, and year in school. In addition, information was collected regarding participants' basketball playing experience and viewing habits. Participants' playing experience, at both the competitive and recreational levels, was assessed. Total number of years of competitive basketball experience, including the number of years at various competitive levels (e.g., junior high, high school varsity), and the total number of years of recreational basketball experience was assessed. Recreational basketball was defined as any playing experience that did not meet the criteria for competitive experience (i.e., coach, standings). Moreover, participants were asked to indicate the average number of hours spent per week watching basketball, either on television or in person. Finally, participants rated how important it was for them to be successful in the basketball decision-making test. Importance ratings were based on an 11-point scale, with 0 denoting "not important at all," 5 "somewhat important," and 10 "very important." As mentioned above, participants who marked an importance rating below "5" were viewed as lacking the requisite incentive; thus, those participants were not included in any data analyses. The demographic questionnaire is presented in Appendix A.

Basketball knowledge test. In order to assess participants' knowledge about the offensive rules, strategies, and tactics of basketball, a 10-item test was constructed for this study (see Appendix B). An example question from the test asked: "When a defensive player is fronting (standing in front of) an offensive low-post player, what pass can be used to get the post player the ball?" The test was a multiple-choice format with four possible answers for each question. Three collegiate coaches took the basketball knowledge test and all received a perfect score. Participants' basketball knowledge was defined as the number of correct responses on the 10-item basketball test. The measure exhibited acceptable internal consistency ($\alpha = .70$).

Decision-making self-efficacy questionnaire. The decision-making self-efficacy of participants was measured through a task-specific questionnaire designed specifically for this study (see Appendix C). The self-efficacy questionnaire comprised 10 items reflecting various aspects of offensive decision-making in basketball. The instructions asked participants to rate their confidence in their ability to perform various decision-making tasks in the upcoming basketball video test. Example items included: "know who to pass the ball to" and "make decisions quickly." Participants' degree of certainty was scored on an 11-point scale ranging from 0 (not at all confident) to 10 (extremely confident). The questionnaire was constructed in accordance with Bandura's guidelines (2005). Self-efficacy strength was defined as the average efficacy rating across all items (i.e., sum of all scores divided by 10). The scale exhibited high reliability, as Cronbach's alpha was .96.

Rating of confidence in final decision. A single-item measure was used to assess participants' confidence in each of their decisions. This question asked: "How certain are you that this is the best decision for this situation?" Ratings were based on an 11-point scale ranging from 0 (not at all confident) to 10 (extremely confident). Participants' option-generation confidence score represented their average confidence on the 13 task trials, while decision-making performance confidence score reflected average confidence ratings on the 13 decision-making performance trials.

Video Situations

A total of 26 video clips depicting various offensive basketball situations were used in the study. The video situations were compiled from edited video footage of a high school boy's basketball game. All videos were edited using Windows MovieMaker. High school boys basketball was used because it is a sport with which most college students are familiar, as either a player or a spectator. Moreover, using film from an actual game ensured that the clips illustrated real, competitive situations in basketball. The videotape was filmed from above, such that all of the relevant offensive and defensive players were visible in the frame. For each trial, the video clip played and then froze suddenly when a member of the offensive team was in possession of the ball. The task in both the option-generation and decision-making performance phases of the study was for participants to watch a video clip and decide what the player with the ball should do next (e.g., pass the ball to a specific teammate, drive to the basket, etc.). All videos were viewed on a laptop computer. Video clips ranged from 4.80 – 21.90 seconds (M = 12.20, SD = 5.13). Participants were not given information regarding the length of each video.

The video clips used in the study were determined by three collegiate basketball coaches. Prior to conducting the study, a set of 50 basketball clips were assembled and sent to the coaches. In addition to the videos, the coaches were also sent a list of potential moves for each specific situation. After viewing each video situation, the coaches rated the appropriateness of each of the possible options on a 5-point Likert scale: 0 = inappropriate, 1 = somewhat appropriate, 2 = appropriate, 3 = very appropriate, 4 = best possible. Only situations in which the coaches unanimously agreed on the best possible option were eligible for use in the study. Based on these ratings, 26 video situations were retained for use in the study. Coaches' ratings showed a high amount of agreement on the other options, as the overall intraclass correlation coefficient was .90, with agreement on individual situations ranging from .79 – 1.0. Likewise, the experts also rated, from 0 (not difficult at all) to 5 (very difficult) how difficult it is to make the best decision for each video clip. Difficulty ranged from 1.67 – 4.67 for the 26 videos used in the study, with an average difficulty rating of 2.76 (*SD* = 1.06).

In an attempt to eliminate decision-making advantages based on participants' primary position, dominant hand, or playing style preference, special care was taken to try to balance the video clips that were used in the study. Balancing the videos meant including relatively equal sample of clips that depicted the ball: on the left and right side of the court, on the inside and outside of the low post (or paint area), and in possession of guards or post players. While the clips were not perfectly balanced in all of these aspects, all of these variables are adequately represented. Out of the 26 clips, the ball ended up on the left side of the court 9 times, the middle of the court 4 times, and on the right-hand side of the court 13 times. Additionally, the ball was located inside (i.e., low post area or free throw lane) in 12 of the video clips, while 14 clips ended with the ball outside (i.e., outside of the free throw lane). Finally, guards (i.e., point guards, shooting guards, off guards) had possession of the ball on 16 occasions with post players (i.e., forwards, centers) controlling the ball in 10 video situations.

All video clips were presented with specific game conditions, such as score, half, and time remaining. These game conditions were important because decisions often depend on various aspects that are unique to the specific situation. For example, an opportunity for an open, break-away lay-up is typically the best decision in most situations. However, a chance at a quick, easy score may not be the best decision in some situations, such as those at the end of a game where the team with the ball has a slim lead and needs to run time off the clock. Most of the video clips (20) used the same game conditions, which stated that there were approximately 15 minutes remaining in the game and the score was tied 28-28. However, in order to explore decision-making and TTF in critical situations, six video clips used different game conditions. These clips depicted critical situations in which the game was on the line. All of these critical situations took place with less than a minute to play in the game with no more than three points separating the two teams. For instance, one situation stated that there were 34 seconds left to play in the game with the opposing team leading by 3 points.

Option-Generation Task

This study involved two different phases: an option-generation phase and a decision-making performance phase. The option-generation part of the study required participants to generate options regarding what the player with the ball should do next, decide which option represented the best move, and rate their confidence in that decision. As soon as the video stopped, participants were instructed to verbally state, as quickly as possible, the first option that came to mind. These responses were required to be stated aloud in order to measure response time. After verbally stating their initial response, participants immediately wrote the answer down on the provided form. Next, participants were given approximately 45 s to write down any other options that they felt were acceptable in that situation. Once participants generated all of their options, they selected the option that represented the best possible move and rated how confident they were in that decision. For an example score sheet from the option-generation task, see Appendix D.

An important element of the option-generation task was the time pressure. In order to evaluate the TTF heuristic, it is imperative for researchers to get an accurate assessment of participants' first intuitive options. This requires participants to honestly indicate the first idea that pops into their heads. In this study, time pressure, in the form of a loud buzzer, was used to encourage participants to state their true first intuitive response. Specifically, participants were informed that if they failed to give a response in 2 s, then a loud, annoying buzzer would continue to go off until an answer was given. The buzzer was intended to be an unpleasant stimulus that participants would want to avoid; thereby, giving them incentive to quickly and honestly state the first option that came to mind. The time frame of 2 s was determined from a small pilot study involving experienced and novice basketball players. In this pilot study, participants viewed situations involving various levels of time pressure ranging from 1-5 s. According to the feedback from the pilot study participants, 2 s was the optimal amount of time, as it allotted ample time to generate an option, but was short enough to prevent people from evaluating that option or generating subsequent choices.

Decision-Making Performance Task

The second facet of the study was the decision-making performance phase. In this task, participants viewed a video clip and then stated their decision as fast as possible. Participants were informed that this was to be their final decision and that they could not change it. As in the option-generation phase, decisions were first stated verbally and then recorded on paper. Finally, they rated their confidence in the final decision. Appendix E illustrates an example score sheet for the decision-making performance task.

Scoring of Tasks

Various performance scores were used in the option-generation and decision-making performance tasks. The first score was decision quality. The decision quality score for each possible option was determined by the ratings of the collegiate coaches. Specifically, the average coaches' rating was calculated for each potential move in the 26 situations. Subsequently, the average rating was used as the quality score for the corresponding option. For example, if two coaches rated a potential move "3" (very appropriate) while one coach gave the same option a quality rating of "2" (appropriate), then participants citing that option would receive a decision quality score of 2.67. In the option-generation phase, each option that participants came up with was given a decision-quality score, as was the final decision. Likewise, the decisions made during the decision-making performance tasks were also assigned a decision quality score. The decision quality score in the option-generation phase was the average decision quality of all final decisions in the option-generation phase. These scores could range from 0 to 4. Additionally, decision quality according to serial position was also calculated by the average score for each position (e.g., 1st, 2nd) across the 13 option-generation trials. For the decision-making performance task, the decision quality performance score represented the average decision quality score of all the decision-making performance trials.

The second performance score used in this study was response time. The computer was used to measure response time, which was recorded in seconds, rounded to the nearest hundredth. Specifically, the experimenter was responsible for recording response time by pressing the computer's spacebar when participants gave their responses. This was an important aspect because pressing the spacebar stopped the clock on the computer. Response time measured how long, from the end of the video scene, it took participants to give their first response (option-generation task) or final decision (decision-making performance task).The final response time score for each task was the average response times across all trials in the corresponding phase.

A few additional performance measures were obtained from the option-generation task. One of these scores was TTF frequency. The TTF frequency score simply represented how often participants choose the first option. As such, scores could range from 0 to 13. Another performance measure from the option-generation phase was the average number of options-generated for each trial. This score, which was the sum of generated options divided by the number of trials (i.e., 13), could range from 1-5.

Procedures

Before conducting this study, permission was obtained from the Institutional Review Board for Human Subjects Research. Participants were recruited from various classes offered in the Department of Kinesiology. Prior to initiating any data collection procedures, informed consent was obtained for all participants (see Appendix F). Upon arriving at the testing site, participants completed the basketball knowledge test followed by the demographic and decision-making self-efficacy questionnaires. Next, participants performed the decision-making video trials. The two video tasks, option-generation and decision-making performance, were counterbalanced. In this manner, half of the participants first performed the option-generation phase followed by the decision-making performance task; whereas, the other half performed the tasks in the reverse order. While the order to tasks was counterbalanced, the order of the videos remained the same. Accordingly, all participants watched videos 1-13 in the first phase of the study, with half of the participants performing the option-generation task for those videos and the other half performing the decision-making performance task. Likewise, participants performed the opposite task for videos 14-26.

There are two ways in which counterbalancing was important in this study. The first was to account for a possible priming effect. In other words, to control for the possibility that performing the option-generation task might prime participants to perform better on the decision-making performance task. Another way in which counterbalancing the order of the tasks was important was to provide another test of the TTF heuristic in sport. Thus far, research has only taken a within-person approach to examine use of TTF. However, it may also be fruitful to take a between-persons approach. Applying the between-persons perspective in this study, the results of the option-generation task of one group of participants can be used to predict the decisions made by the other group of participants on the performance task. For instance, imagine that 70% of the participants who performed the option-generation task cited "Pass to A" as their first response to

Video 1. Based on these results, it is possible to infer that participants used TTF in the decision-making performance task if they decided "Pass to A" was the best decision for that same video situation. Assuming the two groups of participants are equal, it would be expected that approximately 70% of the participants performing the decision-making task would make the decision to "Pass to A". It should be noted that it is not being suggested that the between-persons approach be used alone in research on TTF, but rather that it may provide additional information about TTF when combined with the within-person approach.

As there were two different performance orders in this study, the remainder of this section will outline the procedures for those participants who performed the option-generation task followed by the decision-making task (i.e., Order A). After completing the decision-making self-efficacy questionnaire, participants performed the option-generation task. The option-generation task, as described earlier in this chapter, required participants to name their first, intuitive option, generate other acceptable options, select the option representing the best decision, and rate their confidence in that decision. Prior to performing the option-generation task, the experimenter read the task instructions (see Appendix G) to all participants and answered any questions regarding the task. After completing all 13 of the option-generation trials, participants then completed the decision-making performance task. Similar to the previous phase, the experimenter read aloud the instructions for the decision-making performance task (also see Appendix G) and answered any questions. Finally, all participants were debriefed about the details of the study. To better understand the procedures, an outline of the protocol is provided below in Figure 1.

Figure 1. Timeline of Events for Order A.

1. Informed consent
2. Basketball knowledge test
3. Demographic questionnaire
4. Self-efficacy questionnaire
5. Option-generation task
   - 4a. Review game conditions
   - 4b. Watch Video 1
   - 4c. Verbally state first option (within 2 s)
   - 4d. Write down first option
   - 4e. Write down other acceptable options (within 45 s)
   - 4f. Circle option representing the best decision
   - 4g. Rate confidence in decision
   - 4h. Repeat for Videos 2-13
5. Decision-making performance task
   - 5a. Watch Video 14
   - 5b. Verbally state decision
   - 5c. Write down decision
   - 5d. Rate confidence in decision
   - 5e. Repeat for Videos 12-26
6. Debrief participant

Treatment of the Data

Before conducting the primary analyses, the data were screened for outliers, normality, linearity, and homogeneity. Data screening was conducted in accordance with the recommendations of Tabachnick and Fiddell (2001). Boxplots and standardized scores were used to identify univariate outliers. A case was deemed an outlier if it was more than 3 standard deviations away from the mean. Normality was evaluated by histograms and skewness and kurtosis statistics. A non-normal distribution was indicated if the skewness statistic divided by the standard error exceeded ± 2. Bivariate scatterplots were used to evaluate linear relationships between the variables. Linearity is indicated by oval-like plot patterns. Finally, homogeneity between the two test orders was evaluated by Levene's test of homogeneity.

Data Analysis

Following data screening, descriptive statistics (i.e., mean, standard deviation) and bivariate correlations were calculated for all independent and dependent variables. Study hypotheses and research questions were evaluated using various statistical methods. Specifically, one-way ANOVAs (Option-Generation Hypothesis 2, Option-Generation Hypothesis 3, Option-Generation Hypothesis 4, Decision-Making Research Question 3, and Decision-Making Research Question 4, Decision-Making Research Question 5), hierarchical multiple regression analyses (Option-Generation Hypothesis 6, Option-Generation Hypothesis 7, Option-Generation Hypothesis 8, Option-Generation Research Question 1, Option-Generation Research Question 2, Decision-Making Hypothesis 9, Decision-Making Hypothesis 10, and Decision-Making Hypothesis 11), paired t-test (Option-Generation Hypothesis 5), and frequencies (Option-Generation Hypothesis 1) were used to evaluate the various hypotheses and research questions. All statistical analyses were conducted in SPSS 17. An alpha level of .05 was used for all statistical tests.

CHAPTER 4

RESULTS

The purpose of this study was to examine the TTF heuristic and self-efficacy in option-generation and decision-making in sport. This chapter presents the results in five main sections. The first section presents detailed demographic information about the study participants. In the second section, descriptive findings, such as the means and standard deviations, of relevant study variables are cited. Next, the correlations among various study variables are discussed. The fourth section on preliminary analyses outlines results regarding data screening and major assumptions. Finally, the chapter concludes by detailing the results of the various statistical analyses used to evaluate the study hypotheses and research questions.

Demographic Information

Out of the entire sample of 105 participants, 33 were omitted from data analyses due to lack of competitive basketball experience, while 2 other participants were dropped because of low importance ratings. Thus, the final sample comprised 70 participants (34 males, 36 females) who were, on average, 21.19 years of age (SD = 2.25). Participants reported a moderate amount of playing experience, with almost 5 years of competitive experience (M = 4.47, SD = 3.33) and over 6 years of recreational basketball playing experience (M = 6.09, SD = 5.65). In addition, participants represented a wide range of playing positions, as 28 participants reported "forward" as their primary position, followed by 19 "shooting guards", 12 "point guards", and 8 "centers". Three participants did not indicate a primary position. As a whole, participants were avid basketball fans, watching an average of 3.39 hours of basketball each week (SD = 3.08). Overall, the participants thought that it was quite important to do well on the basketball decision-making test (M = 7.04, SD = 1.72).

Descriptive Statistics

Means and standard deviations for basketball knowledge, decision-making self-efficacy, TTF frequency, and quality, confidence and response time scores for the option-generation and decision-making tasks are presented in Table 1. Overall, participants demonstrated an adequate knowledge of basketball (M = 6.84, SD = 2.20) and a moderately high sense of decision-making self-efficacy (M = 6.82, SD = 1.61). Moreover, participants performed similarly on the option-generation and decision-making performance tasks in terms of decision quality. On both tasks, participants made decisions that were classified as "very appropriate". Likewise, participants reported similar levels of confidence in their decisions on the option-generation task as they did on the decision-making performance task. However, participants made decisions faster during the option-generation phase (M = 1.79, SD = .43) than in the decision-making performance task (M = 2.71, SD = 1.18). This likely reflects the time pressure imposed by the buzzer during the option-generation task.

Performance (i.e., decision quality, confidence, and response time) on the option-generation and decision-making tasks was examined according to basketball playing position. Participants' use of TTF was also compared by position. Specifically, a one-way MANOVA was used to determine if guards (i.e., point guards and shooting guards) differed from post players (i.e., forwards and centers) on decision-making performance or use of TTF. Results indicated that the two groups were significantly different on only one variable, decision-making performance quality, $F(1, 65) = 4.05, p = .048$. As this result was only marginally significant and there were no other significant differences between the two groups, position was not included in any of the data analyses.

Additionally, a one-way MANOVA was used to compare male (n = 34) and female (n = 36) participants on all independent and dependent variables, as well as pertinent demographic information. Results indicated that males and females differed significantly on several variables. In particular, females had less recreational basketball experience, watched fewer hours of basketball, thought it was less important to do well on the task, scored lower on the basketball knowledge test, had lower self-efficacy beliefs, used TTF less frequently, made lower quality decisions on both tasks, expressed less decision confidence on both tasks, and generated lower quality first options than did male participants. Table 2 presents descriptive statistics for all variables by gender.

While there were significant gender differences on many study variables, neither self-efficacy theory nor the TTF heuristic suggest that gender should influence any of the relationships among these variables. Consequently, all study hypotheses were evaluated by two separate analyses. The first analysis evaluated each hypothesis as stated, with no consideration for the influence of gender. A second analysis included gender as a covariate (ANCOVA) or control variable (regression). However, gender very rarely changed the substantive interpretation of study hypotheses. Thus, results of the second analysis controlling for gender will only be reported when they differ from the original analysis.

Correlations

In order to gain a better understanding of the relationships among variables, the correlations between all independent and dependent variables were examined. These results indicated that many of the study variables were significantly correlated. For instance, self-efficacy was significantly related ($p < .001$) to gender ($r = .38$), competitive basketball experience ($r = .36$), basketball knowledge ($r = .47$), TTF frequency ($r = .47$), decision quality on both tasks ($r = .48$ option-generation, $r = .36$ decision-making performance), decision confidence on both tasks ($r = .69$ option-generation, $r = .70$ decision-making performance), and decision-making performance response time ($r = -.37$). In addition to self-efficacy, TTF frequency was significantly correlated with gender ($r = .40$), competitive basketball experience ($r = .26$), basketball knowledge ($r = .32$), option-generation decision quality ($r = .24$), decision confidence on both tasks ($r = .39$ option-generation, $r = .37$ decision-making performance), and average number of generated options ($r = -.42$). Table 3 presents the correlations among all relevant study variables.

Preliminary Analyses

As was mentioned in Chapter 3, the data were screened for outliers, normality, linearity, and homogeneity prior to conducting any statistical analyses. Based on the boxplots and z-scores, three instances of univariate outliers were identified. However, univariate outliers are not typically problematic unless they contribute to multivariate outliers (Tabachnick & Fiddell, 2001). Using Mahalanobis distance, it was determined that the data did not contain any multivariate outliers; thus, all cases were retained. Moreover, the skewness statistics revealed several violations of univariate normality. Specifically, TTF frequency (-2.20), option-generation quality (-2.57), option-generation confidence (-4.50), decision-making performance confidence (-2.84), and decision-making performance response time (-4.66) were all significantly and negatively skewed.

Option-generation number, or the average number of options generated for each trial, demonstrated significant positive skewness (2.78). Inspection of histograms and the Kolmogorov-Smirnov tests confirmed these significant deviations from a normal distribution. Thus, the data were transformed using a square root transformation (TTF frequency, option-generation quality, decision-making performance confidence, and option-generation number) and a logarithmic transformation (option-generation confidence and decision-making performance response time). Following transformation, all variables were normally distributed. Transformed variables can be difficult to interpret because they lose the original metric. Thus, all data analyses were conducted twice: once using the skewed raw variables and once using the normally distributed transformed variables. As the main interpretation of the analyses did not differ between the raw and transformed variables, and the original variables are easier to interpret, all results are based on analyses using the raw variables.

Another statistical assumption that was explored was linearity. All combinations displayed an oval-like pattern, indicating that the data met the assumption of linearity. Finally, it was necessary to examine homoscedasticity between the two task orders. Levene's test of homogeneity of variance was used to evaluate this assumption. Results indicated that all variables met this criterion except for decision-making quality ($p <$ .001). Consequently, all data analyses involving this variable assumed unequal variances. Intercorrelations among variables were examined to screen for multicollinearity. Based upon the recommendation of Pedhazur (1982), the minimum tolerance for multicollinearity was set at .80. Inspection of the correlations revealed two potential instances of multicollinearity. In particular, the correlation between option-generation confidence and decision-making confidence was .89, while quality of first option and option-generation decision quality were also highly related ($r = .81$). Due to this high correlation, these two sets of variables will not be simultaneously entered as predictors in any of the analyses. All other correlations fell within acceptable ranges (.02 - .70).

As there were two separate orders in this study, it was necessary to determine if there were any differences between the groups that would prevent the data from being combined. A one-way MANOVA was used to determine if the groups differed on basketball knowledge, self-efficacy, or any of the performance measures (quality, confidence, or response time) on the option-generation and decision-making performance tasks. The MANOVA indicated that the two orders were significantly different on only one factor: option-generation response time, $F(1, 68) = 7.49, p = .008$. Specifically, participants in Order B (who performed the decision-making performance task first) responded 0.27 s faster than those in Order A. However, this difference was relatively small and only occurred on one variable. Thus, it was deemed appropriate to combine data from both groups for further data analyses.

Primary Analyses

Option-Generation Hypothesis 1: Participants will choose the first option generated as the best decision in more than half of the trials.

Participants' use of TTF was evaluated by two separate analyses. The first simply calculated the frequency with which participants chose their first option as their final decision during the option-generation phase. On 658 out of 910 total trials, participants made their final decision in concordance with their first option. In other words, participants used TTF on 72.3% of the option-generation trials. A closer inspection of frequency of use of TTF according to gender indicated males used the heuristic (80.0%) more often than did females (66.0%). However, on average, both male and female participants used TTF on a majority of the trials.

A second between-persons analysis was also used to evaluate the prevalence of TTF. For this analysis, one group's most frequently cited first option in the option-generation task was compared to the frequency with which that same option was used by the other group in the decision-making task. For example, on Situation 1 the most popular first option stated by participants in Order A was "shoot". A total of 21 out of 38, or 55.3%, of the participants gave this answer. If participants in Order B used the TTF heuristic when performing the decision-making performance task, it should be expected that the percentage of participants stating "shoot" would be similar to the results of Order A (55.3%). For this situation, the ratios were relatively close, as 68.8% (22 out of 32) of Order B participants decided that "shoot" was the best option. Across all option-generation trials, the most popular answer for each trial was given 594 out of 988 times (60.1%). Likewise, Order A participants stated those same options 58.3% of the time (485 out of 832).

It is also interesting to note that the most popular answer given during the option-generation phase corresponded with the most popular answer cited in the decision-making performance task on 22 out of 26 trials (84.6%). A chi-square test of independence, based on a 2 x 2 contingency table, was used to statistically compare the proportion of responses in Order A with those in Order B. The results suggested that the two groups did not differ in their responses, χ^2 (1, N = 70) = .63, p = .43. The overall percentage of trials on which participants chose the first option in the option-generation phase (72.3%) combined with the congruence between first options in the option-generation task with that of those decisions being made in the decision-making performance phase suggest that participants often relied on the TTF heuristic when making decisions in dynamic, time pressured sporting environments.

Option-Generation Hypothesis 2: Option quality will be negatively related to serial position.

Another major proposition of the TTF heuristic is that the quality of an option will decrease as serial position increases. An inspection of the raw means supports this consistent decrease in option quality, as earlier options (i.e., first and second) were of higher quality than later ones (i.e., fourth and fifth). See Table 4 for the means and standard deviations for option quality at each serial position. In order to statistically compare option quality based on the order in which it was generated, a one-way ANOVA was conducted. In this analysis, option quality was the dependent variable with serial position serving as the group factor. Results of the ANOVA suggested significant group differences, $F(4, 1802) = 47.24, p < .001, \eta^2 = .10$, so post hoc tests were used to identify these differences. As the number of options at each position varied a tremendous amount (910 first options, 8 fifth options) and there was heterogeneity of variances (Levene's statistic [4, 1802] = 17.30, p <.001), the Games-Howell statistic was used for post hoc analyses. As illustrated in Table 5, the post hoc tests revealed that the first option was significantly better than all other options, except the fifth. Similarly, the second option was significantly better than the third and fourth options, while the third option was of greater quality than the fourth option. It is important to point out that the fifth option was not significantly different from any other options, but that is most likely due to low number of options that were generated in that position. Out of 910 option-generation trials, there were only 8 occasions on which participants generated five different options. A simple inspection of the means, as well as the results of the one-way ANOVA, supports the second hypothesis. However, the effect was rather small ($\eta^2 = .10$).

Option-Generation Hypothesis 3: As the number of generated options increases, the likelihood that the first option will be chosen decreases.

According to TTF, dynamic inconsistency, or the incongruence between the first option and final decision, increases with the number of options a person has to choose from. In other words, the more options a person generates, the less likely that he or she will select the first option as the final decision. A one-way ANOVA was used to compare participants' use of TTF based on the number of options generated. Results indicated overall significant differences, $F(4, 905) = 65.33, p < .001$. However, this effect was small, $\eta^2 = .22$. According to the Games-Howell post hoc test, the only significant differences in dynamic inconsistency were found on situations in which only one option was generated (see Table 6). Therefore, when participants generated only one option, they had significantly lower rates of dynamic inconsistency than when they generated two or more options. This finding makes intuitive sense, as a person simply must choose the first option if that is the only one that they have generated. Based on the post hoc tests, the significant results of the ANOVA should be interpreted cautiously. These findings provide limited support for the hypothesized dynamic inconsistency of TTF.

Option-Generation Hypothesis 4: Confidence in final decision will be negatively related to the number of options generated.

The fourth hypothesis is based on Johnson and Raab's (2003) assertion that a decrease in confidence may be an underlying mechanism for dynamic inconsistency. Based on this assertion, it would be expected that decision confidence would decrease as the number of options generated increased. The raw means demonstrate a relatively consistent decrease in decision confidence. For instance, participants were most confident in their decisions when they generated only one option (M = 8.36, SD = 1.72) and expressed the lowest confidence when four different options were generated (M = 7.28, SD = 1.78). The one way ANOVA used to evaluate these means revealed significant differences in decision confidence, $F(4, 905) = 14.01, p < .001$. However, this effect was very small, $\eta^2 = .06$. Similar to the results on the previous hypothesis regarding dynamic inconsistency, post hoc analyses revealed that confidence was significantly different on situations where one option was generated as compared to situations where two or more options were generated (see Table 7). Accordingly, participants had higher confidence when they came up with only one option than when they generated multiple options. However, confidence did not continue to decrease as more options were generated. In other words, participants' decision confidence was statistically equivalent on situations where they came up with two alternatives as when they generated five options. Thus, Hypothesis 4 was partially supported.

Option-Generation Hypothesis 5: On average, participants would make better choices if they only generated one option.

This hypothesis tested one of the central tenets of TTF: less is more. Based on the heuristic, it is beneficial to stop option generation in the early stages, as the earlier an option is generated, the higher the quality of the option. Accordingly, this hypothesis sought to compare the quality of the first option with the quality of the final decision. Simply in terms of means, the average final decision (M = 2.94, SD = 0.48) was of slightly higher quality than participants' first option (M = 2.71, SD = 0.55). The paired t-test indicated that this difference was significant, $t(69) = 5.75, p < .001$ and that the effect was moderate-to-large, *Cohen's d* = .69. Moreover, separate t-tests by gender suggested that difference between the first and final options was significant in both males, $t(33) = 3.78, p = .02$, and females, $t(35) = 4.71, p < .001$. Further inspection of the data suggested that the difference was based on participants making a positive switch. Throughout the study, there were 252 instances where participants did not choose the first option as their final decision. In 161 of those cases, participants switched from a poor first option to a better final decision. Conversely, participants switched from a good first option to a poor final decision on only 84 occasions. Option-Generation Hypothesis 5 was not supported.

Option-Generation Hypothesis 6: Decision-making self-efficacy will be positively related to final decision quality.

This hypothesis tests the notion that self-efficacy will predict quality of the final decision. The correlation between the variables (r = .48) suggests that self-efficacy is positively related to decision quality on the option-generation task. However, in order to get a more detailed understanding between efficacy and decision quality, it is necessary to control for variables that might influence participants' decision quality. In this study, variables expected to influence quality, speed, and confidence of decisions were basketball knowledge and years of competitive basketball experience. Thus, a hierarchical regression, with years of competitive basketball experience and basketball knowledge entered at Step 1 and self-efficacy at Step 2, was conducted. Results of this analysis indicated that self-efficacy was a significant and positive predictor of final decision quality on the option-generation task, $\beta = .27$, t(66) = 2.40, $p = .019$, after controlling for the effects of competitive experience ($\beta = .10$, $t(66) = 0.91$ $p = .366$) and basketball knowledge ($\beta = .374$, $t(66) = 3.22$, $p = .002$). The overall model predicted 37% of the variance in option-generation decision quality. Accordingly, self-efficacy accounted for an additional 6% of the variance in final decision quality, R^2 change = .06, $F(1, 66) = 5.75$, $p = .019$. Hypothesis 6 was supported.

Option-Generation Hypothesis 7: Decision-making self-efficacy will be negatively related to option-generation speed, in which higher efficacy beliefs will predict faster generation speeds.

This option-generation hypothesis examined the predictive validity of self-efficacy on option-generation speed. First, the correlation between self-efficacy beliefs and speed of option-generation were examined. Self-efficacy and option-generation speed were not significantly related ($r = -.21$, $p = .075$). Likewise, the hierarchical regression, controlling for competitive playing experience and basketball knowledge, also indicated that self-efficacy was not a significant predictor of speed of option-generation, $\beta = -.11$, $t(66) = -0.81$, $p = .42$. These results did not support Option-Generation Hypothesis 7.

Option-Generation Hypothesis 8:Decision-making self-efficacy will predict the confidence in final decision.

The relationship between decision-making self-efficacy and decision confidence on the option-generation task was examined by correlations and a hierarchical regression analysis. Based on the correlation, self-efficacy was significantly and positively related to decision confidence (r = .69, p <.001). Next, a hierarchical regression was conducted to examine if self-efficacy beliefs predicted decision confidence in the option-generation phase after controlling for competitive playing experience and basketball knowledge. The regression indicated that self-efficacy was a positive and significant predictor of decision confidence in the option generation phase, β = .67, t(66) = 6.49, p < .001. This model predicted almost half of the variance in decision confidence on the option generation task, R^2 = .48. Self-efficacy beliefs accounted for a significant amount of additional variance in option-generation confidence, R^2 change= .33, F(1, 66) = 42.13, p < .001. In other words, self-efficacy predicted 33% of the variance in decision confidence after controlling for playing experience and knowledge. Thus, Hypothesis 8 was supported.

Option-Generation Research Question 1: Does self-efficacy predict the use of TTF heuristic?

Point biserial correlations suggested that self-efficacy was significantly related to use of TTF, r = .46, p < .001. Hierarchical regression analysis was used to further investigate. Once again, competitive playing experience and basketball knowledge were entered as control variables in Step 1 of the analysis and self-efficacy beliefs served as the only predictor variable in Step 2. After controlling for experience and knowledge, self-efficacy was shown to be a significant predictor of TTF, β = .39, t(66) = 3.11, p = .003, accounting for 11.2% of the variance, F(1, 66) = 9.66, p = .003. Accordingly, higher perceptions of self-efficacy were associated with choosing the first option more often than lower capability beliefs.

Option-Generation Research Question 2: Does self-efficacy predict the number of options generated?

The predictive validity of self-efficacy on the average number of options generated was explored via bivariate correlations and hierarchical regression analysis. The correlation between efficacy beliefs and the number of options generated was not significant, $r = -.20, p = .105$. However, the hierarchical regression suggested that, after controlling for competitive playing experience and basketball knowledge, self-efficacy was a significant, negative predictor of the number of options participants generated, $\beta = -.35$, $t(66) = -2.67, p = .01, R^2 = .09$. These results demonstrate that higher efficacy beliefs were associated with fewer generated options.

Decision-Making Performance Hypothesis 9: Decision-making self-efficacy will be positively related to decision-making quality.

This hypothesis examined the relationship between decision-making self-efficacy and decision quality on the decision-making performance task. The bivariate correlation between the variables ($r = .36$) revealed that self-efficacy was positively related to decision quality. As in the above analyses, a hierarchical regression analysis was used to examine the relationship between efficacy and decision quality, after controlling for the effects of basketball knowledge and competitive basketball playing experience. Self-efficacy was not a significant predictor of decision quality on the decision-making task, $\beta = .12$, $t(66) = 1.04, p = .301$, after controlling for the effects of competitive experience ($\beta = .07$, $t(66) = 0.57, p = .570$) and basketball knowledge ($\beta = .45$, $t(66) = 3.69$ $p < .001$). Therefore, this hypothesis was not supported.

Decision-Making Performance Hypothesis 10: Self-efficacy will be positively related to decision-making speed.

Similar to decision quality, it was predicted that self-efficacy would be significantly and positively related to decision-making speed. The relationship between self-efficacy and decision speed was evaluated by a hierarchical regression analysis, with years of competitive basketball playing experience and basketball knowledge controlled for at Step 1. According to this analysis, self-efficacy beliefs were not significantly related to decision speed on the decision-making task, $\beta = -.21$, $t(66) = -1.73$, $p = .089$, after controlling for the effects of competitive experience ($\beta = .09$, $t(66) = 0.75$, $p = .455$) and basketball knowledge ($\beta = -.39$, $t(66) = 3.08$, $p = .003$). It is worth noting that the self-efficacy-decision speed relationship was approaching significance ($p < .10$) and was in the predicted, negative direction. Decision-making performance hypothesis 10 was not supported.

Decision-Making Performance Hypothesis 11: Self-efficacy will be positively related to decision confidence on the decision-making performance task.

It was also hypothesized that self-efficacy beliefs would be a significant and positive predictor of decision confidence. The correlation between the two variables supported this relationship ($r = .70$). Further exploration of this relationship was examined using hierarchical regression analysis. After controlling for experience ($\beta = -.08$, $t(66) = -0.80$, $p = .42$) and knowledge ($\beta = .08$, $t(66) = 0.74$ $p = .46$), self-efficacy was a significant predictor of decision confidence on the decision-making performance task, $\beta = .69$, $t(66) = 6.74$, $p < .001$. Self-efficacy beliefs accounted for an additional 35% of the variance in decision confidence, $F(1, 66) = 45.42$, $p < .001$. Thus, this hypothesis was supported.

Decision-Making Performance Research Question 3: Do participants who have a high tendency to use TTF make better decisions than those who have a low tendency to use TTF?

In order to evaluate this research question, participants were split into two extreme groups based on their TTF score. The low TTF group was defined as those participants whose TTF score (i.e., frequency) was in the lowest one-third of all study participants. Participants in the low TTF group ($n = 21$) chose the first option between 3 and 8 times. Conversely, the high TTF group included participants whose TTF scores were in the top one-third of all performers. Twenty-seven participants were grouped into the high TTF category and used TTF at least 11 times out of the 13 trials. As this question related to high and low use of TTF, data from the 21 participants in the moderate TTF group were omitted. A one-way ANOVA was used to examine differences between high and low TTF participants on the quality of decisions made on the decision-making performance task. While the mean decision-making performance of high TTF participants ($M = 3.10$, $SD = 0.58$) was slightly higher than that of the low TTF participants (M = 2.86, $SD = 0.50$), the ANOVA failed to find significant group differences, $F(1, 47) = 2.40, p = .13$.

Decision-Making Performance Research Question 4: Do participants who have a high tendency to use TTF make faster decisions than those who have a low tendency to use TTF?

As in the previous research question, participants were split into low TTF ($n = 21$) and high TTF ($n = 27$) groups. The decision speed of the two groups was compared using a one-way ANOVA. Results suggested that there were significant differences between high and low TTF participants, $F(1, 47) = 6.22$, $p = .016$, *Cohen's d* = .73. Specifically, high TTF participants responded .71 s faster than participants who had a low tendency to use TTF.

Decision-Making Performance Research Question 5: Are participants who have a high tendency to use TTF more confident in their decisions than are those who have a low tendency to use TTF?

This research question was evaluated by a one-way ANOVA in which use of TTF, high or low, served as the between-subjects factor and decision confidence represented the dependent variable. The ANOVA revealed that high and low TTF participants reported significantly different levels of decision confidence, $F(1, 47) = 9.74$, $p = .003$. Specifically, high TTF participants expressed higher confidence ($M = 8.32$, $SD = 1.31$) in their decisions than did low TTF participants ($M = 6.99$, $SD = 1.66$). Additionally, this effect was quite large, *Cohen's d* = .92. However, an ANCOVA indicated that decision confidence did not significantly differ between the high and low TTF groups after controlling for gender, $F(1, 47) = 3.35$, $p = .074$. While not significant at the desired alpha level, this result was approaching significance ($p < .10$).

CHAPTER 5

DISCUSSION

The TTF heuristic was proposed as a tool to understand how people generate options and subsequently choose the best decision from among those options in familiar, yet ill-defined situations. While early research has provided some support for TTF, there is much more that needs to be understood and tested about the heuristic. Therefore, the purpose of this study was to provide a rigorous evaluation of the major propositions of TTF and to explore the influence of self-efficacy on TTF and decision-making in sport. This chapter discusses the findings of the current study, identifies practical implications of these results, and outlines future research directions.

Take the First and Option-Generation

The results of this study support many of the predictions made by the TTF heuristic. First, participants frequently used TTF, as they chose the first option on over 70% of the trials. This finding is similar to previous results, which indicated that people used TTF approximately 60% of the time (Johnson & Raab, 2003; Raab & Johnson, 2007). Likewise, the between-subjects analysis also supported participants' high use of TTF. The frequency with which participants used TTF was somewhat higher in the current study than reported in previous research. One explanation for the different rates of TTF may be related to the study participants. Participants in the current study were undergraduate and graduate students who had at least 1 year of competitive experience. For many of these participants, this experience may have been when they were very young (e.g., elementary school) and they may not have participated in organized basketball for quite some time. However, the Johnson & Raab (2003) sample comprised current adolescent male handball players. It is possible that, as current sport participants, these athletes may have viewed the test as an opportunity to improve their strategic decision-making skills. Thus, they may have had more incentive to do well on the task and may have taken a more critical, analytical approach to making their decisions. However, the participants in the current sample were no longer participating in competitive basketball and were not likely looking to use this experience as an opportunity to improve their skills. As a result, they may have simply been content to choose their first option because they assumed that it would be at least somewhat acceptable. Based on the combined findings, it can be concluded that people often "go with their gut" when making decisions in dynamic, time-pressured situations in sports environments.

A second proposition of the TTF heuristic that was supported in this study was the inverse relationship between option quality and serial position. Based on the original conceptualization of the heuristic, option-generation occurs in a meaningful, sequential fashion in which better options are generated first. The results of this study confirm this hypothesis, as earlier options were of higher quality than later ones. In this manner, the first option was, on average, the best option, with the second option representing the next best decision. However, the fourth option, as opposed to the fifth option, was found to be the poorest option. Likewise, the fifth option was not statistically different than any of the other positions, including the first. This finding is likely due the very low number of fifth options that were actually generated. Out of the 910 possible trials, participants only generated 8 options in the fifth position. With such a small number of instances, one must be cautious when interpreting the statistical results regarding the fifth option. The finding that option quality decreased with serial position supports Johnson and Raab's (2003) contention that options are not randomly generated. Rather, options are generated in a meaningful order, likely determined by the strength of the connection within the associative network. This meaningful, sequential order of option-generation can be used to explain why option quality decreased according to serial position.

Another aspect of TTF that was investigated in the option-generation task was dynamic inconsistency. According to the TTF heuristic, dynamic inconsistency, or failure to choose the first option, increases with the number of options that are generated. Upon first glance, it would appear that the results of this study suggested that there were differences in dynamic inconsistency based on number of options participants generated. While the overall results of the ANOVA suggested significant differences, η^2 revealed that the effect was small. Moreover, the post hoc tests revealed that dynamic inconsistency was only different for the first option. In other words, when participants generated more than one option they were more likely to choose an option other than the first one than when they only came up with one choice. This finding is not surprising considering that a person must choose the first option when it is their only choice. However, there were no differences in dynamic inconsistency when participants came up with two, three, four, or five options. Thus, participants who came up with only two options were no more or less likely to TTF than were those who generated five different choices.

This finding is in contrast to the heuristic and previous research (Johnson & Raab, 2003; Raab & Johnson, 2007). The previous results may be different due to the way in which the data were analyzed. Linear regression was used to analyze the results of these previous studies. As the articles make no mention of omitting any data, it can be assumed that the regression included instances in which only one option was generated. These instances, which force participants to TTF, would have a powerful impact on the results by presenting a somewhat misleading positive relationship between dynamic inconsistency and number of options. The results from the Johnson and Raab studies could be considered misleading because the relationship may not hold true except in cases when only one option was generated. Therefore, it is important to consider the differences in the manner in which the data were analyzed and interpreted when comparing the results of the current study with previous findings.

Another possible explanation for the present study's finding is that the participants may not have really considered the other options, but simply generated those options because of the experimental conditions. For example, simply knowing that the researcher would see their answers may have made participants feel pressured to come up with several alternatives. In other words, participants may have felt that it would look bad if they only came up with one option, so they cited other options in order to please the researcher. However, these additional options may have never been seriously considered as potential choices for the best decision. Rather, participants may have already known that the first option was the best, but they just wrote down a few other options to give the false impression that they were contemplating other alternatives.

According to Johnson & Raab (2003), dynamic inconsistency may be related to one's confidence. Specifically, they state that people may be less likely to choose the first option after generating subsequent ones because they lose confidence that the first one is actually the best. While the current study did not measure confidence in the first decision, it did examine confidence in the final decision. By extending the logic presented in

Johnson & Raab (2003), it could be assumed that having more options to choose from would reduce one's confidence in his or her final decision. Initial results indicated that there were differences in confidence based on the number of options generated. Participants were more confident in their final decisions when they only generated one decision. However, generating two, three, four, or five options made no impact on participants' confidence. These findings combined with the small effect size suggest that confidence plays at least a minor role in dynamic inconsistency. However, it does not appear to have a significant impact beyond the second option. Similar to the explanation offered above, this could be because the participants did not really view the other options as serious contenders for the best decision; therefore, those additional choices did not affect confidence in their final decision.

A major facet of TTF is the notion that participants can make better decisions simply by going with the first idea that springs to mind. In other words, choose the first option because generating more than one choice only serves to hurt the quality of the final decision. As was discussed earlier in this chapter, Option 1 was better than any of the other options, on average. However, results indicated that the average final decision was significantly better than the average first decision. This suggests that on situations when participants did not TTF, the switch had a positive impact on decision quality. In fact, out of the 252 trials on which participants did not TTF, switching from the first option to the final decision proved to be beneficial on 161 of those occasions. The switch was considered beneficial because it increased decision quality by switching from a poor first option to a good final decision. Conversely, participants made a poor switch, from a good first option to a poor final decision, 84 times.

This finding contradicts previous results by Johnson & Raab (2003). These researchers reported that participants in their study would have done better, on average, if they had only generated one possibility. In other words, the average first option was better than the average final option. Moreover, these researchers reported that participants predominantly switched from a good first option to a poor final decision. It is worth mentioning that the Johnson and Raab study did not look at the quality of each option, but rather at the frequency of responses rated as "appropriate". Therefore, "appropriate" options were more frequently cited as the first option as compared to the final decision. However, this does not account for different levels of "appropriateness". The scoring system employed by Johnson and Raab did not differentiate between those responses that were simply adequate and those that were very good, or even the best. Perhaps if the researchers had employed an interval scale, not a dichotomous scoring system, they would have found results similar to the current study.

Another explanation as to why the studies may have yielded different findings is related to the participants. As was discussed earlier in this chapter, previous research on TTF involved current athletes; whereas, the present sample consisted of athletes who were no longer participating in organized, competitive basketball. Likewise, it is possible that some participants had not played basketball in several years. This prolonged period of inactivity in the sport could have had a negative impact on the intuitive decision-making capabilities of study participants. In other words, the participants may have been a little "rusty" and it took them a few tries to generate the best answer. Accordingly, the findings of the present study suggest that while it may be best to TTF most of the time, there are instances when it can be beneficial to choose another option.

Self-Efficacy and Option-Generation

The current study also examined the influence of self-efficacy on various aspects of the option-generation task. First, the relationship between self-efficacy and decision quality in the option-generation phase was explored. Consistent with previous research on self-efficacy and decision-making (Bandura & Wood, 1989; Hepler & Feltz, 2008), efficacy beliefs were positively associated with decision quality in the option-generation task. Accordingly, participants with higher efficacy beliefs made better decisions than did participants with lower efficacy beliefs. This finding is not surprising, as the relationship between self-efficacy and performance has been consistently supported by theory and previous research (Bandura, 1997; Moritz, Feltz, Farbach, & Mack, 2000).

Furthermore, the relationship between self-efficacy and speed of option-generation was also investigated. In sport, superior decision-making performance can be conceptualized as making good decisions quickly. Likewise, failure can result from making a poor decision (e.g., taking a bad shot) or from making a good decision too slowly (e.g., waiting too long to pass to an open teammate, allowing the defense to intercept the pass). In this manner, decisions must be of high quality and high speed. As self-efficacy is purportedly related to performance, and speed is a key aspect of decision-making performance in sport, it was expected that self-efficacy would predict speed of option-generation. However, self-efficacy was not significantly related to the speed with which participants generated the first option. One reason why self-efficacy did not predict response time may be the time-pressure utilized in the option-generation task. The purpose of the time pressure was to serve as an incentive for participants to give their intuitive first responses. However, this time-pressure may have forced some participants, particularly those with low efficacy beliefs, to respond quicker than normal. This idea is supported by the fact that participants responded approximately 1 s faster on the option-generation task than they did on the decision-making performance task. Therefore, the time-pressure used in the option-generation task may have eliminated the influence of self-efficacy on option-generation speed.

In addition to decision quality and option-generation speed, the study also explored the link between self-efficacy and decision confidence. Intuitively, it makes sense that people who feel more confident in their decision capabilities would ultimately express more confidence in their final decisions. Indeed, self-efficacy was positively related to decision confidence. Participants with higher efficacy beliefs were significantly more confident than were participants with lower ability perceptions. This suggests that general capability beliefs extend to situation-specific confidence.

A particularly unique contribution of the current study was the investigation of the relationship between self-efficacy and participants' use of TTF. This research question was based on the assertion that efficacy beliefs are related to analytic strategies (Bandura, 1997; Wood, Bandura, & Bailey, 1990) and heuristics (Wood et al., 2000). However, there are no published studies that have examined the link between self-efficacy and the TTF heuristic. As predicted, self-efficacy was a significant and positive predictor of TTF. Accordingly, higher efficacy beliefs were associated with more frequent use of TTF as compared to lower capability beliefs. Bandura and Wood (1989) suggest that high efficacy beliefs facilitate efficient cognitive functioning by allowing people to focus their full attention and energy on analyzing and solving problems. Conversely, people with low efficacy beliefs are often distracted from the task at hand by thoughts of personal shortcomings, fear of evaluation, and visions of failure; thereby impairing cognitive capabilities. Results of the current study lend support for this assertion, as high efficacy individuals relied on TTF more than low efficacy individuals. Some people may view TTF as a very risky strategy because it represents intuitive decision-making, as opposed to logical, rational, and deductive decision-making. Therefore, using TTF requires a person to have a great deal of confidence in his or her abilities and leaves no room for second-guessing or fear of failure. In the case of TTF, it is possible that feelings of efficaciousness allow people to trust their instincts more than people with lingering self-doubts. This finding is important because it establishes a clear, empirical link between efficacy beliefs and the use of judgmental heuristics.

The final purpose related to self-efficacy and option-generation examined the number of options generated. According to Bandura (1997, p. 216), "if self-efficacious individuals find solutions readily, they have no need to persist". In other words, when people who have a firm belief in their capabilities generate a desirable first option, there is no reason to think of additional alternatives. Thus, it was predicted that self-efficacy would be negatively related to the number of options generated. Results of this study supported this hypothesis, as high efficacy beliefs were associated with fewer options than were low efficacy beliefs. Similar to the previous discussion, it is possible that people with high self-efficacy beliefs simply trust their first options more than those with lower perceptions of efficacy. Therefore, they do not feel it necessary to come up with alternative choices because they believe that their first option represents a desirable course of action.

Self-Efficacy and Decision-Making Performance

Similar to the option-generation phase, the relationship between self-efficacy and decision quality, speed, and confidence on the decision-making performance task were investigated. Unlike the results of the option-generation task, self-efficacy was not a significant predictor of decision quality in the decision-making performance phase, after controlling for competitive basketball playing experience and basketball knowledge. Not only is this inconsistent with the results in the option-generation phase, but it is also contrary to the predictions of self-efficacy theory and previous research findings. It is important to note that self-efficacy, by itself, is significantly and positively related to decision quality.

These results may be related to the role of basketball knowledge and competitive playing experience, as well as the nature of the two experimental tasks. As can be seen from the results of the statistical analyses and the raw correlations, basketball knowledge and previous playing experience were important factors in influencing decision quality on both the option-generation and decision-making performance tasks. Likewise, both of these factors were significantly correlated with self-efficacy. Thus controlling for knowledge and experience in the hierarchical multiple regression likely removed a large amount of common variance in decision quality. This type of statistical control may have been more influential on the decision-making performance task than on the option-generation task due to the amount of time participants had to make their decisions. In the option-generation task, participants were allowed up to 45 s to generate various options and choose among them. During this deliberation, it is likely that participants took into consideration their perceived decision-making capabilities. In particular, 45 s is a long time to sit and think about one's decision-making deficiencies and may have made them more susceptible to doubt their first top choice and pick a different option as the best decision. So, this prolonged decision time may have allowed self-efficacy beliefs to exert a stronger influence on performance. Conversely, the decision-making performance task required participants to make a final decision rather quickly. On average, participants made those decisions in less than 3 s. This may have been such a short time that self-efficacy beliefs were not able to exert a powerful enough influence that could be detected after removing the effects of competitive playing experience and basketball knowledge. Perhaps when quick decisions must be made, decision-making self-efficacy exerts its influence on the execution of that decision, rather than on the actual decision itself. In other words, low self-efficacy may make a person hesitate when executing their decision (e.g., pass to Player B) whereas high ability perceptions allow a person to act without hesitation. Thus, one should not interpret these results as self-efficacy had no influence on decision quality. Rather, that self-efficacy did not exert a detectable influence when controlling for other pertinent variables such as knowledge and playing experience.

Another possible explanation for this relationship could be related to a discrepancy between initial ratings of decision-making self-efficacy and efficacy beliefs while performing the decision-making performance task. While participants did not receive any feedback, it is possible that their efficacy beliefs changed throughout the course of the study, particularly during the decision-making performance task. For instance, it was not uncommon on the decision-making performance tasks for participants to state one answer and then ask if they could change their answer. In other words, they doubted their decision and that doubt served as a source of perceived performance feedback. Based on their perceived performance, participants' self-efficacy beliefs may have changed during the course of the study. Accordingly, the initial self-efficacy measure would no longer be an accurate predictor of performance. A key factor to keep in mind is that this same type of self-doubt probably did not exist on the option-generation task because participants were allowed an extended period of time to make their decisions. In fact, participants were slightly more confident in their decision on the option-generation task (M = 7.81) than they were on the decision-making performance task (M = 7.68). However, this difference was not significant (p = .14).

Similarly, self-efficacy was also not a significant predictor of decision-making speed, after controlling for the influence of playing experience and knowledge. This finding is congruent with the results regarding the option-generation task. However, it should be mentioned that this relationship was marginally significant (p < .10). Moreover, the correlation between the two variables was also significant. Perhaps with a larger sample size, this relationship would have been statistically significant.

Finally, self-efficacy was also found to be a positive predictor of confidence in one's decision. This result, which is in accordance with what was found on the option-generation task, suggests that participants with high self-efficacy are more confident in their final decisions than are participants with low efficacy beliefs. Once again, this supports the notion that confidence in one's abilities extends to confidence in one's decisions. This could have important implications in sport, as it is likely that a confident decision about what move to make next will produce quick, distinct actions. Confident, resolute action is a key ingredient to success, because a moment of hesitation or self-doubt can result in a disastrous outcome.

Take the First and Decision-Making Performance

An important aspect in evaluating the TTF heuristic is to determine if using the rule helps improve decision-making performance. A key element to decision-making performance is the quality of the decision. Previous research, as well as the option-generation phase of the current study, has supported the link between TTF and decision quality. However, the way in which decision-making was examined in these tasks was rather artificial. Previously, participants were asked to watch a video scenario, state the first intuitive option, generate other options, and finally choose one of the options as the best decision. Additionally, these actions were performed serially, not simultaneously. Participants may have spent many seconds or even a few minutes completing these tasks. In real-world settings, such as those in sports, people are required to do all of these tasks in an instant. Therefore, the decision-making performance task in the current study was designed to be more realistic, as participants were put in a situation and asked to make a decision. Unlike previous findings involving option-generation tasks, results of the decision-making performance task found that participants who had a high frequency of choosing the first option did not make better decisions than did participants who used TTF less frequently. This finding suggests that using TTF does not produce higher quality decisions on realistic tasks not requiring explicit option-generation.

One possible explanation for this result relates to the TTF groups themselves. The TTF groups, which represented the one-third most frequent and least frequent users of TTF, were created based on the results of the option-generation task. A main assumption was that participants would continue to follow the same pattern during the decision-making performance task. However, participants may have changed how much they relied on TTF. For instance, participants in one or both groups may have regressed closer to the mean. In this manner, participants in the low TTF group may have became more frequent users of TTF or those in the high TTF group may have used TTF less often. The results of this study would have been significantly influenced if participants changed their use of TTF. However, based on the study design, it is not possible to determine whether or not participants continued their same pattern of use of TTF.

While the high and low TTF groups did not differ on decision quality, there were significant differences on another aspect of decision-making performance: decision speed. Participants with a high tendency to TTF made their decisions significantly faster than low TTF participants. Furthermore, the effect size of TTF on decision speed was moderate-to-large (*Cohen's* $d = .73$). This finding is likely related to the number of options generated. Participants in the high TTF group may typically only generate one option, as one choice is all that is really necessary. However, on trials when participants did not TTF, then they must have generated at least one additional alternative. Thus, it would take more time to generate multiple options and choose among them than to generate and choose one single option. Results from the option-generation phase support this contention, as participants in the high TTF group generated fewer options ($M = 1.79$) than did participants who had a low TTF frequency ($M = 2.29$). This finding suggests that using the TTF heuristic can be advantageous for decision-making by decreasing their decision response time.

The final research question evaluated differences in decision confidence. Results of an ANOVA suggested that high TTF participants were more confident in their decisions than were low TTF participants. However, after controlling for gender, these differences became only marginally significant ($p < .10$). There are two possible explanations for this finding. The first is related to the number of options generated. As mentioned above, it is likely that participants who frequently used TTF generated fewer options than participants who did not use TTF very often. Generating more options may have made participants feel less certain in their final decision. Differences in self-efficacy could also explain the different levels of decision confidence between the two TTF groups. Results of this study found that self-efficacy has a strong relationship with decision confidence. Upon inspection of the average self-efficacy beliefs of the two TTF groups, the high TTF group was discovered to have much higher self-efficacy beliefs (M = 7.70, SD = 1.18) than participants in the low TTF group (M = 5.79, SD = 1.58). Consequently, group differences on decision confidence may have been due to group differences on self-efficacy.

Gender Differences

Another aspect of this study that warrants discussion is the issue of gender differences. Preliminary analyses revealed that males and females differed on many pertinent study variables. For instance, females scored lower on the basketball knowledge test, had lower perceptions of decision-making self-efficacy, used TTF less, and had lower confidence in their decisions than did male participants. These results may be related to differences in experience playing and watching basketball. There were no differences between men and women on years of competitive experience or on number of years at various competitive levels (e.g., junior high, high school varsity). However, there were significant differences on years of recreational experience, $F(1, 68) = 17.98$, and average number of hours spent watching basketball per week, $F(1, 68) = 6.87$. Specifically, males had more years of recreational basketball playing experience (M =

8.71, $SD = 5.78$) and watched more basketball ($M = 4.34$) than did females ($M = 3.54$, $SD = 4.25$; $M = 2.49$; $SD = 2.70$). Basketball viewing habits reflected participants' current behavior. Moreover, it is also likely participants' recreational basketball experience may have represented their most current basketball playing experience. Only 22 (12 females, 10 males) of the 70 participants played high school varsity basketball. As males reported rather extensive recreational playing experience, it is likely that they continued to play basketball even after they stopped playing competitively. Additionally, it is important to understand that watching basketball and playing the sport recreationally can have a significant influence on decision-making capabilities and ability perceptions. So, the gender differences observed in this study may simply be related to more extensive and more recent experiences with the sport of basketball.

Implications

A critical step in changing or improving behavior is to understand how and why the behavior occurs. In terms of decision-making, it is important to understand how people make decisions. In conjunction with previous research, the present study has helped to shed light on how athletes make decisions in sport. First, this study helped reveal that not only do people use the TTF heuristic to make decisions in dynamic, time pressure situations, but also that TTF can be advantageous to decision-making performance (i.e., decision speed). This finding suggests that it is important for experienced athletes to learn to trust their gut instincts when making decisions in sport. Coaches can play an influential role in this process by providing positive feedback, discouraging second-guessing, and teaching athletes what decisions are best in different situations. This last aspect, training correct intuitive responses, is a key aspect because learning to trust one's gut would only be advantageous if those first intuitive responses were of high quality. Simulation training, including video and real-life situations, could be used as an important teaching tool to better develop athletes' decision-making capabilities. This type of training could be particularly useful for athletes who play key decision-making positions, such as quarterback, point guard, shortstop, setter, or goal keeper. Decision training would help to strengthen the connections among high quality options within the associative network; thereby, facilitating the generation of high quality first options.

Moreover, results indicated that self-efficacy plays an important role in decision-making and in the use of TTF. Thus, it would be beneficial to build the decision-making self-efficacy beliefs of athletes. A few techniques that might be particularly effective at enhancing decision-making efficacy beliefs are simulation training, guided practice, and modeling. Simulation training, as mentioned above, could include real-life simulations or video presentations. Real-life simulations would involve physical practice of various situations. Many coaches commonly use simulations, such as practicing three-on-two fast break situations, in their practices. However, more frequent simulation practice involving a more diverse array of situations could help increase athletes' efficacy beliefs. Video simulation training typically involves game and practice footage, but could also include cutting-edge technologies such as virtual reality or video games. In this type of simulation training, athletes can practice making decisions in almost any type of situation. In guided practice, a coach, or other knowledgeable authority, would walk athletes through various situations and explain why specific decisions would be good or bad. This type of training would not only increase self-efficacy, but also help to develop athletes' situation-specific knowledge and strengthen connections of the best options in the associative network. Modeling could be a useful technique by allowing athletes to observe the effective decisions made by other players. For a more complete discussion on efficacy-enhancing techniques in sport, see Feltz, Short, & Sullivan (2008).

Future Research Directions

The findings of this study suggest that TTF is an important heuristic in sport and that self-efficacy beliefs play an influential role in TTF and decision-making. However, TTF is a relatively new construct which has not yet been studied extensively. There are several new directions in which future research could help enhance our understanding of TTF and self-efficacy in sport decision-making. First, future research should try to identify the situations on which people do and do not use the TTF heuristic. According to research, people use the heuristic 60-70% of the time. But why do people not rely on the rule 100% of the time? Are there specific conditions or situations where people do not use TTF? Moreover, what are the common elements of the 60-70% of the cases in which people do TTF? This research could also advance our understanding of heuristics by identifying the rule(s) people use when they do not TTF. Future research should try to identify those factors which influence whether or not a person chooses the first option. For instance, there is some research to suggest that pressure can influence a person's use of specific problem-solving strategies (Beilock & DeCaro, 2007). Accordingly, different levels of anxiety may affect a person's tendency to TTF.

The type of task is another factor that could also be explored in the future. Research should examine TTF in the context of open and closed, interdependent and independent, and gross and fine motor skills. This research would help researchers better understand who uses TTF, how often they use TTF, and what sports TTF is advantageous (i.e., better and/or faster decisions). Likewise, research should also examine option-generation and decision-making in dynamic, time pressured environments outside of sport, such as those encountered by police officers, military personnel, and medical professionals.

In the future, research should attempt to explore TTF in real-world settings. Thus far, TTF research has been conducted experimentally. However, these findings on simulated, experimental tasks may not generalize to real-life decision-making. In other words, just because participants use the heuristic in the lab does not mean that they use it to make decisions on the basketball court. Field research would help determine whether or not TTF is a salient decision-making strategy in the real-world.

Another suggestion for future research is to include participants of varying abilities and experience. This line of research could use novice, intermediate, and expert performers to examine some of the main predictions of TTF, as well as other pertinent questions. For example, research could compare participants of different experience levels on the frequency of TTF use. Likewise, it could also explore relationships, such as the relationship between TTF and decision quality, decision speed, and decision confidence, and the self-efficacy-TTF link. Another way to vary the participants is to consider age and maturational factors. It is possible that TTF is related to age, cognitive development, or physical maturation. For example, TTF may not have a positive impact on the decision-making performance of 10-year olds, but may be useful for 14-year olds. Perhaps this effect is not due to age, but rather to experience or cognitive and/or physical development. Likewise, this research could shed some light how a person develops a tendency to TTF. Furthermore, future TTF research should not only focus on athletes, but should also examine the decision-making of coaches.

Future studies could also expand on the current study by making minor methodological changes. One such way would be to include an option-generation task that did not involve any time pressure. This would help determine if participants cited the same first responses under conditions of time pressure as they did with no time pressure. This would be important to help evaluate the validity of previous research (i.e., did previous studies get accurate measures of first options) and to help shape the methodology of future research studies. Another way in which an untimed option-generation task would be useful is to compare those response times to the response times observed with time pressure. The current study found a nearly significant relationship between option-generation speed and self-efficacy; however, it was hypothesized that the time pressure exerted undue influence on response times. Thus, the self-efficacy-option-generation speed relationship could be clarified by introducing a condition with no time pressure. Another useful modification would be to ask participants to indicate the position of the option they chose on the decision-making performance task. Participants were categorized into high and low TTF groups based on the results of the option-generation task. However, it is impossible to know if participants exhibited the same tendencies on the decision-making performance task. In order to truly understand how TTF influences performance on the more realistic decision-making performance task, participants could be asked to list the serial position of the option that they chose (i.e., first, second, etc.).

Conclusions

To date, there has been very limited research on how people generate and select options in sport. The TTF heuristic has helped researchers gain better insight into these cognitive processes. Accordingly, the current study supported the notion that people do in fact use the TTF heuristic to make decisions, but also that using TTF can improve decision-making performance. Moreover, a person's self-efficacy beliefs are also related to TTF and their decision-making performance.

Appendix A

Demographic and Importance Questionnaire

1. Gender (circle ONE): Female Male

2. Age: ________

3. Year in school (circle ONE):

   First Year Sophomore Junior Senior Other

4. Total number of years of **organized, competitive** basketball experience (i.e., a coach, records/standings): _________

5. Please indicate the number of years of **organized, competitive** (i.e., a coach, records/standings) basketball experience at EACH of the following levels:

_________ Elementary (Grades K-6) ________ Junior high (Grades

_________ H.S. Junior varsity (Grades 9-12) _________ H.S. Varsity (Grades 9-12)

_________ H.S. travel ball (e.g. AAU) _________ College club

_______________________________Other (explain)

6. Please indicate the number of years of **recreational** basketball experience:

____

7. Primary position played (circle ONE):

   point guard shooting guard forward center

8. Approximately how many hours of basketball do you watch, in person and/or on TV, in an average week: ________________

9. How important is it for you to be successful in this basketball decision-making skill test?

0	1	2	3	4	5	6	7	8	9	10
not at all important					somewhat important					very important

Appendix B

Basketball Knowledge Test

Circle ONE answer for each question.

1. When a defensive player is fronting (standing in front of) an offensive low-post player, what pass can be used to get the post player the ball?

    a. chest pass c. lob pass

    b. bounce pass d. don't pass it, you should shoot it

2. How many seconds can an offensive player dribble in place while being closely guarded by a defensive player?

    a. 3 seconds c. 10 seconds

    b. 5 seconds d. as long as they want

3. In general what should an offensive player do when he/she is double-teamed by the defense?

    a. change pivot feet c. shoot

    b. pass to the open player d. dribble penetrate

4. What player is typically responsible for handling the ball and running the offense?

    a. point-guard c. shooting guard

    b. forward d. center

5. When playing against a zone defense, offensive players should cut to the:

    a. baseline c. top of the key

    b. elbow d. gaps

6. What does the term "weak side" mean?

   a. side of court with guards   c. side of court away from ball

   b. side of court with posts   d. side of court with ball

7. If a defensive player is overplaying (denying) the passing lane, what should the offensive player do?

   a. cut harder   c. clear out

   b. cut to the basket   d. set a screen (pick)

8. A free throw is worth:

   a. 1 point   c. 3 points

   b. 2 points   d. a foul

9. In a "give and go" a person ___________ the ball and then ______________.

   a. shoots, rebounds   c. rebounds, passes

   b. dribbles, shoots   d. passes, cuts

10. When posting up, players should set up above the:

    a. baseline   c. free throw line

    b. block   d. 3 point line

Appendix C

Decision-Making Self-Efficacy Questionnaire

Directions: In this basketball video task you will watch videos depicting offensive situations in basketball. When the video stops, you must decide what the player with the ball should do next.

For this video test, please rate your confidence in your ability to…

	Not at all Confident										**Extremely Confident**
1. Make the right decision at the right moment	0	1	2	3	4	5	6	7	8	9	10
2. Know who to pass the ball to	0	1	2	3	4	5	6	7	8	9	10
3. Make good decisions when playing against a zone defense	0	1	2	3	4	5	6	7	8	9	10
4. Know when to shoot the ball	0	1	2	3	4	5	6	7	8	9	10
5. Make good decisions when playing against a person-to-person defense	0	1	2	3	4	5	6	7	8	9	10
6. Make decisions when the game is on the line	0	1	2	3	4	5	6	7	8	9	10
7. Know when to drive to the basket	0	1	2	3	4	5	6	7	8	9	10
8. Make decisions quickly	0	1	2	3	4	5	6	7	8	9	10
9. Make good decisions in critical situations	0	1	2	3	4	5	6	7	8	9	10
10. Know what do to next with the ball	0	1	2	3	4	5	6	7	8	9	10

Appendix D

Example Option-Generation Score Sheet

Situation 1: 15 minutes to play in 2^{nd} half, score is tied 28-28.

1. Write down the first intuitive option that came to your mind

    a. ____

2. Write down any options YOU feel are appropriate in this situation.

    b. ____

    c. ____

    d. ____

    e. ____

3. Please circle the option YOU feel is BEST in this situation.

4. Using the scale below, rate how confident are you that this is the BEST decision.

Not at all Confident										Extremely Confident
0	1	2	3	4	5	6	7	8	9	10

Appendix E

Example Decision-Making Score Sheet

Write down the BEST decision for each situation.

<u>Situations 14-23: 15 minutes to play in 2nd half, score is tied 28-28.</u>

14. ____

Using the scale below, rate how confident are you that this is the BEST decision.

Not at all Confident										Extremely Confident
0	1	2	3	4	5	6	7	8	9	10

Appendix F

Informed Consent Form

You are being asked to participate in a study conducted by graduate student Teri Hepler, under the supervision of Deborah Feltz, Ph.D., from Michigan State University. The purpose of this study is to examine the relationship between self-efficacy and decision-making performance in sport. It is believed that this study will have practical implications for athletes and coaches regarding training practices in sport.

As part of this research, you will be asked to complete a questionnaire about your decision-making capabilities. The questionnaire consists of 10 questions and takes approximately 2 minutes to complete. Also, you will be asked to watch 20 video clips of offensive situations in basketball and decide upon a course of action you believe to be the best decision in each situation. The duration of your participation in this study should last no longer than 45 minutes.

Your participation in this study will remain confidential; no one except the principal investigators will have access to these responses or to participation records. After participating, you will not be able to be identified. At the end of the project, responses will be presented at the group level to ensure the confidentiality and anonymity of individual responses. Group-based findings will be made available to those who are interested. Your privacy will be protected to the maximum extent allowable by law.

Your participation in this study would be greatly appreciated. However, please know that you may refuse to participate or withdraw from the project at any time and without penalty. Also, you may also refuse to answer any specific qucstions. If you would likc to participate, please sign this form and return it. If you have any questions concerning this study, please contact Dr. Deborah Feltz, at 517.355.4732 [dfeltz@msu.edu] or Teri Hepler at 517.896.7491 [heplerte@msu.edu].

If you have any questions or concerns about your role and rights as a research participant, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Director of MSU's Human Research Protection Program, Dr. Peter Vasilenko, at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 202 Olds Hall, MSU, East Lansing, MI 48824.

Thank you for your time and cooperation,

______________________________ __________

Dr. Deborah Feltz, Principal Investigator Date

______________________________ __________

Teri Hepler, Graduate Student Date

I, ______________________________, have been informed of and voluntary agree to participate in the above-mentioned study.

______________________________ __________

Signature Date

Appendix G

Study Directions

General Directions

In this basketball test, you will watch a total of 26 of basketball video clips. These clips depict various offensive situations in a high school boys basketball game. When the video stops, you will be asked to decide what the player with the ball should do next. You should be very specific in your answers. For instance, if you think the player should pass to a teammate, be sure to indicate the letter of the player he should pass to. Your performance score will be based on the speed and quality of your decision. High quality decisions that are made quickly will receive the best scores. Quality of decisions will be evaluated by basketball experts, while the computer program will determine decision speed.

A few general things to keep in mind:

- assume all offensive and defensive players are of average and equal ability (for high school boys basketball players)
- there is no shot clock (or time limit to shoot) in high school basketball
- carefully review the game conditions before viewing the video
- You can only watch each clip ONE time, so pay close attention
- Clips range from 2-25 seconds
- Be specific (which direction, teammate, etc.)

Before we begin, please read and sign this consent form if you agree to participate. Next, please complete the first three pages in the packet, which includes a short basketball quiz, a background questionnaire, and a self-appraisal inventory.

Directions for Option-Generation Task

This part of the study requires you to watch 13 of video clips, generate potential options about what move the player with the ball should make, and then to choose the best decision from among those options. First, you will need to review the game conditions and then I will start the video. When the video stops, verbally state the **very first option** that comes to mind. Please do this as quickly as possible, as 2 seconds after the video stops, a loud buzzer will sound. The buzzer will continue to go off until you give a response. However, if you respond in less than 2 seconds, the buzzer will not sound. When you state your response, I will stop the video and record your response time. After giving your verbal response, please record this option on the provided score sheet. Next, you will have 45 seconds to write down any other options you feel would be appropriate. After generating all desired options, please circle the option you feel represents the best possible decision. Finally, rate how confident you feel that your decision is in fact the best decision. In this task, you will always be a member of the team in black jerseys. Likewise, you are the home team. Remember that your decision will be rated on speed and quality.

Let's go through an example, to help familiarize you with the process.
Here are the game conditions for Situation 1. Please read these over carefully, and when you are ready, I will start the video.

Directions of for Decision-Making Performance Task

This part of the study requires you to watch 13 video clips and make a decision regarding what move the player with the ball should make next. You will need to read the game conditions before I play the video. After viewing the clip, you will, as quickly as possible, state what you believe the player should do. Just to remind you, each decision will be scored based how fast you make the decision and how good the decision is. In this task, you are the home team, indicated by the white jerseys.

Let's do a quick example before we begin the test. Here are the game conditions for Situation 14. Please read these over carefully, and when you are ready, I will start the video.

Table 1

Means and Standard Deviations of all Independent and Dependent Variables (N = 70)

Variable	Mean	Standard Deviation
Competitive basketball experience	4.47	3.33
Basketball knowledge score	6.84	2.20
Self-efficacy	6.82	1.61
O-G decision quality	2.94	0.48
DMP decision quality	2.97	0.52
O-G response time	1.79	0.43
DMP response time	2.71	1.18
O-G decision confidence	7.81	1.47
DMP decision confidence	7.68	1.56
TTF frequency	9.40	2.14
Number of options generated	1.98	0.61
First option quality	2.71	0.55

O-G: Option-generation task; DMP: Decision-making performance task; TTF: Take the First

Table 2

Descriptive Statistics for all Independent and Dependent Variables and Various Demographics by Gender (N = 70)

	Males (n = 34)		Females (n = 36)	
	M	SD	M	SD
Competitive basketball experience	4.26	3.24	4.67	3.44
Recreational basketball experience	8.71	5.77	3.54	4.25
Hours watching basketball	4.34	3.20	2.49	2.70
Importance rating	7.47	1.76	6.64	1.61
Basketball knowledge score	7.82	1.78	5.92	2.18
Self-efficacy	7.44	1.12	6.23	1.79
O-G decision quality	3.08	0.42	2.80	0.49
DMP decision quality	3.11	0.46	2.85	0.54
O-G response time	1.75	0.41	1.83	0.45
DMP response time	2.47	1.26	2.94	1.06
O-G confidence	8.40	0.93	7.26	1.67
DMP confidence	8.30	1.12	7.10	1.71
TTF frequency	10.26	1.64	8.58	2.26
Number of options generated	1.97	0.66	1.99	0.57
First option quality	2.91	0.43	2.52	0.60

O-G: Option-generation task; DMP: Decision-making performance task; TTF: Take the First

Table 3

Correlations between all Independent and Dependent Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Basketball playing experience	----											
2. Basketball knowledge	.42*	----										
3. Self-efficacy	.36*	.47*	----									
4. TTF frequency	.26*	.32*	.47*	----								
5. O-G quality	.35*	.54*	.48*	.24	----							
6. O-G response time	-.03	-.33*	-.21	-.07	-.14	----						
7. O-G confidence	.25*	.37*	.69*	.39*	.54*	-.24	----					
8. Number of options generated	-.02	.18	-.20	-.42*	.09	-.14	-.15	----				
9. First option quality	.50*	.57*	.53*	.47*	.81*	-.22	.53*	.04	----			
10. DMP quality	.30*	.54*	.36*	.18	.48*	.02	.38*	-.14	.44*	----		
11. DMP response time	-.15	-.46*	-.37*	-.19	-.29*	.41*	-.36*	-.11	-.39*	-.24	----	
12. DMP confidence	.20	.37*	.70*	.37*	.52*	-.07	.89*	-.17	.50*	.53*	-.34*	----

O-G: option-generation task; DMP: decision-making performance task; TTF: Take the First *Correlations are significant $p < .05$

Table 4

Means and Standard Deviations of Option Quality according to Serial Position

Variable	Mean	Standard Deviation
Option 1 (n = 910)	2.71	1.41
Option 2 (n = 579)	2.18	1.31
Option 3 (n = 253)	1.66	1.23
Option 4 (n = 57)	1.19	1.01
Option 5 (n = 8)	1.33	1.24

Table 5

Post Hoc Test Comparing Option Quality according to Serial Position

	1	2	3	4	5
1. Option 1	----				
2. Option 2	0.53 *(.00)*	----			
3. Option 3	1.05 *(.00)*	0.52 *(.00)*	----		
4. Option 4	1.52 *(.00)*	0.99 *(.00)*	0.46 *(.03)*	----	
5. Option 5	1.38 *(.09)*	0.85 *(.39)*	0.32 *(.94)*	-0.14 *(1.00)*	----

Mean difference *(p-value)*

Table 6

Post Hoc Test Comparing TTF Frequency according to Number of Options Generated

	1	2	3	4	5
1. 1 Option	----				
2. 2 Options	0.43 *(.00)*	----			
3. 3 Options	0.45 *(.00)*	0.02 *(.99)*	----		
4. 4 Options	0.40 *(.00)*	-0.03 *(.99)*	-0.06 *(.95)*	----	
5. 5 Options	0.37 *(.34)*	-0.06 *(1.00)*	-0.08 *(.99)*	-0.03 *(1.00)*	----

Mean difference *(p-value)*

Table 7

Post Hoc Test Comparing Decision Confidence according to the Number of Options Generated

	1	2	3	4	5
1. 1 Option	----				
2. 2 Options	0.78 *(.00)*	----			
3. 3 Options	0.98 *(.00)*	0.20 *(.72)*	----		
4. 4 Options	1.08 *(.00)*	0.30 *(.81)*	0.10 *(1.00)*	----	
5. 5 Options	0.61 *(.34)*	-0.17 *(1.00)*	-0.37 *(.94)*	-0.47 *(.91)*	----

Mean difference *(p-value)*

REFERENCES

Abernethy, B. & Russell, D.B. (1987). Expert-novice differences in an applied selective attention task. *Journal of Sport Psychology*, 9, 326-345.

Allard, F., Graham, S., & Paarsalu, M.E. (1980). Perception in sport: Basketball. *Journal of Sport Psychology*, 2, 14-21.

Allard, F. & Starkes, J.L. (1980). Perception in sport: Volleyball. *Journal of Sport Psychology*, 2, 22-23.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Bandura, A. (2005). Guide for creating self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307-338). Greenwich, CT: Information Age Publishing.

Bandura, A. & Wood, R.E. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision-making. *Journal of Personality and Social Psychology*, 56, 805-814.

Bar-Eli, M., & Tractinsky, N. (2000). Criticality of game situations and decision making in basketball: an application of performance crisis perspective. *Psychology of Sport &Exercise, 1*, 27-29.

Beilock, S. L., & DeCaro, M. S. (2007). From poor performance to success under stress: Working memory, strategy selection, and mathematical problem solving under pressure. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 33,* 983-998.

Bennis, W.M. & Pachur, T. (2006). Fast and frugal heuristics in sports. *Psychology of Sport and Exercise, 7*, 611-629.

Bouffard-Bouchard, T., Parent, S., Larivee, S. (1991). Influence of self-efficacy on self-regulation and performance among junior and senior high-school age students. *International Journal of Behavioral Development, 14,* 153-164,

Bröder, A. (2000). Assessing the empirical validity of the Take the Best heuristic as a model of human probabilistic inference. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 1332-1346.

Bryant, P. (2007). Self-regulation and decision heuristics in entrepreneurial opportunity evaluation and exploitation. *Management Decision, 45*, 732-748.

Chamberlain, C.J. & Coelho, A.J. (1993). The perceptual side of action: Decision-making in sport. In J.L. Starkes & F. Allard (Eds.), *Cognitive issues in motor expertise* (pp 135-158). Amsterdam: Elsevier

Chase, M.A. (2001). Children's self-efficacy, motivation intentions, and attributions in physical education and sport. *Research Quarterly for Exercise and Sport*, 72, 47-54.

Clark, B. & Warren, N. (1935). Depth perception and interpupillary distance as factors in proficiency in ball games. *American Journal of Psychology*, 47, 485-487.

ESPN (n.d.). Biggest chokes of the last 25 years. Retrieved February 9, 2008, from http://sports.espn.go.com/espn/espn25/story?page=listranker/25biggestchokes.

Feltz, D.L., Short, S.E., & Sullivan, P.J. (2008). *Self-efficacy in sport.* Champaign, IL: Human Kinetics.

George, T. R. (1994). Self-confidence and baseball performance: A causal examination of self-efficacy theory. *Journal of Sport and Exercise Psychology, 16*, 381-399.

Gigerenzer, G. (2004). Fast and frugal heuristics: The tools of bounded rationality. In D. J. Koehler & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making* (pp. 62-88). Oxford, UK: Blackwell.

Gigerenzer, G. (2007). *Gut Feelings: The intelligence of the unconscious.* New York: Viking Press.

Gigerenzer, G., Czerlinski, J., & Martignon, L. (1999). How good are fast and frugal heuristics? In R. Elio (Ed.), *Common sense, reasoning, and rationality* (pp. 148-173). New York: Oxford University Press.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103*, 650-669.

Gigerenzer, G., Todd, P.M., & ABC Research Group (1999). *Simple heuristics that make us smart.* New York: Oxford University Press.

Goldstein, D.G. & Gigerenzer, G. (2002). Models of ecological rationality: The recognition heuristic. *Psychological Review, 109*, 75-90.

Grehaigne, J-F., Godbout, P., & Bouthier, D. (2001). The teaching and learning of decision-making in team sports. *Quest*, 53, 59-76.

Helsen, W., & Pauwels, J.M. (1988). The use of a simulator in evaluation and training of tactical skills in soccer. In T.Reilly, A. Lees, K. Davids & W.J. Murphy (Eds.), *Science and Football* (pp 493-497). London: E. & F.N. Spon Ltd.

Hepler, T.J., & Chase, M.A. (2008). Relationship between decision-making, task self-efficacy, and the performance of a sport skill. *Journal of Sports Sciences, 26*, 603-610.

Hepler, T.J., & Feltz, D.L. (2008). Self-efficacy and decision-making performance on a simulated baseball task. Manuscript submitted for publication.

Johnson, J.G., & Raab, M. (2003). Take the first: Option-generation and resulting choices. *Organizational Behavior and Human Decision Processes, 91*, 215-229.

Martignon, L., & Schmitt, M. (1999). Simplicity and robustness of fast and frugal heuristics. *Minds and Machines, 9*, 565-593.

McLeod, P., & Dienes, Z. (1996). Do fielders know where to go to catch the ball or only how to get there? *Journal of Experimental Psychology: Human Perception and Performance, 22, 531-543.*

Moritz, S.E., Feltz, D.L., Fahrbach, K.R., & Mack, D.E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Research Quarterly for Exercise and Sport*, 71, 280-294.

Morris, D. (1981). *The Soccer Tribe.* London: Jonathan Cape.

Olsen, E. (1956). Relationship between psychological capacities in college athletics. *Research Quarterly*, 27, 78-89.

Raab, M., & Gigerenzer, G. (2005). Intelligence as smart heuristics. In R.J. Sternberg & J.E. Pretz (Eds.), *Cognition and Intelligence: Identifying the mechanisms of the mind* (pp. 188-207). Cambridge, MA: Cambridge University Press.

Raab, M., & Johnson, J.G. (2007). Expertise-based differences in search and option-generation strategies. *Journal of Experimental Psychology: Applied, 13*, 158-170.

Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D.R. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology, 83*, 1178-1197.

Serwe, S., & Frings, C. (2006). Who will win Wimbledon? The recognition heuristic in predicting sports events. *Journal of Behavioral Decision-Making, 19*, 321-332.

Shank, M.D. & Haywood, K.M. (1987). Eye movement while viewing a baseball pitch. *Perceptual and Motor Skills*, 64, 1191-1197.

Simon, H.A. (1956). Rational choice and the structure of the environment. *Psychological Review, 63,* 129-138.

Simon, H.A. (1957). A behavioral model of rational choice. *Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting.* New York: Wiley.

Simon, H.A. (1990). Invariants of human behavior. *Annual Review of Psychology, 41*, 1-19.

Snook, B., & Cullen, R.M. (2006). Recognizing National Hockey League greatness with an ignorance-based heuristic. *Canadian Journal of Experimental Psychology, 60,* 33-43.

Starkes, J.L. (1987). Skill in field hockey: The nature of the cognitive advantage. *Journal of Sport & Exercise Psychology, 9*, 146-160.

Starkes, J.L. & Deakin, J. (1984). Perception in sport: A cognitive approach to skilled performance. In W.F. Straub & J.M. Williams (Eds.), *Cognitive Sport Psychology* (pp 115-128). Lansing, NY: Sport Science Association.

Starkes, J.L., & Ericsson, K.A. (Eds.) (2003). *Expert performance in sports.* Human Kinetics: Champaign, IL.

Tabachnick, B.G. & Fidell, L.S. (2001). *Using multivariate statistics (4th ed.).* Boston: Allyn and Bacon.

Tenenbaum, G. (2004). Decision making in sport. *Encyclopedia of applied psychology, 1*, 575-584.

Tenenbaum, G., Levy-Kolker, N., Sade, S.S., Lieberman, D., & Lidor, D. (1996). Anticipation and confidence of decisions related to skilled performance. *International Journal of Sport Psychology, 27*, 293-307.

Tenenbaum, G., Yuval, R., Elbaz, G., Bar-Eli, M., & Weinberg, R. (1993). The relationship between cognitive characteristics and decision-making. *Canadian Journal of Applied Physiology, 18*, 48-62.

Thomas, K.T. (1994). The development of sport expertise: From Leeds to MVP legend. *Quest*, 46, 199-210.

Todd, P.M., & Gigerenzer, G. (2001). Putting naturalistic decision making into the adaptive toolbox. *Journal of Behavioral Decision Making, 14*, 353-384.

Wood, R.E., Atkins, P., & Tabernero, C. (2000). Self-efficacy and strategy on complex tasks. *Applied Psychology: An International Review, 49*, 430-446.

Wood, R.E., & Bandura, A. (1989). Impact of conceptions of ability on self-regulatory mechanisms and complex decision-making. *Journal of Personality and Social Psychology*, 56, 407-415.

Wood, R. E., Bandura, A., & Bailey, T. (1990). Mechanisms governing organizational performance in complex decision-making environments. *Organizational Behavior and Human Decision Processes, 46*, 181-201.