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Game Reading Skills in Soccer

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To equality, fairness, freedom and happiness: my inspirations and guiding tools

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ABSTRACT

In the study, anticipation and situational assessment skills were examined using a video-based simulated task environment (STE). The objectives of the study were to examine skill and gender based differences in the ability to predict what an opponent will actually do next in a given scenario (anticipation), the ability to pick-up specific information cues from their opponent, and assess the importance of that information (option generation and prioritization). High and low skill male and female soccer players were shown action clips of developing plays, frozen (i.e., cued) or occluded (i.e., non-cued) at three temporal points (i.e., 400ms, 200ms and 0ms prior to an opponent player's action). Participants were then asked to predict what will happen next, generate plausible options, and rank them. Results indicated that high-skill players performed better on the anticipation and situational assessment tasks throughout the task conditions (i.e., cued/non-cued, temporal). Moreover, task conditions affected high and low skill participants differently. Gender differences were also observed. Males were able to anticipate what will happen next more accurately, generate more plausible options, and prioritize them more efficiently, than females. Task conditions affected both genders similarly. The study is one of the first in the area, and findings provide insight into the option generation and anticipation processes in a dynamic team sport setting.

INTRODUCTION

"When a cross comes into a box, there's so many things that go through your mind in a split second, like five or six different things you can do with the ball." (Wayne Rooney as cited in Winner, 2012).

The ability to "read the game" is crucial in team sports. Expert players can anticipate what will happen next accurately and quickly (Gabbett, Rubinoff, Thorburn & Farrow, 2007; Grehaigne, Godbout & Bouthier, 2001). They are able to assess game situations efficiently and make successful decisions (Vaeyens, Lenoir, Williams, Mazyn & Philippaerts, 2007; Vaeyens, Lenoir, Williams & Philippaerts, 2007). Additionally, perceptual-cognitive skills (e.g., anticipation, situational assessment, decision making) have consistently been shown to differentiate players of various skill levels (Hodges, Huys & Starkes, 2007; Mann, Williams, Ward & Janelle, 2007; Williams & Ward, 2007). In the realm of perceptual-cognitive processes, researchers have primarily focused on understanding anticipation skills in individual sports (e.g., tennis) and individual game situations (e.g., baseball batter and goal keeper) (Ward**,** Farrow, Harris, Williams, Eccles & Ericsson 2008). The vast amount of knowledge accumulated in the area indicates primarily, that efficient (a) search strategies, and (b) cue utilization techniques, facilitate an athlete's ability to successfully predict what will occur next, and contribute to the achievement of expert performance (Caserta & Singer, 2007).

However, few researchers have examined the underlying mechanisms that mediate superior anticipation in team sports, and even fewer have traced the cognitive processes involved in assessing situations (e.g., generating and prioritizing options) during developing plays in team settings (Raab & Johnson, 2007; Ward et al., 2008). The complexity of studying team dynamics and the difficulty of measuring and capturing perceptual-cognitive processes are the main reasons for the scarcity of research in the area. Nevertheless, in the past decade a growing number of researchers have attempted to examine perceptual-cognitive processes in team sports and have used innovative paradigms (e.g., video simulation) to resolve the difficulties that were previously encountered (Ward, Suss, Eccles, William & Harris, 2011).

Additionally, the majority of researchers in the area have focused their attention on capturing skill level differences, and neglected to explore other individual differences such as gender. This is somewhat surprising because research findings in other psychological domains (e.g. developmental, social) indicate that gender differences exist in related skills (e.g., spatial abilities, intuitive thinking) (Epstein, Pacini, Denes-Raj, & Heier, 1996; Voyer, Voyer & Bryden, 1995).

The purpose of this study was to examine the anticipation and option generation processes (of skilled and unskilled males and females) in a dynamic team sport setting. The specific factors that were explored included: a) the underlying mechanisms that lead to advanced perceptual-cognitive skills, b) the option generation and prioritization process, and c) perceptual-cognitive differences between genders.

LITERATURE REVIEW

Anticipation

Definition

Anticipation is defined as the ability to predict what will happen next from current limited/partial information (Poulton, 1957). This is consistent with the definition of the anticipation stage in the cognitive Decision Making (DM) model proposed by Tenenbaum (2003). According to Tenenbaum’s DM model, anticipation is one of the stages in the decision making process, and is crucial for successful performance. Anticipation is described as the ability to predict with accuracy what will happen next by integrating information available from the environment with information obtained from past experience (i.e., knowledge base; memory). Specifically, this refers to the ability to extract important and relevant cues from the environment; cues that will provide the performer with an indication of what might occur next.

Individual Sport Settings

Anticipation skills have been studied extensively, especially in individual sport settings (Mann et al., 2007; Ward et al., 2008). For example, findings from studies in which researchers examined anticipation skills in tennis serves (Caserta & Singer, 2007), field hockey penalty plays (Williams et al., 2003), and soccer penalty shots (Williams & Burwitz, 1993), indicated that successful performance was mediated by the ability to anticipate the direction and speed of the ball. Furthermore, the ability to anticipate was mediated by the ability to “pick-up” relevant cues from the opposing player (i.e., cue utilization). Thus, in tennis for example, successful performers were able to anticipate more accurately and quicker where the ball will eventually land and fixated more often and for longer durations on areas related to the racquet and shouldertrunk, compared to low-level performers who fixated their gaze mainly on the ball and head regions (Singer, Cauraugh, Chen, Steinberg, & Frehlich, 1996).

Additionally, successful performers were able to anticipate what will happen next earlier, compared to less successful performers (Gabbett et al., 2007; Grehaigne et al., 2001). This is a crucial advantage, especially in fast paced sports where time (and timing) is of utter importance (Caserta, Young & Janelle, 2007). Therefore, experts have more time to process information, make a decision and perform an action. Recently, researchers have expanded the measurement methods in the area and have included process tracing methods (e.g., eye-tracking, verbal reports) to try and identify the underlying mechanisms that lead experts to superior anticipation performance (Williams & Ward, 2007).

Team Settings

Although the anticipation process in individual and team sport settings is similar, “team sports offer an even more complex situation, providing a bigger challenge in terms of decision making. The basic challenge for each player is to cooperate with partners in order to oppose more effectively the opponents either while attacking (keeping defense in mind) or while defending (setting ready to attack)” (Grehaigne et al., 2001, p.60). Thus, in team settings there is a need to anticipate movements of several players (i.e., teammates and opponents), and to recognize the relationship among them (i.e., team formation, pattern and structure). Additional parameters and factors, such as tactics, coordination, and communication need to be considered when examining anticipation skills in team settings (Ward & Eccles, 2006).

Few anticipation studies (and perceptual-cognitive studies in general) have been conducted in team settings. Initially, researchers in the sport domain examined skills that were related to anticipation, such as the ability to recall and recognize patterns and team formations

(Allard, Graham, & Paarsalu, 1980; Allard & Starkes, 1980). Specifically, athletes' abilities to recall and recognize players' positions were examined in team sports such as basketball, volleyball, and soccer. Findings indicated that experts were better able to recall and recognize structured patterns of play, while no skill base differences were found in unstructured patterns (Allard et al., 1980; Allard & Starks, 1980; Borgeaud & Abernethy, 1987; Williams, Davids, Burwitz & Williams, 1993). However, further research indicated that recognizing and recalling structured patterns were a derivative of domain-specific skills. Although these memory skills might be important and necessary for successful performance, they do not represent the underlying mechanisms needed for the development of expertise (Allard, Parker, Deakin, & Rodgers, 1993; Williams & Davids, 1995). In fact, findings from studies in which novices were trained on recall and recognition tasks revealed that although they were able to develop these skills and perform as well as experts on these tasks; they were not able to perform representative tasks as successfully as experts (Ericsson & Oliver, 1998; Ericsson & Staszewski, 1989).

More recently eye-tracking technologies were used to examine gaze behavior variables in team settings. Williams and Davids (1998) used an eye-tracking system to examine the relationship between search strategies and skill level. Experienced and less-experienced players responded by moving to offensive plays shown on a large screen. Following an earlier study where 11X11 simulations were used (Williams et al., 1994), in this follow-up study, 1X1 and 3X3 film simulation was used to investigate the search patterns under different task constraints. Results indicated that skilled players were able to change search strategies according to the situation and constraints. Specifically, in the 11X11 condition, skilled players demonstrated high frequency of fixations with short durations, because of the amount of information needed to anticipate the play, and eventually make the right decision. However, in the 3X3 condition, there were no differences in search strategies between skill-level groups.

In one of the few anticipation studies in team sport settings, Ward and Williams (2003) examined skill and age based differences on a series of perceptual-cognitive tasks. Specifically, on the anticipation task, soccer players were required to watch a series of video clips of a developing soccer play that was stopped 120ms before ball contact. They were then asked to predict what will occur next. Elite players were better able to anticipate the outcome than sub-elite players. Although, the results of the study were similar to results obtained in anticipation studies pertaining to individual sport settings, further research is needed to enhance the knowledge regarding the anticipation process in team settings.

Occlusion Studies

The dominant research paradigms used to study and capture anticipation skills in the past 20 years were mostly conducted in the lab environment (Williams & Ward, 2007). Specifically, the presentations of dynamic simulations using temporal and spatial occlusion paradigms were applied. These methods of study initiated by Haskins (1965), and developed by Jones and Miles (1978), enabled researchers to compare anticipation skills under conditions varying in temporal and spatial exposure. In the temporal occlusion paradigm the film is stopped and occluded at varying time periods of a developing play or action (e.g., 300ms, 150ms, and 0ms before ball contact), and the participant is asked to predict (e.g., anticipate) the next occurrence. While in the spatial occlusion paradigm, varying parts/sections of the film are masked. As in the temporal paradigm, the participant’s task is to anticipate the opponent’s action or the outcome of the developing play based on the information available. Differences in performance and behavioral characteristics among various temporal and/or occluded conditions are then analyzed and examined. With the use of these paradigms, researchers were able to determine the temporal and spatial locations of perceptual cues in the environment used by skilled players to successfully anticipate the final outcome of opponents' actions. Additionally, researchers were able to trace the anticipation process and gain insight into crucial time periods that lead to successful outcomes (Panchuk & Vickers 2006).

An example of a relatively early study that used the occlusion paradigm measured soccer players' anticipation skill using video simulation (Williams & Burwitz, 1993). In this particular study, goalkeepers where required to predict the direction of a penalty shot. Results showed that skilled keepers could anticipate the ball's final location earlier and more accurately than novices. Furthermore, experienced keepers relied on information prior to ball contact (Williams & Burwitz, 1993). In a similar study, Abernethy and Russell (1987) examined cue utilization differences between expert and novice badminton players. Findings from the study indicated that experts utilized cues earlier to accurately predict the final destination of where the shuttlecock would be played to.

These set of studies consistently support the notion that expert players are not only better in predicting action outcomes (i.e., anticipation skills), but are able to make successful predictions earlier, while utilizing fewer (e.g., subtle) environmental cues than less skilled players (Mann et al., 2007). The majority of studies using the temporal occlusion paradigm investigated anticipation in individual type settings (Ward et al., 2008). Future studies need to expand this line of research, and utilize similar paradigms (i.e., temporal and spatial occlusion) in team settings (e.g., soccer, basketball).

Situational Assessment

Definition

Situational assessment refers to the performer's ability to first generate plausible options and subsequently prioritize those options (Ward, Suss & Basevitch, 2009). Situational assessment is a process that mediates successful decision making (Ward et al., 2011).

Previous Research in the Sport Domain

Researchers in the sport domain have only recently initiated studies that investigated these processes; mainly using video simulation and occlusion paradigms, together with innovative techniques (see Raab & Johnson, 2007; Ward et al., 2011). An example of a technique that was used to examine situational assessment, involved video presentations of developing plays, which are stopped at a certain time period, and thereafter the performers are asked to report the plausible options (quantity) and rank them (quality) (Ward, Ericsson & Williams, 2012). Findings from studies utilizing these methods showed that experts generated options of higher quality compared to less-skilled players. However, some findings were ambiguous. For example, it was unclear if there was a positive or negative relationship between the number of options generated and success (see Johnson & Raab, 2003; Ward et al., 2011). While situational assessment skills have only recently been examined in the sport domain, the area is generating much interest, and attempts are being made to uncover the optimal option generation, prioritization, and situational assessment processes required for successful decision making and performance (Johnson & Raab, 2003).

In recent years, questions such as, how do athletes generate options, and whether it is better to generate many, few, or perhaps only one option, are being examined (Ward et al., 2011). Nonetheless, there does seem to be a consensus within the research findings, indicating that there are situational assessment and option generation differences between expert and novice performers. For example, Ward and Williams (2003) investigated situational assessment skills among other skills (i.e., anticipation and visual abilities) of soccer players of different levels (i.e., elite and sub-elite) and different age groups (i.e., U9-U17). Results pointed to significant differences between skill level groups and between age groups in the situational assessment tests. Specifically, the elite and mature players were able to generate relevant options and identify key players better than sub-elite younger players. Simultaneously with anticipation, the situational assessment skills were the best discriminators between the groups, compared to basic visual functions (e.g., static and dynamic acuity) and basic memory skills (recall/recognition).

Finally, although there is general agreement that a prioritization process exists, there is ambiguity as to the actual underlying mechanisms and specific processes (e.g., probability, ranking) that lead to option generation and prioritization (Ward et al., 2011). Recently, proponents of two different views (i.e., Recognition-Primed-Decision model (RPD) and Long Term Working Memory theory (LTWM) have attempted to address these questions and examine the underlying mechanisms involved in the situational assessment process (Ward et al., 2012).

Recognition-Primed-Decision (RPD) Models and Take-The-First (TTF) Heuristic

Proponents of the RPD model and TTF heuristic, assume that anticipation and decision making are based on fast automated recognition-based processes. They predict that fewer options are generated as expertise is developed, and that the first option generated is the best option (Klein, Wolf, Mitello & Zsambok, 1995; Raab, de Oliveira & Heinen, 2009).

Johnson and Raab (2003) examined the option-generation process in team handball. Specifically, they were interested in testing the predictions of the TTF heuristic (i.e., that the first options generated are correspondingly the best options). The heuristic is based on naturalistic decision making models (e.g., RPD model, see Klein, 1989) that suggest that “people can recognize a situation as typical, thereby calling forth typical reactions without having to sift through large sets of alternatives" (Klein et al., 1995, p.63). Thus, proponent of this approach, claim that experts rely on automatic and serial recognition-based processes, and subsequently generate few options (Raab et al., 2009).

Specifically, in their study, participants watched a set of video clips of developing attacking plays, frozen at the last frame (Johnson & Raab, 2003). They were asked to take the perspective of the attacking player with the ball, and generate the first option that came to mind, any additional options, and the best option, respectively. Results revealed that participants generated relatively few options per trial (M = 2.30). In addition, the number of options generated was inversely related to the quality of the final option. Thus, findings supported the TTF heuristic and the RPD models (Johnson & Raab, 2003). In a related study using a similar method, Raab and Johnson (2007) examined skill-based differences (i.e., experts, near-experts, and non-experts) in the option generation process among handball players. Findings revealed that there were no skill-based differences in the number of options generated (i.e., relatively few options, as in the previous study). However, experts generated better initial and final options (i.e., quality) than near-experts and non-experts (Raab & Johnson, 2007).

Long Term Working Memory (LTWM) Theory

Findings from studies in various domains such as chess (Chabris & Hearst, 2003), soccer (Ward & Williams, 2003), and nursing (Ward, Torof, Whyte, Eccles & Harris, 2010) support an opposing view. Namely, that experts use detailed representations (i.e., long term working memory; LTWM) and schemas to analyze, evaluate, and assess situations (Ericsson & Kintsch, 1995; Tenenbaum & Land, 2009). Thus, according to the LTWM theory, experts develop the skills to efficiently encode and retrieve information to and from long term memory (LTM), which enables them to generate situational representations and utilize feed-forward information to achieve successful decisions (Ericsson & Ward, 2007; Tenenbaum, 2003). Proponents of this approach suggest a positive relationship between the number of options generated and quality of decision making (Ward et al., 2010), and propose that the ability to analyze a situation and think ahead lead to enhanced decision making (Chabris & Hearst, 2003).

Additionally, experts attend to all the relevant cues available, and have the ability to efficiently alternate their decision in dynamic environments and uncertain situations, such as in team sports (Tenenbaum, 2003). Thus, it is essential to keep alternative options accessible (i.e., generate more options) on-the-fly to adjust to dynamic situations and perform at an optimal level.

In a recent study, researchers examined the situational assessment process from a LTWM approach, and attempted to expand the knowledge in the area by capturing and measuring game reading skills in soccer (Ward et al., 2012). Similar to the handball studies, a video simulation paradigm was utilized, in which action clips were shown to participants. However, two main deviations from the original method were introduced: (a) participants were asked to generate and prioritize options from a defensive perspective (i.e., options that are potential threatening to the defense; see Ward & Williams, 2003), and not from the perspective of the player with the ball (i.e., an attacking perspective; see Raab & Johnson, 2007) as in previous studies. The rationale for using a different perspective was grounded on the notion that the decision making process is constructed from several phases, namely an assessment phase (i.e., decision based on others' actions or on environmental cues), and an intervention phase (i.e., decisions based on ones' own course of actions; Ward et al., 2011). Thus, in the assessment phase, where there is more uncertainty, there is a need to generate a greater number of options. While in the intervention phase, where a player has more control over his/her actions, and more information available, there is a need to generate fewer options, and (b) an anticipation measurement was included, in addition to the option generation and prioritization variables, to explore the relationship between option generation and anticipation (Ward et al., 2012).

Results revealed a positive relationship between number of options generated and quality of options. In addition, a positive relationship between the number of options generated and anticipation was found. However, the number of option generated was relatively small (less than 3). Finally, although there were no skill-based differences in the total number of options generated, experts generated more relevant options and fewer irrelevant options. The findings support predictions of the RPD model that few options are generated, even during the assessment phase when decisions need to be made regarding an opponent's action (Bennis & Pachur, 2006). However, results are also consistent with the predictions of the LTWM approach in that a positive relationship exists between the amount of relevant options generated and quality of decision (r = .80; Ward et al., 2011).

Proponents from both the RPD and LTWM approaches did not utilize the temporal occlusion paradigm in their research and only took a snap-shot of the situational assessment process (i.e., one temporal point). They did not capture several temporal points during the situational assessment process, which might have provided important insights as to the underlying mechanisms involved in option generation and prioritization. Thus, future studies should compare quality and quantity of options at different temporal points.

Perceptual-Cognitive Gender Differences

The majority of previous sport-related studies in the area involved male (or mixed) samples. More importantly, game reading performances of male and female players were not compared in these studies (Raab & Laborde, 2011). In other domains, research has indicated that differences exist between males' and females' perceptual and cognitive abilities (e.g., abilities on spatial tasks and the development and acquisition of cognitive and perceptual skills; See Cahil, 2005; Voyer et al., 1995).

Research in Other Domains

In the education setting, for example, boys perform better in mathematics, and girls achieve higher scores in reading. Interestingly, the gap between genders increases with age, such that in high school the differences are larger than in elementary school (Buchmann, DiPrete & McDaniel, 2008). Researchers have primarily focused on explaining these differences by examining environmental factors (e.g., social and economic). Variables such as parental involvement, teachers' expectations, and gender-roles have been suggested as possible explanations for these inequalities in academic performance (Quaiser-Pohl & Lehmann, 2002). Although the biological accounts have generally been neglected, they too seem to play a role in gender differences in education performance (Spelke, 2005).

In an attempt to explain these cognitive differences, several researchers have examined spatial abilities (Collaer & Nelson, 2002). Spatial ability is described as the capacity to create "a mental representation of a two or three dimensional structure and then assessing its properties or performing a transformation of the representation" (Carpenter & Just, 1986, p. 221). Recall that according to proponents of LTWM theory, mental representations also play a significant role in perceptual-cognitive skills in sports. Furthermore, experts have the advantage of using LTWM and efficient mental schemes required for anticipation and situational assessment in team sport settings (Tenenbaum, 2003).

In a meta-analysis that included 286 studies, Voyer et al., (1995) examined gender differences in spatial abilities (e.g., mental rotation and spatial perception), and found a moderate to high mean effect size ($d = 0.37$), indicating that males have better spatial abilities than females. Additionally, and similar to studies in the education domain, findings indicated a larger effect size as age increased (i.e., under 13, 13-18 and over 18); moreover, the gap in spatial abilities between genders seems to be relatively stable over decades. Various explanations have been suggested for these differences, from environmental (e.g., gender-role), to biological (e.g., sex hormones), and task-specific (e.g., strategy) factors. Furthermore, researchers have examined other related skills, such as working memory and perceptual speed and accuracy. Findings from these studies also supported the notion that gender differences exist on a variety of skills related to perception and cognition (Duff & Hampson, 2001, Geiger & Litwiller, 2005; Speck, Ernst, Braun, Koch, Miller & Chang, 2000). Regardless of what causes the gender gaps in spatial abilities and education performance, there seems to be overwhelming support for gender differences in perceptual-cognitive related skills.

Research in the Sport Domain

In the sport domain, most of the researchers examining gender differences focused on physiological/kinematic (e.g., technique, strength, speed), and psychosocial (e.g., personality and attitude) related factors (Sims, Hardaker & Queen, 2007; Ryan; Atkinson & Dunham, 2004). For example, significant gender differences in kinematics and foot/plantar loading were found in soccer specific movement tasks (Sims et al., 2005). These findings provide important information in advancing the understanding for the causes of gender specific injuries. However, only a few studies have been conducted to examine perceptual-cognitive gender differences in the sport domain (Raab & Laborde, 2011).

Findings from a stimulating study that compared visual orienting of male and female collegiate athletes and non-athletes, suggest that visual attention differences exist between genders (Lum, Enns & Pratt, 2002). Although there were no significant gender differences in eye movement and errors for athletes and non-athletes, gender differences were found for non-athletes in simple reaction-time scores (but not for athletes). Additionally, there were gender differences in short-term alertness, for both athletes and non-athletes. The authors suggested that perhaps some aspects of visual attention are learned and can be improved via sport participation, while other aspects are governed by dispositions and are more difficult to change. It is important to note that the tasks in the visual attention study were not related to sport, but were general and simple visual orienting tasks. Thus, future studies should examine more representative tasks. In an additional study that compared general perceptual-motor speed of female and male athletes, significant differences were found. Specifically, female athletes performed better than males on a set of neuropsychological measures (Ryan et al., 2004). However, as with the previous study, only general tasks, that are not representative of real-world sport related situations, were used.

Finally, Raab and Laborde (2011), examined option generation and decision making gender differences in team handball. Specifically, the authors were interested in investigating deliberate vs. intuitive decision making preferences, and the role that expertise and gender play in these processes. The rationale for investigating these variables was based on the notion that intuitive decision making is fast, automatic, and influenced by emotions. Additionally, results from previous research in other domains indicated that females' utilize intuitive decision making more often than males (Hogarth, 2008). Intuitive decision making is in-line with the TTF heuristic approach, which too predicts that experts make quick, automatic, and non-analytic decisions (Johnson & Raab, 2003). Findings from the handball study supported the notion that experts generate fewer options and quicker than non-experts. Additionally, females rated their preferred intuitive decision making higher than males. However, there were no differences between genders in the option generation and decision making tasks.

A limitation of the study was that the average age of the participants was fifteen and as previously mentioned larger gender differences on similar abilities were observed as age increased. Additional studies are needed to examine a more mature sample. Furthermore, the video task utilized was similar to Raab and Johnson's (2007), in which the last frame of the scenario was frozen and not occluded. Thus, participants were not required to use LTWM, and the use of spatial abilities and mental representations was limited. Further studies comparing frozen and occluded conditions are needed to advance the knowledge in the area.

Summary of Limitations and Gaps in the Literature

Anticipation in Team Settings

There is a large body of literature covering various aspects related to anticipation. These include: skill-level differences, temporal and spatial cues, gaze behavior, memory related tasks, and training methods (for a review see Williams & Ward, 2003; 2007). The knowledge accumulated in the area is vast, and has provided scholars important information related to the anticipation process. However, the overwhelming majority of studies in the area were conducted in individual sport settings (Mann et al., 2007). These include individual sports such as tennis and badminton, and individual settings in team sports such as batting and pitching in baseball/cricket, and penalty shootouts in hockey/soccer (Ward et al., 2008).

Few studies have been conducted in team sport settings. Furthermore, most of those studies were conducted earlier and focused on memory tasks that didn't specifically measure anticipation skills, and were not representative of real-game situations (Ericsson & Ward, 2007).

In the few studies in which anticipation skills and other relevant variables (e.g., gaze behavior) were measured in team settings, findings revealed similar results to the individual team sport setting studies (Ward & Williams, 2003). However, the temporal/spatial occlusion paradigm that was utilized in individual settings was not used in these studies. Thus, there is limited information available about the temporal and spatial cues that are important for successful anticipation in team sport settings.

Finally, for individual and team sport settings, the underlying mechanism responsible for successful anticipation is still ambiguous (Williams & Ward, 2007). Scholars have suggested the amount and organization of knowledge stored in LTM and the ability to utilize LTWM, might point to the mechanisms that allow experts to anticipate events efficiently compared to non-experts (Ericsson & Kintsch, 1995; Ericsson & Roring, 2007). However, few studies have actually attempted to examine these mechanisms in general, and especially in team sport settings.

Situational Assessment

Only a small number of studies have been conducted with the purpose of examining situational awareness (Williams &Ward, 2007). Situational awareness is especially important in team sport settings because of the complexity and dynamic nature that are displayed in such situations.

A major limitation of previous studies in the domain was that the researchers only captured a snapshot of the situational assessment process (Raab & Johnson, 2007). It is important to emphasize here, that situational assessment is a process. Using research paradigms that only capture a snapshot of this process can be misleading and provide findings that are erroneous. Furthermore, the options a player generates and subsequently prioritizes vary with time (Abernethy, Gill, Parks & Packer, 2001). Each temporal point features a unique situation and pattern. The team player is required to continuously assess the developing situation and constantly alter the options generated and their ranking order (Tenenbaum, 2003).

Findings from anticipation studies in individual settings, in which the temporal paradigm was utilized, revealed that experts were able to predict the next action/event earlier than non-experts (Williams & Burwitz, 1993). Additionally, larger differences between experts and non-experts occurred when the temporal point was further from ball contact (e.g., 150ms compared to 0ms before contact). Thus, perhaps by utilizing similar paradigms in situational assessment studies, researchers can enhance the understanding of the option generation and prioritization process. Additionally, measuring situational assessment variables at various temporal points, might bridge the gap between the two dominant theories in the domain (i.e., RPD and LTWM).

The TTF heuristic and RPD models might explain the processes when the temporal point is closer to the actual action (e.g., ball contact), because of the time pressure and certainty/familiarity of the situation. In these instances, the player must make a decision quickly. In addition, the environmental cues are available for a relatively long time, providing the player the opportunity to narrow the amount of options. Thus, fewer options are generated and considered. On the other hand LTWM theory might explain the processes that occur at the temporal point that is farther from the contact point because the situation is less structured, apparent, and familiar to the player. Thus, when the play is still developing, there is more time available to sift through the options. Furthermore, the player will presumably use an analytic process and utilize LTM because of the ambiguity of the situation; generating a larger number of plausible options.

Perceptual-Cognitive Gender Differences

There is abundant support in the literature for gender differences related to perceptual and cognitive abilities (Voyer et al., 1995). In various domains such as education and general psychology, findings have indicated consistent differences in math, reading and spatial tasks (Buchmann et al., 2008). The origins of these differences are still ambiguous, but researchers suggest that a combination of various environmental and biological factors contribute to these gender differences (Spelke, 2005).

In the sport domain, only a few researchers have examined perceptual and cognitive differences. Furthermore, in most of these studies, the tasks used were simple, general, and were not representative of specific sport settings. A recent study by Raab and Laborde (2011) was the first attempt to examine perceptual-cognitive gender differences in the sport domain (i.e., team handball). Although gender differences were not found, the authors suggested that future studies should examine other related skills and sports.

The Current Study

In the current study an attempt was made to further the knowledge regarding the mechanisms needed to achieve successful game reading skills in soccer (i.e., team sport setting), by utilizing the temporal occlusion paradigm. Specifically, anticipation and situational assessment skills (i.e., option generation and prioritization) of male and female high and low skill soccer players were measured at three temporal points (i.e., 400ms, 200ms and 0ms before contact), under cued and non-cued display conditions.

Display Conditions

To further delineate the role of LTWM in the decision making process, a novel paradigm was used in which the last frame was occluded (i.e., non-cued), and compared to the condition in which the last frame was frozen (i.e., cued – consistent with the previous game reading studies). In the occluded condition, the participants were forced to utilize LTM, mental representation and schemas, because on-line information was not available (Ward et al., 2011). Similar paradigms have been utilized to examine the role of environmental information and mental representations, to determine expert-novice differences in movement regulation and motor performance (Robertson & Elliott, 1996). However, the focus of those studies was on outcome and movement performance, and the researchers did not explore perceptual-cognitive skills (Ford, Hodges, Huys, & Williams, 2006).

The analysis of differences between the two display conditions provides insight to the mechanisms utilized during anticipation and situational assessment. According to proponents of the TTF heuristic and RPD models, relatively large differences between the display conditions should be observed for both high and low skill players (Raab & Johnson, 2007). Supporters of these approaches propose that game reading is an automated, serial, and recognition-based process and that LTWM is not utilized in this process (Klein, 1998). Thus, in a non-cued condition, environmental and perceptual information is not available to apply an automated recognition-based process. Consequently, anticipation and situational assessment performances should decline in a non-cued compared to a cued condition.

Conversely, according to proponents of LTWM theory, skilled performers develop enhanced situational representations, are able to utilize LTWM to analyze and evaluate a developing play, and consequently to make successful decisions (Ericsson & Kintsch, 1995). Thus supporters of this approach predict that differences between the conditions will be minimal for high compared to low skill players. High skill players have acquired the necessary mental representations and schemas and can efficiently utilize LTWM even when environmental information is not available (Tenenbaum, 2003). Low skill players have not developed those skills and need to rely on environmental information.

Additionally, the non-cued condition is similar to the dynamic environment of real game situations, in which players do not have the ability to "freeze" the play and assess the situation, but must rely on their recollection of the developing play to make a decision. Accordingly, the non-cued condition might be a more representative task of anticipation and situational assessment skills than the cued condition. The non-cued condition could increase the ecological validity of the task.

Finally, gender differences are predicted to be more prominent under the non-cued condition, because the use of spatial representations will increase. Previous studies have consistently shown gender gaps in spatial abilities (Voyer et al., 1995). These differences are predicted to also exist in perceptual-cognitive measures in team sport settings; especially under the non-cued condition, where spatial representations are necessary to achieve successful performance.

Temporal Conditions

Anticipation studies in individual settings utilizing the temporal occlusion paradigm have provided evidence that experts are able to successfully predict future actions earlier than non-experts (Williams & Burwitz, 1993). Moreover, skill level differences were found to be larger as the temporal point was further away from the action point. These differences are based on the notion that experts are able to utilize cues earlier because of their advanced knowledge base (Ericsson & Roring, 2008). Thus, similar findings should be observed in anticipation skills under team settings. Following the same rationale, larger differences in option generation and ranking (i.e., quantity and quality) should be accentuated earlier, when the play is still developing, than at the action point (i.e., ball contact).

Furthermore, in the earlier stages of a developing play there is more uncertainty, the pattern is less structured, and more time is available compared to the latter stages. Thus, skilled players should have more time to analyze the situation, generate more options, and utilize LTWM to rank the options. Conversely, just before the action point, time is limited, and the situation is more structured and certain. Thus, less time is available to analyze the situation, which will result in a fast, serial, and automatic recognition-based process by the skilled players. As a result, it is predicted that few, albeit quality options, will be generated. Differences between temporal conditions for the low skill players will be relatively small, because they have not acquired the appropriate knowledge base that will allow them to distinguish among situations efficiently. Finally, gender differences are predicted to be more prominent in the earlier stages of the developing play since the use of spatial representation will be increased to adjust for the unstructured pattern and uncertainty of the situation.

Purpose

To summarize, the purpose of the study was to examine the anticipation and option generation processes (of skilled and unskilled males and females) in a dynamic team sport setting. The specific factors that were explored included:

1) The underlying mechanisms that lead to advanced perceptual-cognitive skills,

2) The option generation and prioritization process

3) Perceptual-cognitive differences between genders.

Hypotheses

The hypotheses are:

1) High skill players would exhibit better anticipation and situational assessment skills than low skill players throughout the display and temporal conditions.

2) Larger differences between skill level groups would be observed in the non-cued condition and at the earliest temporal point.

3) Males would perform better than females on the anticipation and situational assessment tasks.

METHODS

Participants

One hundred seven participants completed the study. Participants were recruited from several universities located in the Southeastern region of the United States. Participants in the high-skill group were required to meet the following criteria: (1) played soccer at or above collegiate level, (2) played organized soccer for at least 7 years, (3) played soccer a total of 10 years or more. Low-skill participants needed to meet these conditions: (1) never played soccer above high-school level, (2) played organized soccer for no more than 3 years, (3) played soccer for no more than 5 years in total. Three participants did not fill out the answer sheets as required and another 19 participants did not meet the criteria required to belong to either the high and low skill level groups. Thus, 85 participants were included in the study analyses: 40 high-skill (19 male, 21 female), and 45 low-skill players (21 male, 24 female; see Table 1 for detailed demographic information).

Power Analysis (PA) and Sampling

An a priori power analysis was employed to determine the number of participants needed to be recruited for the study. G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) was used for the analysis (see Appendix A). Effect size was set at .4, α criteria was set to .05 and power at .8. Additionally, number of groups was set to 4 (i.e., skill level X gender) and measurement repetitions to 6 (i.e., cued X temporal conditions).The effect size used in the power analysis was estimated based on the pilot study in which effect size levels (a) between skill levels for anticipation variables ranged from .37-.91 and for option generation variables ranged between .69-1.99, and (b) between gender for anticipation variables ranged from 0-.24 and for option generation variables was between .44-.58. Additionally, similar medium-sized effect size levels (Cohen, 1988) were found in previous studies that utilized similar paradigms to examine anticipation and option generation differences between skill level groups and gender differences in spatial abilities (see Raab, & Johnson, 2007; Tenenbaum, Sar-El & Bar-Eli, 200; Voyer et al., 1995). Interpretation of the results of the power analysis suggests that the total sample size should be 55 (14 in each group), to detect a medium effect size, with 80% power, and with an alpha criteria of .05, using a RM MANOVA analysis.

Table 1: Demographic information by skill level and gender

Skill level	Variable	Gender	*n*	*M*	*SD*
Low Skill	Age (years)	Male	21	22.14	3.49
		Female	24	22.41	4.70
		Total	45	22.28	4.14
	Years played organized soccer	Male	21	1.00	1.14
		Female	24	.83	1.52
		Total	45	.91	1.34
	Total years played soccer	Male	21	2.21	1.75
		Female	24	1.69	2.14
		Total	45	1.93	1.96
High Skill	Age (years)	Male	19	21.00	1.73
		Female	21	19.80	1.28
		Total	40	20.37	1.61
	Years played organized soccer	Male	19	13.78	4.32
		Female	21	12.09	2.62
		Total	40	12.90	3.59
	Total years played soccer	Male	19	16.10	2.84
		Female	21	14.95	1.77
		Total	40	15.50	2.38

Test Film

The test film was adopted from footage used in a previous study (Ward et al., 2012). The original video stimuli were filmed during live, 11X11 professional and semi-professional matches in the U.K., in which the camera was positioned above and behind one of the goals. A similar camera angle was used in previous studies (see Johnson & Raab, 2003; Williams & Davids, 1995). Eighteen developing offensive plays were identified and edited to form a sequence of action clips. Each clip lasted 10s and ended just prior to when the player with the ball passed the ball to another player, took a shot on goal, or retained possession while running with the ball. For the current study the ten clips that differentiated between skilled and less skilled players the most in the pilot study was used for testing.

Tasks

Participants were presented with video stimuli. At the end of each action clip they were required to complete two simultaneous tasks: anticipation and situational assessment.

Anticipation Task

The participants' task was to predict what specifically will happen next (i.e., pass to player X, shot at goal, or retain possession/dribble) by indicating (a) the action that will be taken by the player with the ball, (b) direction of the play, and (c) if determined to be a pass, the destination of the pass/pass recipient.

Situational Assessment Task

Participants were asked to generate all plausible options (i.e., threats - from a defensive perspective) that the player with the ball might take, and that would warrant some consideration (not necessarily recalling all players, just those that are important at the end of the clip), and to prioritize each of their highlighted options by ranking them in an order that will reflect the greatest threat posed to the defense (i.e., rank 1 = highest threat).

Apparatus and Instrumentation

Simulated Task Environment (STE)

A standard classroom 2.7m x 3.5m projection screen and a projector was used to display the video stimuli.

Demographic Information

Demographic details such as age, gender, years playing organized and recreational soccer and age when first started to play soccer, was collected (see Appendix C).

Answer Sheet

The participants were provided with a replica drawing of the pitch on a standard size paper. The answer sheets included information from the final frame of each specific action clip (i.e., goal posts, pitch markings / boundary lines and position of the ball), but did not include any player information (offensive or defensive players). Participants used a pencil to mark their answers on a sheet, using “X” for offensive players, “O” for defensive players, arrows for direction of play, the letter “A” to mark the anticipated action, and numbers (e.g., 1-5) to indicate rank of action threats (see Appendix D).

Task-Specific Self Efficacy (TSSE; Bandura, 1986)

The TSSE was used to measure participants beliefs in their ability to successfully complete the tasks (see Appendix E). The TSSE was administered pre- and post-task and included two items on an 11 point scale ranging from 0 (i.e., Not confident at all) to 100 (i.e., Very confident).

Task Conditions

Display Conditions

Two display conditions were used (i.e., cued and non-cued). In the cued condition, the last frame of the action clip was frozen and remained on the screen until the next clip started (i.e., 35 seconds). Thus, visual information was available throughout the task. The non-cued condition included a blank frame that appeared immediately after the last frame of the action clip and continued to be displayed on the screen until the next clip started (i.e., 35 seconds). The participants completed the task without any detailed visual information and had to rely on their LTWM memory of the preceding pattern of play.

Temporal Conditions

Three temporal conditions were used in which the video clip terminated at a specific time prior to ball contact (i.e., t1 - 0ms, t2 - 200ms and t3 - 400ms). The temporal times chosen were based on previous research with similar temporal-occlusion paradigms that have examined anticipation skills (see Tenenbaum, Sar-El & Bar-Eli, 2000). Hence, in total there were six task conditions (i.e., two display X three temporal; see study design Appendix B).

Procedure

Participants were asked to read and sign a consent form, and provide demographic information. They were then given two practice trials (i.e., one cued and one non-cued) to become familiar with the task. Participants completed the TSSE and then performed a total of sixty trials. Prior to each trial a cue frame, in which a red box marking the initial position of the ball, was presented to prime the participants to the point on the screen they should focus on. Two different stimulus presentation orders were used, i.e., randomly assigned and counter balanced.

Participants had 35s to complete each answer sheet. The time to complete the entire task was approximately 60 minutes. Following the completion of the task, participants filled out the TSSE, and were provided time to ask questions, and were debriefed about the study.

Data Analyses

Anticipation Performance

Three anticipation variables were recorded: action, direction, and destination. One point was awarded for each correct response. Thus, for each trial, the maximum total anticipation score (i.e., action + direction + destination) was 3 (and for each condition, i.e., 10 trials, a maximum of 30). Internal reliability of the total anticipation measurement in the current study was $\alpha = .86$.

Situational Assessment Performance

In the study by Ward et al. (2012), three expert soccer coaches from an English Premier League Football club were employed to identify and prioritize the relevant task options for each trial. The coaches were able to analyze and view the film several times, to ensure they were provided with sufficient time and information to identify the relevant options. The coaches' inter-rater reliability for options ranked was 90.4%. However, only options of total agreement among coaches were included. The current study adopted the coaches' ranking that was used in the study conducted by Ward et al. (2012).

In the current study three situational assessment variables were analyzed: number of relevant options, number of irrelevant options, and option prioritization. Option prioritization was calculated using a weighted point system. Five points was awarded for identifying the highest priority, four points for the second highest rank, and so on. Additionally, when an option was relevant but not prioritized in the correct order (i.e., lower or higher than the coaches' ranking), the absolute difference between the two was deducted from the number of points allocated to the specific ranking. For example, if the coaches ranked an option "2" and a participant ranked the same option "3", the points that were awarded to the participant for that option was 3 (i.e., a correct response for the second highest option is 4 points, and by deducting from that the absolute difference between the participant's ranking and the coaches', the weighted points for that option was 3). To standardize the scores among the trials, the total number of points for each trial was divided by the maximum number of points available. The final option prioritization value for each trial was between 0 and 1 (a score of 1 indicating a perfect match between the participant's and coaches' prioritization).

One rater scored the variables for all the participants, while another rater scored 20% of the participants. The two raters were given the same instructions, and scored all the variables independently. Raters were not provided with any details regarding the group (i.e., skill level, gender) and condition (i.e., display, temporal), to assure unbiased ratings (i.e., blind scoring). Inter-rater agreement was calculated for 20% of the variables that both raters scored. Percent agreement was above 85% (i.e., 87.4%) and inter-rater reliability using the Kappa statistic was .81, which is considered between a strong and almost perfect agreement level (Landis & Koch, 1977; McHugh, 2012). In addition, all of the option generation measures in the study were reliable (relevant options: $\alpha = .90$, irrelevant options: $\alpha = .94$, option prioritization: $\alpha = .88$)

Analyses

To examine group (skill level, gender) and condition (display and temporal) differences in performing each task (i.e., anticipation and situational assessment), a mixed-design RM ANOVA was used to analyze each variable. Skill level (high and low) and gender were the between-participants factors in each analysis and the display and temporal conditions were the within-participants factors. Effect size coefficients (partial eta squared, Cohen's *d*) were used to estimate the effects magnitudes where necessary.

RESULTS

Anticipation Data

The analysis of total anticipation scores (i.e., action + direction + destination; for descriptive statistics see table 2) revealed a significant main effect for skill level, F (1, 81) = 16.32, $p < .001$, $\eta_p^2 = .17$. High skill participants were able to anticipate the opponents action more accurately (M = 15.77, SD = 3.55) than low skill participants (M = 13.57, SD = 3.52, d = .63; see Figure 1). Additionally, the gender main effect was significant, F (1, 81) = 11.40, $p <$ .001, $\eta_p^2 = .13$. Male participants (M = 15.60, SD = 3.63) predicted what will happen next more accurately than female participants (M = 13.73, SD = 3.20, d = .55; see Figure 2).

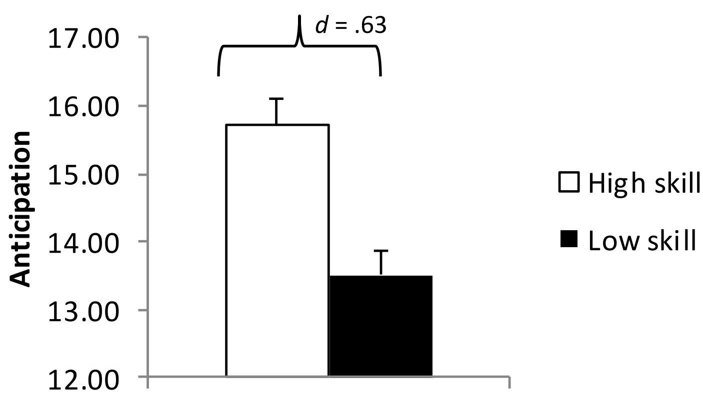


Figure 1: Average anticipation scores by skill-level.

Task condition main effects were significant for both display conditions (i.e., cued and non-cued), F (1, 81) = 45.00, $p < .001$, $\eta_p^2 = .36$, and temporal conditions (t1-0ms, t2-200ms, t3-400ms), F (2, 80) = 8.42, $p < .001$, $\eta_p^2 = .09$. Participants performed better in the cued condition (M = 15.50, SD = 3.51) compared to the non-cued condition (M = 13.83, SD = 3.91, d = .55; see

Figure 3), and in the later temporal conditions (t1 - 0ms: M = 15.04, SD = 4.00; t2 - 200ms: M = 15.01, SD = 3.55) compared to the earlier temporal condition (i.e., t3 - 400ms: M = 13.95, SD = 3.55; d = .28 & d = .31, respectively; see Figure 4).

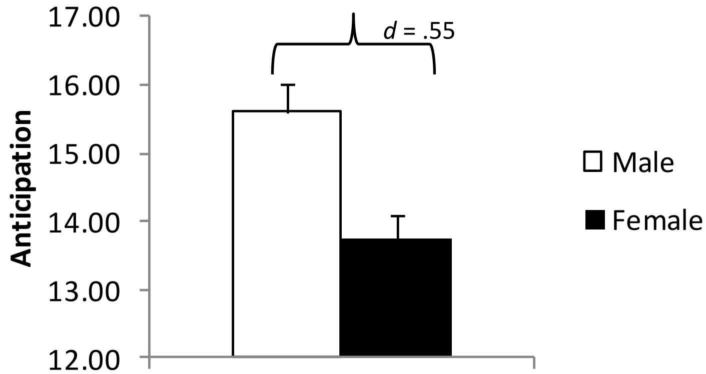


Figure 2: Average anticipation scores by gender.

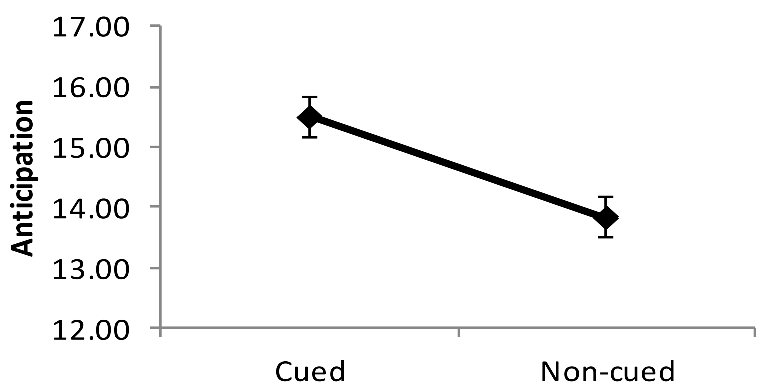


Figure 3: Average anticipation scores by display conditions.

The Skill X Temporal condition interaction resulted in a significant effect for total anticipation scores, F (2, 80) = 4.55, p = .01, $\eta_p^2 = .05$. The temporal conditions affected the performance of the high skill group on the anticipation task in a systematic manner, i.e., decreasing anticipation accuracy as the temporal point was farther from the action point. Low skill participants performance was not affected by the temporal conditions in a systematic manner, i.e., anticipation fluctuated among the temporal conditions (see Figure 5). The Skill X Display condition interaction was not significant.

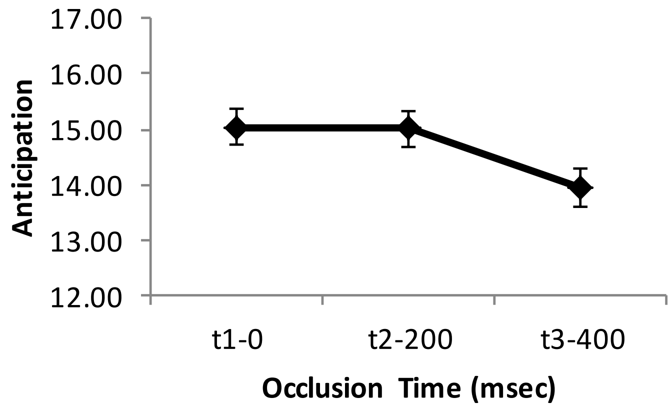


Figure 4: Average anticipation scores by temporal conditions.

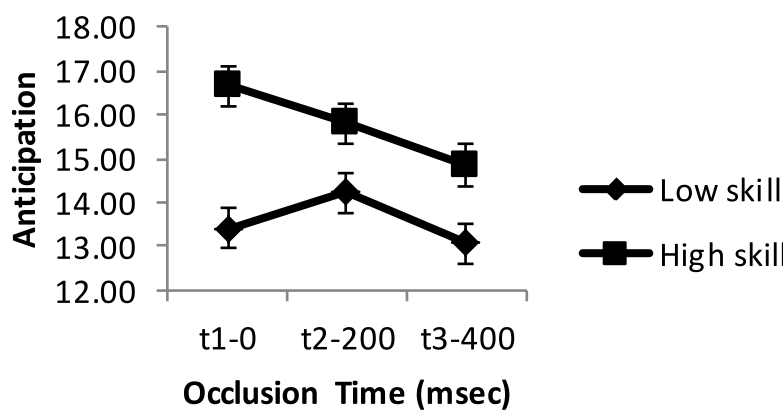


Figure 5: Means and SEs for anticipation by skill-level and temporal condition

The gender interactions with display conditions and temporal conditions were not significant, but trends were observed, F (1, 81) = 3.13, p = .08, η_p^2 = .04; F (2, 80) = 2.21, p = .09, η_p^2 = .03, respectively, suggesting that females were affected by the task conditions more than males. All other interactions were non-significant.

Table 2: Mean, SD, percent correct, and effect size for anticipation scores by skill level, gender and task condition.

		Anticipation (action + direction + destination) (max. score: 30)					
Skill level	Gender	Non-Cued			Cued		
		t1 - 0ms	t2 - 200ms	t3 - 400ms	t1 - 0ms	t2 - 200ms	t3 - 400ms
Low skill	Male	14.19(4.58)	14.00(3.62)	13.95(3.63)	14.19(3.88)	15.86(3.89)	15.14(3.00)
		47%	47%	47%	47%	53%	50%
	Female	11.75(3.21)	12.33(3.69)	10.92(2.99)	13.58(2.78)	14.67(3.28)	12.25(2.33)
		39%	41%	36%	45%	50%	41%
High skill	Male	17.37(3.65)	15.32(3.52)	15.11(4.24)	18.32(3.38)	17.21(3.08)	16.63(3.08)
		58%	51%	50%	61%	57%	55%
	Female	13.85(3.68)	14.24(3.16)	12.95(3.92)	17.10(3.13)	16.43(3.19)	14.67(3.20)
		46%	47%	43%	57%	55%	49%

Situational Assessment Task

Task-Relevant Options

Significant main effects were observed on task-relevant options generated for gender, F (1, 81) = 8.621, $p < .001$, η_p^2 = .10, display conditions, F (1, 81) = 118.633, $p < .001$, η_p^2 = .59

and temporal conditions *F* (2, 80) = 4.73, $p < .001$, $\eta_p^2 = .06$ (for descriptive statistics see table 3). Specifically, male participants generated more task-relevant options (*M* = 15.80, *SD* = 3.12) than female participants (*M* = 14.10, *SD* = 3.49, *d* = .52; see Figure 6). In addition, more task-relevant options were generated in the cued condition (*M* = 16.1, *SD* = 3.39), than in the non-cued condition (*M* = 13.78, *SD* = 3.46, *d* = .67; see Figure 7), and at the latest temporal point, t1-0ms (*M* = 15.331, *SD* = 3.38) compared to the earlier temporal points, t2-200ms (*M* = 14.84, *SD* = 3.48, *d* = .15) and t3-400ms (*M* = 14.67, *SD* = 3.41, *d* = .21; see Figure 8). The main effect for skill level was non-significant, *F* (1, 81) = 2.21, *p* = .14, $\eta_p^2 = .03$.

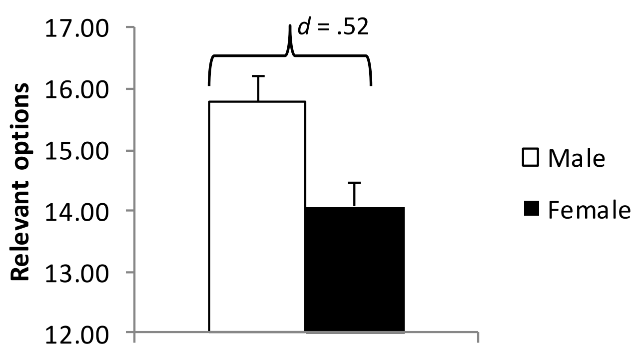


Figure 6: Average number of relevant options generated by gender.

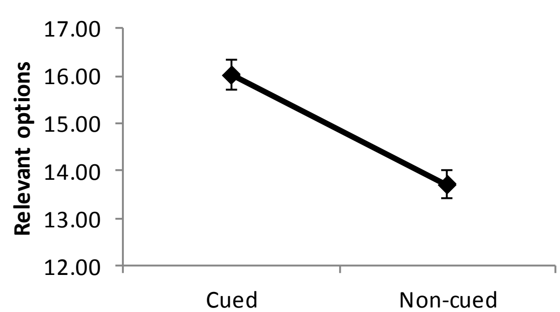


Figure 7: Average number of relevant options generated by display condition.

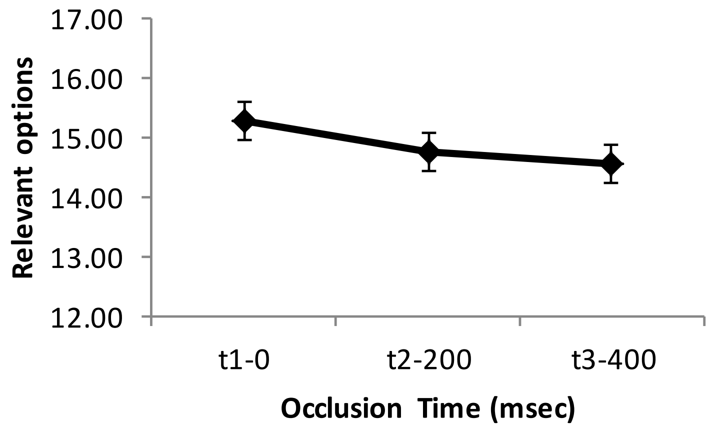


Figure 8: Average number of relevant options generated by temporal condition.

The Skill X Temporal condition interaction was significant, F (2, 80) = 1.56, $p < .001$, $\eta_p^2 = .02$, indicating that temporal conditions only affected the low skill participants (see Figure 9). Finally, the Display X Temporal condition interaction was significant, F (2, 80) = 4.07, p = .02, $\eta_p^2 = .05$. Temporal conditions affected the amount of relevant options generated in the non-cued condition more than in the cued condition (see Figure 10). Gender interactions were not significant in the analysis of the task-relevant options.

Task-Irrelevant Options

The analysis of task-irrelevant options revealed main effects for skill level, F (1, 81) = 37.85, $p < .001$, $\eta_p^2 = .32$, display condition, F (1, 81) = 20.54, $p < .001$, $\eta_p^2 = .20$, and temporal condition, F (2, 80) = 9.10, $p < .001$, $\eta_p^2 = .12$. Skilled participants (M = 13.74, SD = 5.19) generated fewer task-irrelevant options than less skilled participants (M = 19.38, SD = 5.54, d = 1.02; see Figure11). In addition, participants generated more irrelevant options in the cued condition (M = 17.38, SD = 6.45), compared to the non-cued condition (M = 15.74, SD = 5.59, d = .28; see Figure12). All three temporal conditions were significantly different from each other, with participants generating the fewest number of irrelevant options in the t1-0ms condition (*M* = 15.75, *SD* = 5.68), followed by the t3-400ms (*M* = 16.66, *SD* = 6.10), and the t2-200ms (*M* = 17.28, *SD* = 6.32) conditions (see Figure 13).

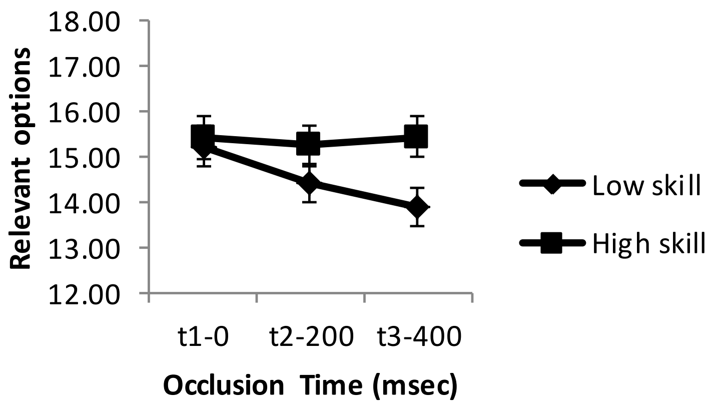


Figure 9: Means and SEs of relevant options by skill-level and temporal condition.

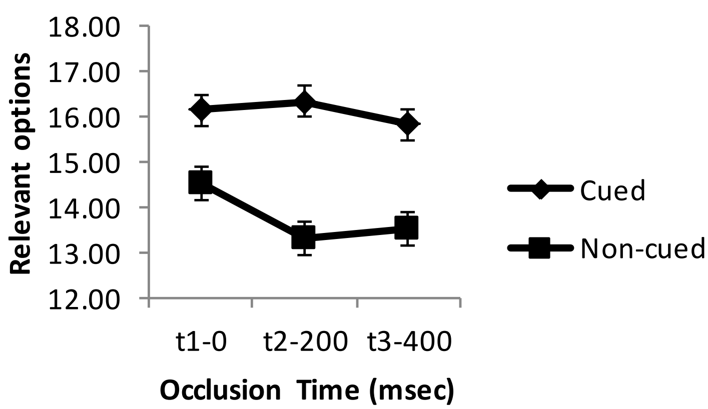


Figure 10: Means and SEs of relevant options by display and temporal conditions.

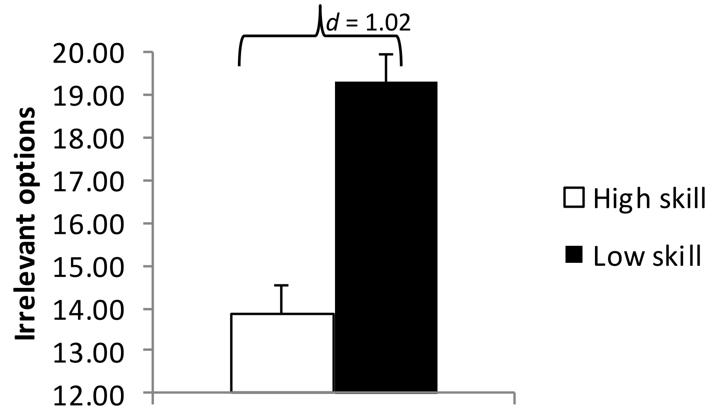


Figure 11: Average number of irrelevant options generated by skill level.

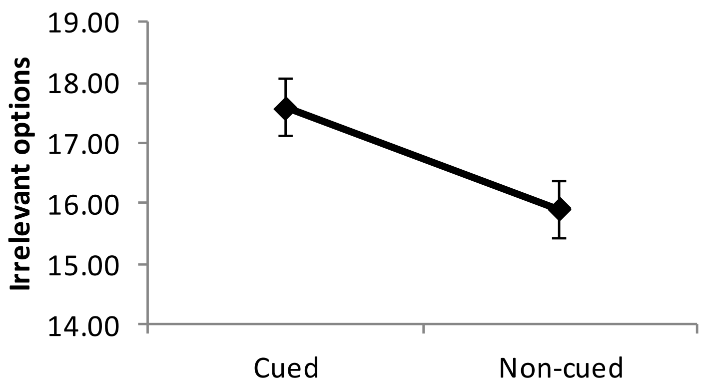


Figure 12: Average number of irrelevant options generated by display condition.

Furthermore, a significant Skill X Gender interaction effect emerged, F (1, 81) = 15.08, $p < .001$, $\eta_p^2 = .16$. Larger differences between skill level groups were observed within males, than females (see Figure 14). Finally, the Display X Temporal condition interaction was significant, F (2, 80) = 5.90, $p < .001$, $\eta_p^2 = .07$. In the non-cued condition participants generated more irrelevant options as the temporal point was farther from the action point, while in the cued condition the most irrelevant options generated was in the middle temporal point (i.e., t2-200ms; see Figure 15). The gender main effect and all other interaction effects were non-significant.

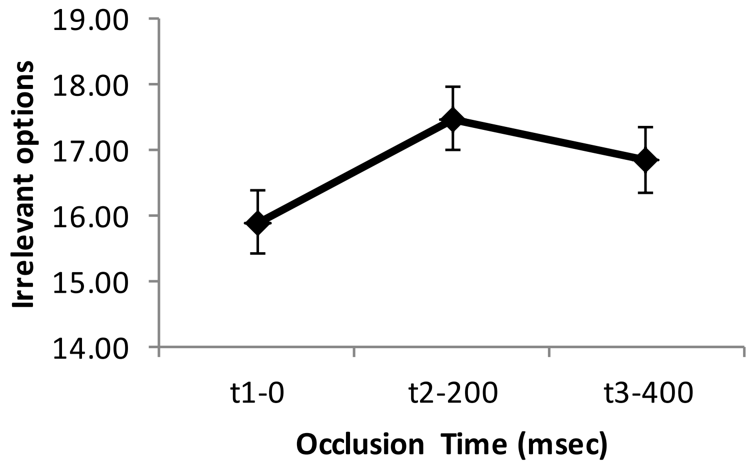


Figure 13: Average number of irrelevant options generated by temporal condition.

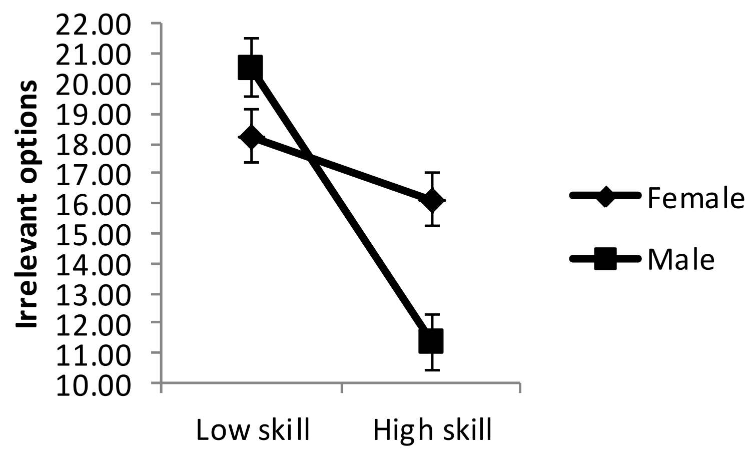


Figure 14: Means and SEs of irrelevant options by skill-level and gender.

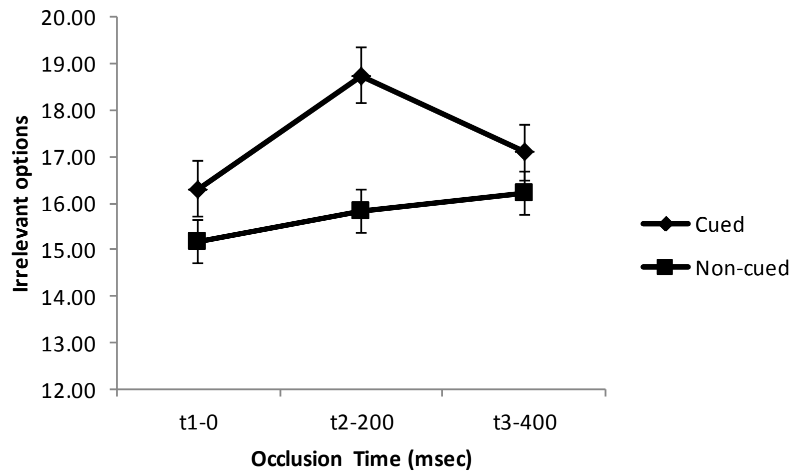


Figure 15: Means and SEs of irrelevant options by display and temporal conditions.

Option Prioritization

Finally, significant main effects were observed on the option prioritization scores for skill, F (1, 81) = 7.45, $p < .001$, $\eta_p^2 = .08$, gender, F (1, 81) = 15.19, $p < .001$, $\eta_p^2 = .16$, display conditions, F (1, 81) = 50.60, $p < .001$, $\eta_p^2 = .39$, and temporal conditions F (2, 82) = 9.13, $p < .001$, $\eta_p^2 = .10$. High skill participants were able to prioritize the relevant options better than the low-skill participants (M = 4.45, SD = 1.03 and M = 4.01, SD = .96, d = .44, respectively; see Figure 16). Male participants (M = 4.54, SD = .98) prioritized options better than females (M = 3.92, SD = .98, d = .64; see Figure 17). Furthermore, participants were able to prioritize the relevant options better in the cued condition than the non-cued condition (M = 4.44, SD = .98 and M = 4.03, SD = 1.08, d = .38, respectively; see Figure 18), and in the later temporal conditions (t1-0ms: M = 4.30, SD = 1.01 and t2-200ms: M = 4.33, SD = 1.12) than the earliest temporal point (t3-400ms: M = 4.06, SD = .99; see Figure 19).

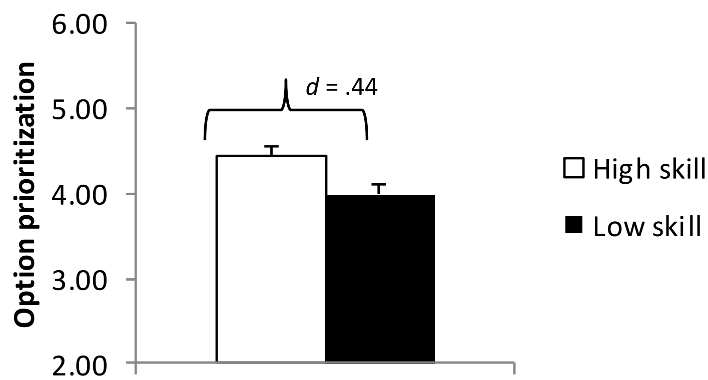


Figure 16: Mean option prioritization scores by skill level.

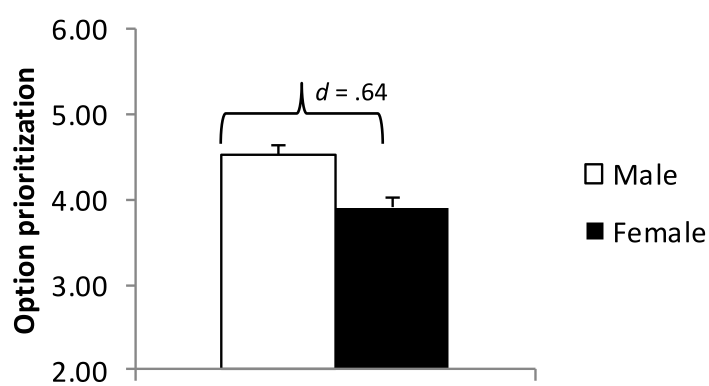


Figure 17: Mean option prioritization scores by gender.

The Skill X Display conditions F (1, 81) = 20.48, p < .001, η_p^2 = .20, and Skill X Temporal conditions, F (2, 80) = 3.16, p = .04, η_p^2 = .04, interactions were significant. The results suggest that display conditions only affected the skilled group; while the temporal conditions only affected the low skilled group (See Figure 20 and 21, respectively). Finally, the Display X Temporal condition interaction was significant, F (2, 80) = 4.80, p = .01, η_p^2 = .06. There was a sharp decline in option prioritization scores at the earliest temporal point (i.e., t3-

400ms) in the non-cued condition, which was not observed in the cued condition (see Figure 22).The gender interactions and all other interactions were non-significant.

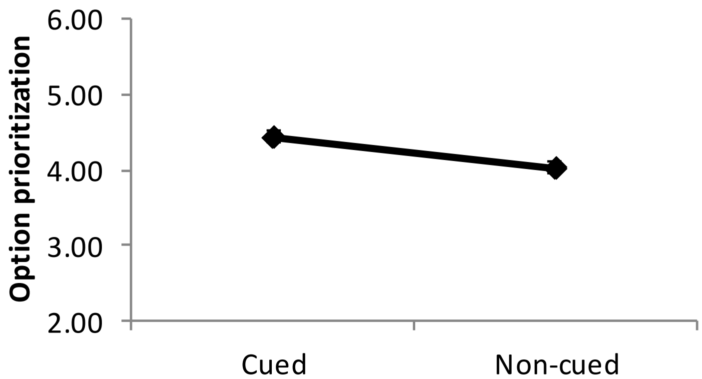


Figure 18: Mean option prioritization scores by display condition

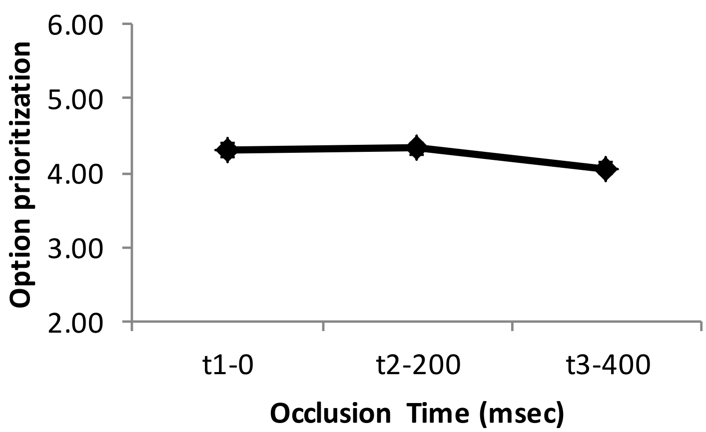


Figure 19: Mean option prioritization scores by temporal condition.

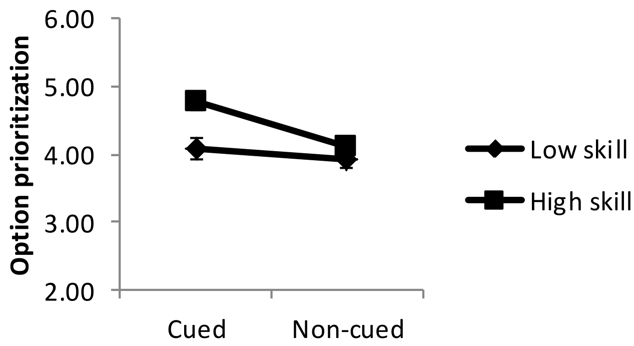


Figure 20: Means and SEs of option prioritization scores by skill and display condition.

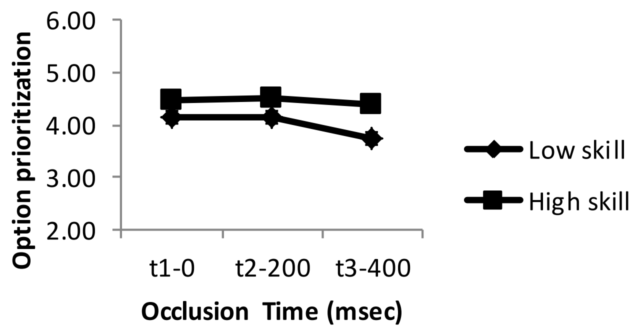


Figure 21: Means and SEs of option prioritization scores by skill and temporal condition.

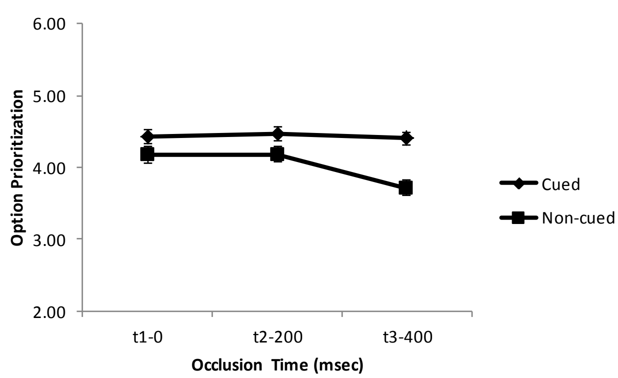


Figure 22: Means and SEs of option prioritization scores by display and temporal conditions.

Table 3: Mean, SD, percent correct, and effect size for situational assessment by skill level, gender and task condition.

Situational assessment	Skill level	Gender	Non-Cued			Cued		
			t1 - 0ms	t2 - 200ms	t3 - 400ms	t1 - 0ms	t2 - 200ms	t3 - 400ms
Task -relevant options (max. 30 options)	Low skill	Male	15.43(3.64) 51%	14.57(3.89) 49%	13.67(3.47) 46%	17.14(3.02) 57%	16.52(3.67) 55%	16.19(3.23) 54%
		Female	13.88(4.22) 46%	11.63(3.29) 39%	11.75(3.27) 39%	14.50(3.01) 48%	15.00(3.39) 50%	13.96(3.72) 47%
	High skill	Male	14.37(2.56) 48%	14.21(2.97) 47%	15.16(2.74) 51%	17.00(2.21) 57%	17.42(2.97) 58%	17.79(2.25) 59%
		Female	14.38(2.91) 48%	12.90(3.39) 43%	13.43(3.36) 45%	15.95(4.22) 53%	16.43(3.33) 55%	15.43(3.20) 51%
Task -irrelevant options	Low skill	Male	18.62(6.03) 1.86(per trial)	19.95(4.73) 2.00(per trial)	20.48(5.60) 2.05(per trial)	20.19(6.18) 2.02(per trial)	22.71(6.40) 2.27(per trial)	21.86(5.46) 2.19(per trial)
		Female	15.92(4.45) 1.59(per trial)	17.54(5.12) 1.75(per trial)	18.29(5.19) 1.83(per trial)	18.08(5.31) 1.81(per trial)	21.08(5.68) 2.11(per trial)	18.42(5.52) 1.84(per trial)
	High skill	Male	11.42(4.51) 1.14(per trial)	10.53(3.98) 1.05(per trial)	10.42(3.75) 1.04(per trial)	10.63(3.52) 1.06(per trial)	13.21(6.54) 1.32(per trial)	11.84(4.39) 1.18(per trial)
		Female	14.76(3.46) 1.48(per trial)	15.29(3.66) 1.53(per trial)	15.67(4.31) 1.57(per trial)	16.33(4.94) 1.63(per trial)	17.95(6.58) 1.80(per trial)	16.86(5.40) 1.69(per trial)
Option prioritization (max. 10)	Low skill	Male	4.33(1.29) 43%	4.52(1.42) 45%	3.74(.89) 37%	4.40(.81) 44%	4.45(1.09) 45%	4.28(.7) 43%
		Female	4.08(1.02) 41%	3.83(1.16) 38%	3.11(1.05) 31%	3.75(1.05) 38%	3.79(.70) 38%	3.83(.89) 38%
	High skill	Male	4.28(.78) 43%	4.54(1.00) 45%	4.41(.90) 44%	5.16(.70) 52%	5.21(.60) 52%	5.19(.71) 52%
		Female	4.02(.87) 40%	3.84(1.15) 38%	3.60(.85) 36%	4.41(1.16) 44%	4.42(.88) 44%	4.32(.94) 43%

Summary of Results

A series of RM ANOVAs were conducted to test the main hypotheses of the study. In general and as predicted high skill players performed better on the anticipation and situational assessment tasks. Specifically, findings revealed that high skill players (a) were better able to predict what will happen next (i.e., anticipation), (b) generated less irrelevant options, and (c) prioritized the relevant options better, than low skill players. The only non-significant difference between the skill level groups was on the amount of relevant options generated.

Results pertaining to the second hypothesis were equivocal. It was predicted that larger differences between the skill level groups will be revealed in the non-cued condition and at the earliest temporal point (i.e., t3-400ms before the action point). For the display conditions (i.e., cued and non-cued), no interaction effects were revealed for anticipation scores, and relevant and irrelevant option generated. However, contrary to expectations, for option prioritization scores the largest difference between the skill level groups existed in the cued condition.

For the temporal conditions, findings for relevant options generated and option prioritization scores supported expectations, in which the largest differences between the skill level groups was in the earliest time point (i.e., t3-400ms). Opposing findings emerged for anticipation scores, in which the largest difference was in the latest temporal point (i.e., t1-0ms). Additionally, a non-significant interaction effect, Skill X Temporal condition was found for irrelevant options generated.

Finally, as expected and stated in the third hypothesis, males generally performed better than females on the anticipation and situational assessment tasks. Gender differences were observed for anticipation, relevant options and option prioritization scores. Specifically, for these variables males performed better than females. A non-significant difference between genders was found for irrelevant options generated.

DISCUSSION

The purpose of this study was to examine the anticipation and option generation processes (of skilled and unskilled males and females) in a dynamic team sport setting. The specific factors that were explored included: a) the underlying mechanisms that lead to advanced perceptual-cognitive skills, b) the option generation and prioritization process, and c) perceptual-cognitive differences between genders. High- and low-skill level participants of both genders were assessed on anticipation and situational assessment skills under two display conditions (i.e., cued and non-cued) and three temporal conditions (i.e., t1-0ms, t 2-200ms, t3-400ms).

Anticipation Skills

Skill Level

As expected and as supported by both RPD and LTWM approaches high-skill players anticipated opponents' actions more accurately than low-skill participants under all task conditions. Thus, with regards to anticipation skills, findings supported the predictions that high skill players will perform better on the perceptual-cognitive tasks. Previous studies examining anticipation skills using the temporal occlusion paradigm found similar results; namely that skilled players are able to anticipate an opponent's next move more accurately and earlier than less skilled players (Gabbet et al., 2007; Mann et al., 2007). Thus, similar to findings in tennis, for example, where successful performers were able to anticipate more accurately the final destination of a served ball (Singer et al., 1996), high-skill soccer players were able to predict more accurately the specific action the player with the ball will make (i.e., pass, shoot, dribble), including the direction and final destination of the ball.

Display conditions. Contrary to expectations the display conditions affected participants of both skill levels similarly. Specifically, participants of both skill levels performed better in the display condition in which the last frame was frozen and environmental information related to the task was available (i.e., cued). Performance declined when environmental information was not available and participants were required to rely primarily on LTWM and utilize mental representations. Recall that according to proponents of the LTWM approach a relative minimal decline was expected for high-skill participants in the non-cued condition, because of their ability to utilize situational representations (Ericsson & Ward, 2007; Tenenbaum, 2003). However, a larger decline in anticipation performance was expected for the low-skill participants who lack accurate representations and have not acquired advanced LTWM capabilities. Alternatively, based on the RPD model and TTF heuristic, a significant decline for participants of both skill levels was expected. Proponents of these models argue that anticipation is an automatic recognition-based process which utilizes limited capacity STWM and thus, would be constrained under the non-cued condition (Klein et al., 1995).

Though the high-skill group maintained an advantage under the non-cued condition and, moreover, performed better in the non-cued condition than the low-skill group in the cued condition, the findings only partially support the predictions emanating from the LTWM and the RPD models. It is plausible that the low-skill participants had already acquired the situational representations needed, and thus were able to perform relatively well under the non-cued condition. Alternatively, it could be that the high-skill group did not develop the ability to utilize LTWM efficiently (Ericsson & Ward, 2007). Thus, future studies should compare anticipation skills of more experienced players (i.e., professional/experts) to participants with no experience at all, while also including additional skill level groups (e.g., near-experts, intermediate, amateur).

Another plausible explanation for the findings in the current study (and one that bridges between the distinctions of the two approaches) is that when on-line information is available it is utilized regardless of experience level; however, when environmental information is unavailable the perceptual-cognitive system adjusts, alters the decision making process and relies on LTM to efficiently predict future actions (Ericsson & Roring, 2007). Thus, future studies should trace the decision making process under the two conditions with the use of verbal reports to gain access to performers thought process during the task (Williams & Ericsson, 2005).

Temporal conditions. Contrary to what was anticipated, high skill participants were affected by the temporal conditions more than low skill participants. Specifically, performance of high skill participants declined as the temporal point was farther from the action point, while no differences in anticipation scores were observed for the low skill group. Moreover, the largest difference between the skill level groups was under the latest temporal point (i.e., t1-0ms – at ball contact). However, it is important to note that the skilled participants displayed superior anticipation skills compared to less skilled participants throughout the temporal conditions.

Findings from previous temporal occlusion studies indicated that as the temporal moment is further from the actual action (e.g., 400ms second as compared to 200ms seconds before action), anticipation differences between skilled and low skilled performers are accentuated (Gabbett et al., 2007; Tenenbaum et al., 2000). However, the majority of the previous studies were conducted in individual sport settings. Furthermore, although differences still existed under earlier temporal points, in some studies the differences were larger at later temporal points (Abernethy & Russell, 1987; Farrow & Abernethy, 2003). Thus, for example, in a study in which a temporal occlusion paradigm was utilized to examine differences in service anticipation accuracy between expert and novice tennis players, larger differences were observed at 600ms compared to 900ms before racquet-ball contact (Farrow & Abernethy, 2003).

Another possible explanation for these differences may arise because of discrepancies between individual and team sport settings such as: the increase of task complexity and inclusion of additional relevant environmental cues (e.g., team structures/patterns) in team sports (Grehaigne et al., 2001). These distinctions could cause the decisive temporal points to be altered (e.g., earlier/later) in team sport settings. Hence, future studies should include more temporal points with smaller gaps between the points to gain a better understanding of the underlying mechanisms and temporal cues that mediate superior anticipation performance in team sports.

Gender

Male participants were able to predict what will happen next more accurately then females throughout the task conditions (i.e., display and temporal). Thus, similar to findings in other domains (e.g., education, spatial abilities; see Buchmann et al., 2008 & Voyer et al., 1995) differences in perceptual-cognitive skills were also observed in a team sport setting. Furthermore, although significant interactions were not observed, effect sizes indicate that the task conditions affected the female participants more than the male participants as expected (i.e., display conditions - males: $d = .32$ & females: $d = .62$); temporal conditions (t1-t3) – males: $d = .19$ & females: $d = .41$). Under non-cued and earlier temporal conditions the use of spatial abilities and mental representations is increased, which might have caused anticipation scores to decline, especially for female participants. These results support previous findings in other domains indicating that males have better perceptual-cognitive abilities than females (Geiger & Litwiller, 2005). Future studies should expand on the current study and include general spatial abilities and perceptual-cognitive tasks, while at the same time measuring sport specific perceptual-cognitive abilities (e.g., anticipation, situational assessment).

Situational Assessment Skills

Skill Level

Consistent with previous research and with the RPD model, relatively few options were generated per trial (3.15) with high-skill participants generating fewer options (2.91) than low-skill participants (3.39) (Raab & Johnson, 2007). In a similar study in team handball but with younger participants (M_{age} = 15.27) and with different skill level groups, experts generated less options (2.99) than near-experts (3.19) and non-experts (3.72) (Raab & Laborde, 2011). Thus, findings in the handball study and the current soccer study are comparable.

However, a further analyses examining relevance of options revealed that high-skill players generated less irrelevant options compared to low-skill players. Additionally, differences in relevant option generated between skill levels were not significant. Thus, together the findings indicate that generating a greater amount of relevant options is *not* necessary for superior game reading skills. Conversely, generating fewer irrelevant options is *vital* in the decision making process.

These findings partially support predictions generated from the RPD model, that few options (albeit, irrelevant options) are needed for successful performance, while correspondingly, the findings partially support LTWM theory that larger number of relevant options are positively correlated with superior performance (Ward et al., 2011). Specifically, these findings indicate that both approaches complement each other and that efficiency of option generation is the crucial factor needed for achieving optimal decisions. Indeed, when examining the ratio of relevant to irrelevant options generated, large difference were observed between the high and low skill level groups (*M* = 1.30, *SD* = .67; *M* = .80, *SD* = .28, respectively, *d* = 1.05). Thus, these findings support the predictions that there would be skill level differences in performance on the perceptual-cognitive tasks because high skill players' option generation process was more efficient than low skill players. Future studies should examine the relationship between the ratio of relevant to irrelevant options, and the perceptual-cognitive processes in further detail.

Finally, analyses of the option prioritization scores revealed that high-skill participants were better able to indicate which options were more threatening than less-skill participants. Thus, although there were no significant differences in amount of relevant options generated between the skill level groups, high-skill participants were able to prioritize the relevant options better than low-skill participants. These findings indicate that the analytic ability to prioritize options plays a major role in the perceptual-cognitive process, and is in-line with LTWM theory (Ericsson & Kintsch, 1995; Tenenbaum, 2003).

Display conditions. Both skill level groups generated more task relevant and irrelevant options in the cued condition. Thus, when forced to rely on LTM (non-cued condition, where environmental information is not available) the number of relevant and irrelevant options generated decreases regardless of skill level. These findings indicate that perhaps the mechanisms utilized to generate relevant and irrelevant options are similar, or alternatively, that when perceptual information is not available, the amount of relevant and irrelevant options generated decrease.

In addition, option prioritization scores revealed an interaction between skill level and display conditions. Namely, that a larger difference between skill level groups was observed under the cued condition than the non-cued condition. These results coupled with the option generation findings diverge from what was anticipated and are difficult to explain using either

LTWM or RPD models. According to LTWM theory, differences were predicted to be greater under the non-cued condition because of the advantages high-skill players have in utilizing LTWM and mental schemas (Tenenbaum & Land, 2009). On the other hand, proponents of RPD and TTF models would argue that option generation and prioritization differences between display conditions should be similar for both skill level groups because the process is automatic, serial, and does not rely on LTM (Klein, 1989).

A plausible interpretation of these findings is that the cued condition is a more representative task, and that the task and environmental constraints under this condition resembles on field situations more than the non-cued condition (Pinder, Davids, Renshaw & Araujo, 2011). Indeed, more research is needed to further investigate these findings and increase our understanding of the mechanisms involved in the decision making process and elucidate the role LTWM, recognition-based processes, and task constraints play in team sport performance.

Temporal conditions. As predicted and stated in the second hypothesis, greater differences between the skill groups were observed in the earliest temporal point (i.e., t3-400ms) for relevant options generated and option prioritization scores. No significant differences were found for task irrelevant options. Interestingly, the amount of relevant options generated and prioritization of these options remained similar throughout the temporal conditions for high-skill participants, while low-skill participants generated fewer relevant options and performed poorly on the option prioritization task as the temporal condition was further away from the action point. Thus, perhaps skilled players are able to assess the developing situation relatively early, which provides them with advantages in the anticipation and decision making process (Abernethy & Russell, 1987). Conversely, less-skilled players change the amount and prioritization of relevant options as the play develops and thus have less time to anticipate, make a decision and react. This is the first study in the team sport domain that examined the option generation and prioritization process using the temporal occlusion paradigm. Thus, further research is needed to investigate the option prioritization process, which has scarcely been examined. Additionally, it is important to examine the relationship among the various perceptual-cognitive processes in future studies.

Gender

As with anticipation, male participants performed better in the situational assessment tasks than females. Specifically, males generated more task relevant options and prioritized the relevant options better than females. In the only other study in which option generation and decision making gender differences were explored in team sports (i.e., handball), non-significant differences were found between genders on the perceptual-cognitive tasks (Raab & Laborde, 2011). However, an examination of the effect sizes revealed medium to large effects between genders on quality of options generated for the expert group (d = .92), and non-expert group (d = .50), and a trivial effect for the near-expert group (d = .01). Specifically, males generated better options than females within the expert and non-expert groups, while no effects were observed in the near-expert group.

Additionally, in the current study differences between skill level groups on irrelevant options generated were larger for male than female participants. Interestingly, at the high-skill level males generated significantly less irrelevant options than females. However, at the low-skill level the difference in irrelevant options generated between genders was relatively small. Based on these findings it seems that even with years of experience and training female soccer players still generate relatively large amounts of irrelevant options. A plausible explanation for this finding is that females play at a slower pace than males (Kirkendall, 2007). This allows them more time to generate options and they are not “forced” to reduce the number of irrelevant options to succeed as males do.

Conclusion, Limitations and Future Research

The study contributes to the literature in that it is one of the first in the domain to examine anticipation and situational assessment skills in a dynamic *team* sport setting. Additionally, in the study an innovative video based temporal occlusion paradigm, adapted from previous studies (see Johnson and Raab, 2003; Ward et al., 2012), was utilized and findings provided support that perceptual-cognitive skills can be captured.

Two dominant and opposing perspectives (i.e., LTWM and RPD) guided the framework and methodology used in the study (Ericsson & Kintsch, 1995; Klein, 1989). Findings indicated that skilled players possess enhanced game reading skills more than less skilled players. Moreover, there were skill level differences in anticipation and situational assessment scores among the task conditions. These results suggest that there are differences between skilled and less-skilled participants in cue utilization, interpretation of environmental information and use of mental representation (i.e. differences in the perceptual-cognitive process) in team sport settings.

However, results pertaining to the mechanism employed to achieve these perceptual-cognitive advantages were inconclusive. A plausible explanation for the ambiguous findings is that the quality of film used (i.e., relatively low video quality, not in high definition) was insufficient to capture the hypothesized effects. Even though both skill level groups saw the same clips, the presentation quality might have affected the high-skill participants and low-skill participants differently. Furthermore, perhaps more ecologically valid methods (e.g., time constraints, full body responses, and inclusion of additional environmental information such as sounds and fans) are required to fully capture the processes that lead to superior decision making and to the development of expertise (Williams & Ericsson, 2005). Additionally, it is possible that because of the differences in task constraints between team and individual sport settings, results were ambiguous and were not in-line with previous findings in individual sport settings.

Furthermore, the current study was one of the first to examine gender based differences of perceptual-cognitive skills in the sport domain (Raab & Laborde, 2011). Consistent with findings in other domains males performed better than females on the perceptual-cognitive sports tasks (Collaer & Nelson, 2002). Moreover, gender differences on the anticipation and situational assessment tasks were observed for both skill level groups and were even heightened for irrelevant options generated in the high skill groups.

These findings indicate the perceptual-cognitive differences between genders are maintained even when females have similar training experiences as males, as is observed in other domains as well (Voyer et al., 1995). An explanation for these differences can be rooted in biological differences (Spelke, 2005). However, another plausible explanation is that the quality and quantity of training is different between the genders. Thus, future research should take into account the practice and training history of participants when examining gender differences. Additionally, in the current study although there were non-significant gender differences between each skill level group in total and organized years played soccer, males tended to have more experience in soccer. Thus, future studies should match subject experience to ensure that these differences do not affect the results. It is important to note that the video clips shown were of male soccer players only. None of the video clips were of female soccer players. It is plausible that there are differences in the way males and females play soccer (e.g., speed, movement and passing technique). Thus, in future studies in which gender differences are examined, video clips of both gender should be included to take into account the possible differences in the style of play of male and female soccer players.

Finally, the current findings combined with findings from similar studies in the domain indicate that it is possible to capture and measure anticipation and situational assessment skills using action clips and simulated task environments. Future studies should focus on applying the knowledge gained from these set of studies to examine and develop training methods that utilize video-based simulated task environment and create reliable and valid game reading measurement tools that will allow coaches and players to evaluate and monitor progress and acquisition of perceptual-cognitive skills.

Applications

The importance of applying theory to practice and research in the lab to on-field settings is crucial to improving training methods and performance outcomes. The findings in the current study suggest that it is possible to capture game reading skills in soccer. Soccer, as most other team sports, combines the utilization and development of physical, motor, and *cognitive* skills to achieve superior performance. To develop these skills, there first must be a reliable and valid tool that can be used to measure/capture these skills. Then, there must be specific training methods designed to improve and develop these skills. Finally, to evaluate the training methods, there is a need to assess improvement from one time period to another.

Today, there are an abundance of objective methods for measuring soccer specific physical abilities (e.g., endurance/fitness, agility, and speed), and motor skills (e.g., shooting and passing). Unfortunately, there are no available tools to measure soccer specific perceptual and cognitive skills (e.g., anticipation). Currently, these skills are assessed subjectively by coaches and other staff personnel, or alternatively by using general cognitive/psychological measures. For example the National Football League (NFL) uses the Wonderlic Personnel test to evaluate players. However, studies that have examined the predictive value of the test, found no relationship between scores on the test and success in the NFL (Kuzmits & Adams, 2008).

The current study, together with previous studies in the domain, has provided evidence that these sport specific skills can be measured and that it is possible to assess improvement on these skills. Moreover, perceptual-cognitive skills have consistently been shown to distinguish among players of different skill levels more than other skills such as physical abilities and basic visual functions (Ward & Williams, 2003). Additional research is needed to further develop and improve these assessment tools. However, this is a natural process, just as physical and motor ability assessment tools have been developed and improved throughout the years. It is the author's belief that the time has come to incorporate perceptual-cognitive assessment tools in developmental sport organizations and sport teams of various skill levels.

APPENDIX A

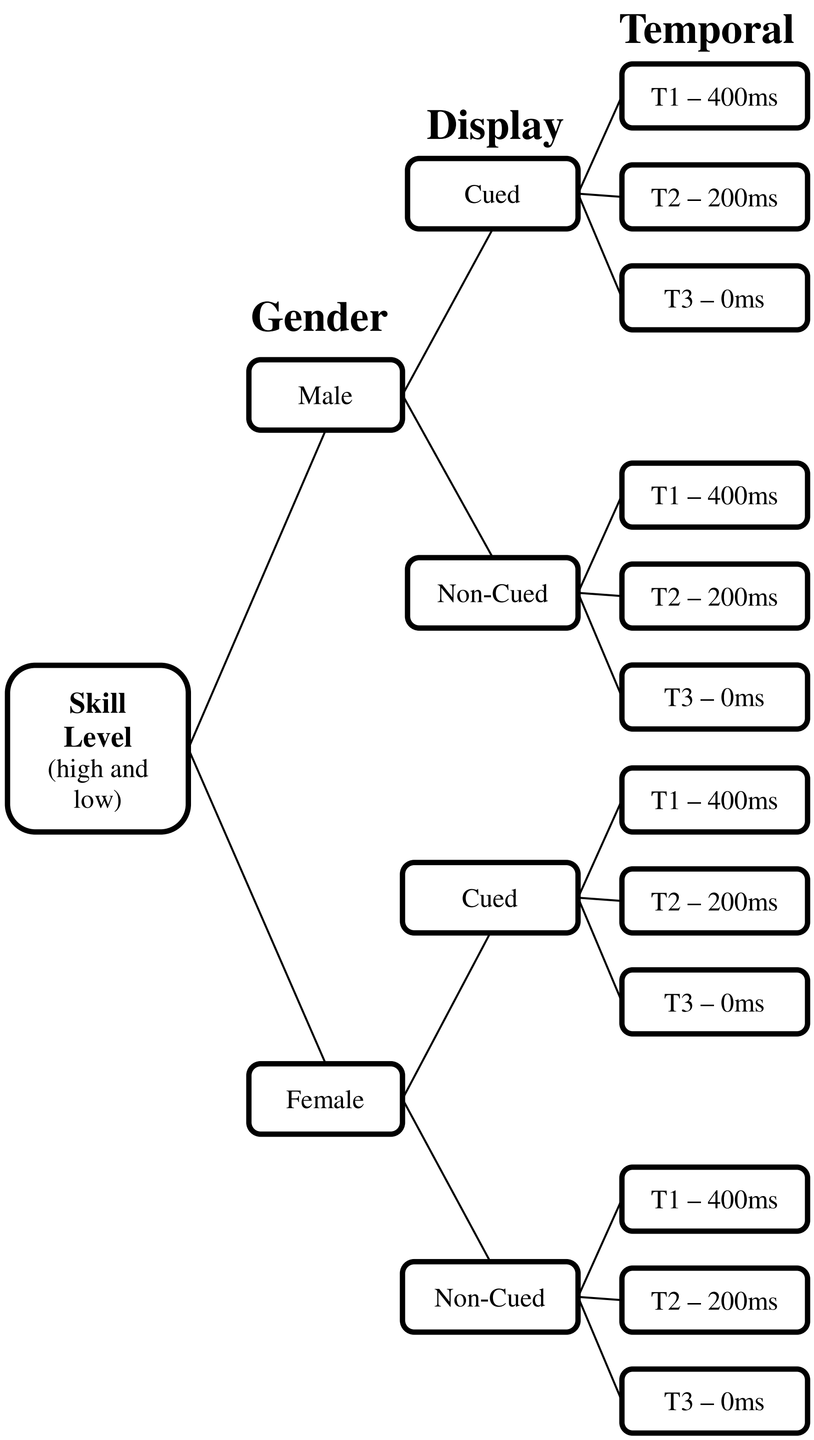
POWER ANALYSIS

F tests - MANOVA: Repeated measures, within-between interaction

Options:	Wilks U, Muller-Peterson Algorithm		
Analysis:	A priori: Compute required sample size		
Input:	Effect size f(U)	=	.4
	α err prob	=	0.05
	Power (1-β err prob)	=	.8
	Number of groups	=	4
	Number of measurements	=	6
Output:	Noncentrality parameter λ	=	20.8236325
	Critical F	=	1.7438765
	Numerator df	=	15.0000000
	Denominator df	=	130.1477
	Total sample size	=	55
	Actual power	=	0.8045784
	Wilks U	=	0.6638346

APPENDIX B

STUDY DESIGN



APPENDIX C

DEMOGRAPHIC INFORMATION

ID # ____

Please fill out the following information about yourself

1. Age __________

2. Gender __________

3. How many years have you been playing organized soccer? _______ years.

4. What is the highest level or organized soccer that you have played?

None/HS/College/Other_____

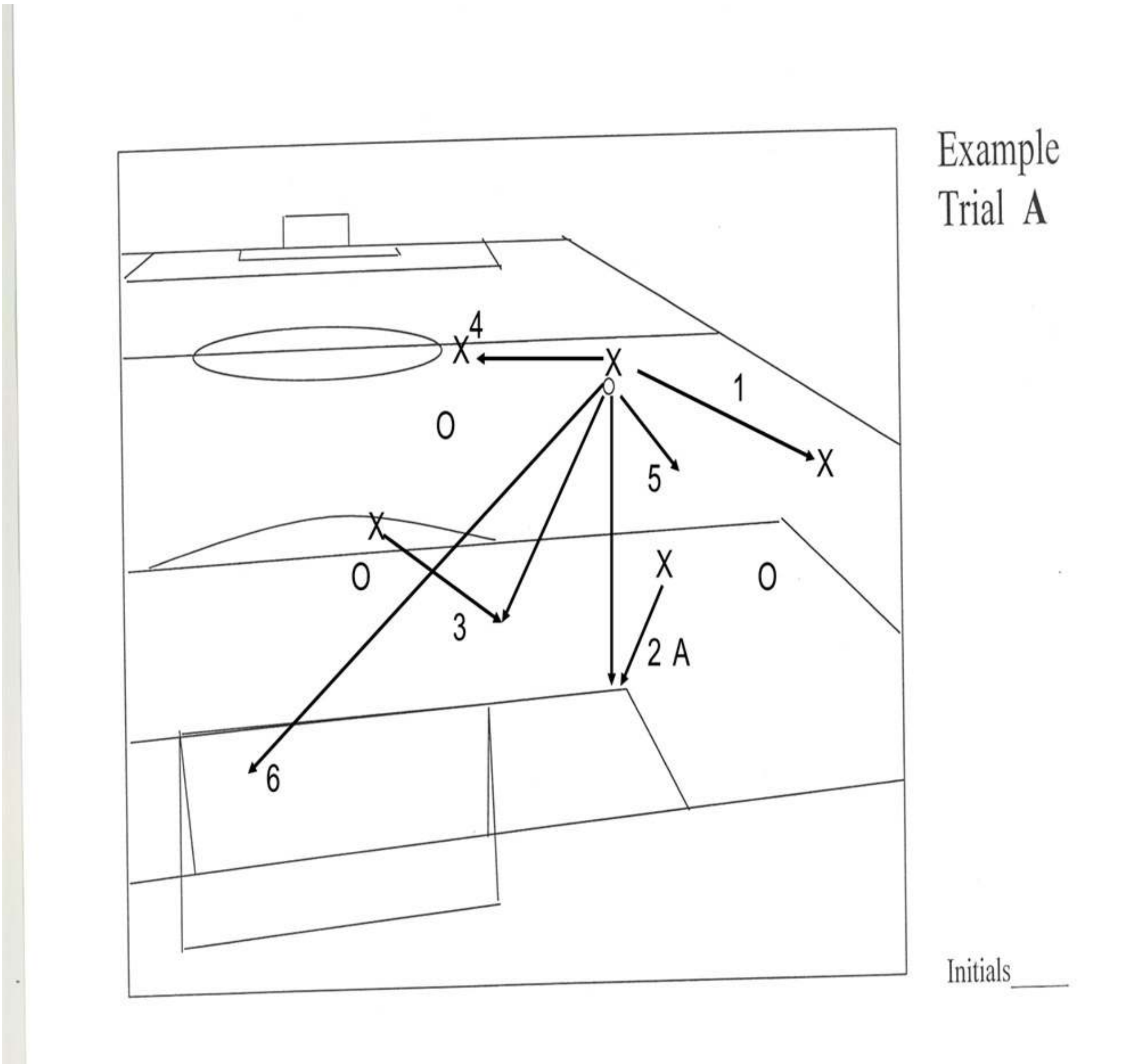
5. How many years have you been playing soccer (any form)? _________ years.

6. How old were you when you started playing soccer? _______ years old.

7. What position do you play? G/D/M/F and L/M/R (side).

APPENDIX D

ANSWER SHEET EXAMPLE



APPENDIX E

TASK EFFICACY

PRE

ID # ___

Please indicate to what degree you are confident that you can accurately predict what specifically will happen next (anticipation)?

Not confident at all *Very confident*

0 10 20 30 40 50 60 70 80 90 100

Please indicate to what degree you are confident that you can accurately generate all plausible options (i.e., threats - from a defensive perspective) that the player with the ball might take?

Not confident at all *Very confident*

0 10 20 30 40 50 60 70 80 90 100

POST

Please indicate to what degree you are confident that you accurately predicted what specifically happened in the clips (anticipated)?

Not confident at all *Very confident*

0 10 20 30 40 50 60 70 80 90 100

Please indicate to what degree you are confident that accurately generated all plausible options (i.e., threats - from a defensive perspective) that the player with the ball might have taken?

Not confident at all *Very confident*

0 10 20 30 40 50 60 70 80 90 100

APPENDIX F

CONSENT FORM

Florida State University
Consent to Participate in a Research Study

Dear Participant,

The purpose of this research is to better understand and measure game reading skills (e.g., anticipation, decision making) in soccer. You will be awarded 2 credit points for participating in the study if you have signed up for the study through the COE subject participation pool. Your participation in this study is strictly voluntary and there are no consequences if you decide not to participate in the study or if you decide to withdraw at any point (you will still receive full credit). This study is being conducted under the supervision of Dr. Gershon Tenenbaum of the Department of Educational Psychology and Learning Systems.

I am requesting your participation, which will involve watching a series of short video clips. You will respond to the video clips by marking the position of players from the video on a piece of paper. You will be given instructions on how to perform the task. The task should take no longer than 90 minutes in total.

You may stop participating in the research project at any point in time. You can also be assured that all answers to questions and surveys will be kept confidential to the extent allowed by law. Responses to the demographic form, questionnaires, and tests will be stored in a secure personal portfolio and destroyed on August 15, 2016.In addition, all identifying information on the demographic form filled out for the purpose of this study will be removed from the researcher's copy of the demographic form. Participants' responses will only be identified by a randomly assigned identification number. Results of the study may be published, but your name will not appear on any of the results. In addition, individual responses will be combined with group findings for reporting purposes.

You may benefit from this process. You may gain a greater awareness of your game reading skills in soccer. There are also some benefits of your participation to the broader community including improved soccer training procedures and an increased understanding of the mechanisms responsible for successful performance and learning. There are no anticipated risks in this research. Therefore the benefits outweigh any potential cost.
If you have any further questions please contact me, Itay Basevitch, or Dr. Gershon Tenenbaum, Thank you.

Sincerely,

Itay Basevitch

I have read the information in this consent form and agree to participate in this study. I have had the chance to ask any questions about this study, and they have been answered for me

______________________________(signature) _______________________ (date)

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

FSU Human Subjects Committee approved on 6/25/2012. Void after 6/24/2013. HSC # 2012.7880

APPENDIX G

IRB APPROVAL LETTER

Florida State
UNIVERSITY

Office of the Vice President for Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 06/26/2012

To: Itay Basevitch <>

Address:

Dept.: EDUCATIONAL PSYCHOLOGY AND LEARNING SYSTEMS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
GAME READING SKILLS IN SOCCER

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Expedited per 45 CFR § 46.110(7) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 06/24/2013 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Gershon Tenenbaum < >, Advisor
HSC No. 2012.7880

REFERENCES

Abernethy, B. B., Gill, D. P. D., Parks, S. L. S., & Packer, S. T. S. (2001). Expertise and the perception of kinematic and situational probability information. *Perception, 30,* 233-252.

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

Allard, F., Deakin, J., Parker, S., & Rodgers, W. (1993). Declarative knowledge in skilled motor performance: Byproduct or constituent? In J. L. Starkes & F. Allard (Eds.), *Cognitive issues in motor expertise* (pp. 95–108). Amsterdam, Netherlands: North-Holland/Elsevier Science Publishers, Amsterdam.

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*, 22-33.

Bandura, A. (1986). *Social foundation of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

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

Borgeaud, P., & Abernethy, B. (1987). Skilled performance in volleyball defense. *Journal of Sport Psychology, 9*, 400–406.

Buchmann, C., DiPrete, T. A. and McDaniel, A. (2008). Gender Inequalities in Education. *Annual Review of Sociology, 34*, 319–337.

Cahill, L. (2005, May). His brain, her brain. *Scientific American, 292*, 40–47.

Carpenter, P. A., & Just, M. A. (1986). Spatial ability: An information processing approach to psychometrics. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 3, pp. 221-253). Hillsdale, NJ: Erlbaum.

Caserta, R. J., & Singer, R. N. (2007). The effectiveness of situational awareness learning in response to video tennis match situations. *Journal of Applied Sport Psychology, 19*, 125-141

Caserta, R. J., Young, J., & Janelle, C. M. (2007). Old Dogs, New Tricks: Training the Perceptual Skills of Senior Tennis Players. *Journal of Sport and Exercise Psychology*, *29*, 479-497.

Chabris, C. F., & Hearst, E. S. (2003). Visualization, pattern recognition, and forward search: Effects of playing speed and sight of the position on grandmaster chess errors. *Cognitive Science, 27*, 637-648.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Collaer, M. L., & Nelson, J. D. (2002). Large visuospatial sex difference in line judgment: Possible role of attentional factors. *Brain and Cognition, 49*, 1-12.

Duff, S. J., & Hampson, E. (2000). A beneficial effect of estrogen on working memory in postmenopausal women taking hormone replacement therapy. Hormones and Behavior, 38, 262–276.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive–experiential and analytical–rational thinking styles. *Journal of Personality and Social Psychology, 71*, 390-405

Ericsson, K. A., & Kintsch, W. (1995). Long term working memory. *Psychological Review, 102*, 211–245.

Ericsson, K. A., & Oliver, W. (1988). Methodology for laboratory research on thinking: Task selection, collection of observations and data analysis. In R. J. Sternberg & E. E. Smith (Eds.). *The psychology of human thought* (pp. 392–428). Cambridge, UK: Cambridge University Press.

Ericsson, K. A., & Roring, R. W. (2008). Memory as a fully integrated aspect of skilled and expert performance. (pp. 351-380). San Diego, CA, US: Elsevier Academic Press, San Diego, CA.

Ericsson, K. A., & Staszewski, J. (1989). Skilled memory and expertise: Mechanisms of exceptional performance. In D. Klahr & K. Kotovsky (Eds.), *Complex information processing: The impact of Herbert A. Simon* (pp. 235–267). Hillsdale, NJ: Erlbaum.

Ericsson, K. A., & Ward, P. (2007). Capturing the naturally occurring superior performance of experts in the laboratory: Toward a science of expert and exceptional performance. *Current Directions in Psychological Science, 16*, 346-350.

Farrow, D., & Abernethy, B. (2003). Do expertise and the degree of perception-action coupling affect natural anticipatory performance? *Perception*, *32*(9), 1127-1140.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavioral Research Methods, 39*, 175-191

Ford, P., Hodges, N.J., Huys, R. & Williams, A.M. (2006). The role of external action-effects in the execution of a soccer kick: A comparison across skill-level. *Motor Control, 10,* 386-404.

Gabbett, T., Rubinoff, M., Thorburn, L., & Farrow, D. (2007). Testing and training anticipation skills in softball fielders. *International Journal of Sports Science & Coaching, 2*, 15-24.

Geiger, J. F., & Litwiller, R. M. (2005). Spatial working memory and gender differences in science. Journal of Instructional Psychology, 32, 49–58.

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

Haskins, M. J. (1965). Development of a response-recognition training film in tennis. *Perceptual and Motor Skills, 21*, 207-211.

Hodges, N. J., Huys, R., & Starkes, J. L. (2007). Methodological review and evaluation of research in expert performance in sport. In G. Tenenbaum, & R. C. Eklund (Eds.), *Handbook of Sport Psychology* (pp. 161–183). Hoboken, NJ: John Wiley and Sons.

Hogarth, R. M. (2008). On the learning of intuition. In H. Plessner, C. Betsch, & T. Betsch (Eds.). *A new look on intuition in judgment and decision making* (pp. 91–106). Mahwah, NJ: Erlbaum.

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

Jones, C. M., & Miles, T. R. (1978). Use of advance cues in predicting the flight of a lawn tennis ball. *Journal of Human Movement Studies*, *4*, 231-235.

Kirkendall, D. T. (2007). Issues in training the female player. *British journal of sports medicine*, *41*(suppl 1), i64-i67.

Klein, G. A. (1989). Recognition-primed decisions. In W.B. Rouse (Ed.), *Advances in man-machine systems research* (pp. 47-92). Greenwich, CT: JAI Press, Inc.

Klein, G. (1993). A recognition-primed decision making model of rapid decision making. In G. Klien, J. Orasanu, R. Calderwood and C., Zsambok Eds., *Decision Making In Action: Models and Methods*, pages 138-147. Norwood, NJ: Ablex.

Klein, G., Wolf, S., Militello, L., & Zsambok, C. (1995). Characteristics of skilled option generation in chess. *Organizational Behavior and Human Decision Processes, 62*, 63-69.

Kuzmits, F. E., & Adams, A. J. (2008). The NFL Combine: Does It Predict Performance in the National Football League?. *The Journal of Strength & Conditioning Research*, *22*(6), 1721-1727.

Landis, J. R., Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics. 33*, 159-174.

Lum, J. J., Enns, J. T., & Pratt, J. J. (2002). Visual orienting in college athletes: explorations of athlete type and gender. *Research Quarterly for Exercise and Sport*, *73*, 156-167.

Mann, D. Y., Williams, A., Ward, P., & Janelle, C. M. (2007). Perceptual-Cognitive Expertise in Sport: A Meta-Analysis. *Journal of Sport and Exercise Psychology*, *29*, 457-478.

McHugh, M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia Medica*, *22*(3), 276-282.

Panchuk, D., & Vickers, J. N. (2006). Gaze behaviors of goaltenders under spatial-temporal constraints. *Human Movement Science, 25*, 733-752.

Pinder, R. A., Davids, K., Renshaw, I., & Araújo, D. (2011). Manipulating informational constraints shapes movement reorganization in interceptive actions. *Attention, Perception, & Psychophysics*, *73*(4), 1242-1254.

Poulton, E. C. (1957). On prediction in skilled movements. *Psychological Bulletin, 54*, 467-478.

Quaiser-Pohl, C., & Lehmann, W. (2002). Girls' spatial abilities: Charting the contributions of experiences and attitudes in different academic groups. *British Journal of Educational Psychology, 72*, 245-260.

Raab, M., de Oliveira, R.F., Heinen, T. (2009). How do people perceive and generate options*?* *Progress in Brain Research, 174*, 49-59.

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

Raab, M., & Laborde, S. (2011). When to Blink and When to Think: Preference for Intuitive Decisions Results in Faster and Better Tactical Choices. *Research Quarterly For Exercise and Sport*, *82*, 89-98.

Robertson, S., & Elliott, D. (1996). The influence of skill in gymnastics and vision on dynamic balance. *International Journal of Sport Psychology, 27,* 361-368.

Ryan, J. P., Atkinson, T. M., & Dunham, K. T. (2004). Sports-related and gender differences on neuropsychological measures of frontal lobe functioning. *Clinical Journal of Sport Medicine*, *14*, 18-24.

Sims, E. L., Hardaker, W. M., & Queen, R. M. (2008). Gender differences in plantar loading during three soccer-specific tasks. *British Journal Of Sports Medicine*, *42*, 272-277.

Singer, R. N., Cauraugh, J. H., Chen, D., Steinberg, G. M., & Frehlich, S. G. (1996). Visual search, anticipation, and reactive comparisons between highly-skilled and beginning tennis players. *Journal of Applied Sport Psychology, 8,* 9-26

Speck, O., Ernst, T., Braun, J., Koch, C., Miller, E., & Chang, L. (2000). Gender differences in the functional organization of the brain for working memory. *NeuroReport: For Rapid Communication of Neuroscience Research, 11*, 2581-2585

Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science? A critical review. *American Psychologist, 62*, 950–958.

Tenenbaum, G. (2003). An integrated approach to decision making. In J. L. Starkes, & K. A. Ericsson (Eds.), *Expert performance in sport: Advances in research on sport expertise* (pp. 191–218). Champaign, IL: Human Kinetics.

Tenenbaum, G. & Land, W. (2009). Mental representations as an underlying mechanism for human performance. In Raab, M., Johnson, J., and H.R. Heekeren (Eds.), *Progress in Brain Research* (p. 251-266). The Netherlands: Elsevier.

Tenenbaum, G., Sar-El, T., & Bar-Eli, M. (2000). Anticipation of ball location in low and high-skill performers: A developmental perspective. *Psychology of Sport and Exercise, 1*, 117-128.

Vaeyens, R., Lenoir, M., Williams, A. M., Mazyn, L., & Philippaerts, R. M. (2007). The effects of task constraints on visual search behavior and decision-making skill in youth soccer players. *Journal of Sport and Exercise Psychology, 29*, 147-169.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2007). Mechanisms underpinning successful decision making in skilled youth soccer players: An analysis of visual search behaviors. *Journal of Motor Behavior, 39*, 395-408.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*, 250-270.

Ward, P., & Eccles, D. W. (2006). A commentary on "team cognition and expert teams: Emerging insights into performance for exceptional teams.". *International Journal of Sport and Exercise Psychology, 4*, 463-483

Ward, P., Ericsson, K. A., & Williams, A. M., (2012). *Complex perceptual cognitive expertise in a simulated task environment.* Manuscript submitted for publication.

Ward, P., Farrow, D., Harris, K. R., Williams, A. M., Eccles, D. W., & Ericsson, K. A. (2008). Training perceptual-cognitive skills: Can sport psychology research inform military decision training? *Military Psychology, 20*, S71-S102

Ward, P., Suss, J., & Basevitch, I. (2009). Expertise and expert performance-based training (ExPerT) in complex domains. *Technology, Instruction, Cognition and Learning, 7,* 121-145.

Ward, P., Suss, J., Eccles, D. W., Williams, A. M., & Harris, K. R. (2011). Skill-based differences in option generation in a complex task: A verbal protocol analysis. *Cognitive Processing, 12*, 289-300.

Ward, P., Torof, J., Whyte, J., Eccles, D. W., & Harris, K. R. (2010). Option generation and decision making in critical-care nursing. Paper presented at the 54th Annual Meeting of the Human Factors and Ergonomics Society, San Francisco, CA.

Ward, P., & Williams, A. M. (2003). Perceptual and cognitive skill development in soccer: The multidimensional nature of expert performance. *Journal of Sport and Exercise Psychology, 25*, 93-111.

Williams, A. M., & Burwitz, L. (1993). Advance cue utilization in soccer. In T. Reilly, J. Clarys, & A. Stibbe (Eds.), *Science and football* (Vol II, pp. 239–244). London: E & FN Spon.

Williams, M., & Davids, K. (1995). Declarative knowledge in sport: A by-product of experience or a characteristic of expertise? *Journal of Sport and Exercise Psychology, 17*, 259-275.

Williams, A. M., & Davids, K. K. (1998). Visual search strategy, selective attention, and expertise in soccer. *Research Quarterly For Exercise and Sport*, *69*, 111-128.

Williams, A. M., Davids, K., Burwitz, L., & Williams, J. (1993). Cognitive knowledge and soccer performance. *Perceptual and Motor Skills, 76*, 579-593.

Williams, A. M., Davids, K. K., Burwitz, L. L., & Williams, J. G. (1994). Visual search strategies in experienced and inexperienced soccer players. / Strategies de recherche visuelle chez des joueurs de football experimentes et inexperimentes. *Research Quarterly For Exercise & Sport*, *65*, 127-135.

Williams, A.M., & Ericsson, K.A. (2005). Some considerations when applying the expert performance approach in sport. *Human Movement Science, 24*, 283–307.

Williams, A. M., & Ward, P. (2003). Perceptual expertise: Development in sport. In J. L. Starkes & K. A. Ericsson (Eds.), *Expert performance in sport: Advances in research on sport expertise* (pp. 219–249). Champaign, IL: Human Kinetics.

Williams, A. M., & Ward, P. (2007). Perceptual-cognitive expertise in sport: Exploring new horizons. In G. Tenenbaum, & R. C. Eklund (Eds.), *Handbook of Sport Psychology* (pp. 203–223). New York: John Wiley and Sons.

Williams, A. M., Ward, P., & Chapman C. (2003). Training perceptual skill in field hockey: is there transfer from the laboratory to the field? *Research Quarterly for Exercise and Sport*, *74*, 98-103.

Winner, D. (2012, May 16). Beautiful game. Beautiful mind. *ESPN the Magazine*. Retrieved from http://espnfc.com/en/news/1071240/beautiful-game-beautiful-mind-.html

BIOGRAPHICAL SKETCH

My name is Itay Basevitch, a regular person who is living his dreams! I was born in TelAviv, Israel. When I was 5 I moved to Miami, FL. for 5 years and then moved back to Ceasarea, Israel. At the age of 15 I moved back to the USA, this time to Palo Alto, Cal. for another 4 years. I pursued my study interests and completed my B.S. in psychology at Tel Aviv University in 1997. I completed my M.S and PhD At Florida State University in 2013. Following my love for photography, I worked as a photography instructor for 2 years and eventually decided to shift my attention to computer programming and was a project manager in a start-up company and a software developer in a Fashion Company. I love to travel and am intrigued by places and people. I also love playing, watching, discussing and reading sports. My hobbies led to me to pursue my dream of becoming a sport psychologist.