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Examining the relationship between imagery use and mental toughness

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Examining the Relationship between Imagery Use and Mental Toughness

By

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EXAMINING THE RELATIONSHIP BETWEEN IMAGERY USE AND MENTAL TOUGHNESS

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ABSTRACT

The motivational functions of imagery include images of feeling confident, in control, and mentally tough (Hall et al., 1998). Despite the important contribution of mental toughness to athletic performance (Jones et al., 2007), little quantitative research has been devoted to examining this construct, or to developing strategies to enhance or maintain mental toughness. The present study investigated the relationship between imagery use and mental toughness. Participants included 151 varsity athletes (M_{age} = 20.70 ± 1.84). Imagery use was assessed using the Sport Imagery Questionnaire (Hall et al., 1998) and mental toughness with the Mental Toughness 48 Inventory (Clough et al., 2002). Hierarchical multiple regression analyses revealed that the motivational functions of imagery significantly predicted mental toughness, while the cognitive functions contributed minimally to the variance in mental toughness. Findings from the present study suggest that imagery use may be an effective strategy for developing or enhancing mental toughness in athletes.

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Introduction

Imagery is a training strategy employed by athletes of all ages (Munroe-Chandler, Hall, Fishburne, O, & Hall, 2007), sport types (Munroe, Hall, Simms, & Weinberg, 1998) and competitive levels (Hall, Rodgers, & Barr, 1990). In addition to being an effective performance enhancement technique (Beauchamp, Bray, & Albinson, 2002; Caliari, 2008), mental imagery is used as a method of increasing sport confidence (Callow, Roberts, & Fawkes, 2006) and reducing competitive anxiety levels (Hale & Whitehouse, 1998). Imagery has been defined as:

> …an experience that mimics real experience. We can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smells, tastes, or sounds without actually experiencing the real thing…It differs from dreams in that we are awake and conscious when we form an image. (White & Hardy, 1998, p. 389)

Paivio (1985) proposed an analytic framework of the functions of imagery that suggests that athletes employ imagery for both cognitive and motivational purposes. Further, these functions are purported to operate at both a general and a specific level. Cognitive Specific (CS) imagery pertains to the mental execution of specific skills, whereas Cognitive General (CG) imagery involves mentally rehearsing plans, routines, or strategies of play. Motivational Specific (MS) imagery entails imaging goal-oriented responses or achievements, while Motivational General (MG) involves imaging emotional or physiological arousal. Hall, Mack, Paivio, and Hausenblas (1998) later expanded on this last function of imagery, dividing it into two more specific categories.

Motivational General- Arousal (MG-A) imagery involves images related to the arousal and anxiety associated with competition, while Motivational General- Mastery (MG-M) involves images of feeling confident, in control, or mentally tough. Previous research has demonstrated associations between the motivational functions of imagery with self-confidence (Callow, Hardy, & Hall, 2001; Vadocz, Hall, & Moritz, 1997), self-efficacy (Beauchamp et al., 2002), collective efficacy (Munroe-Chandler & Hall, 2004; Shearer, Thomson, Mellalieu, & Shearer, 2007), controlling arousal and anxiety (Jones, Mace, Bray, McRae, & Stockbridge, 2002), and modifying cognitions (Martin & Hall, 1995). In an examination of the effects of an MS imagery intervention, Martin and Hall found beginner golfers to engage in more voluntary practice, to adhere more to training programs and to have more realistic self-expectations when using this type of imagery. The MG-A function of imagery is employed by athletes as a means to get psyched up or motivated, as well as to stay calm and maintain composure (Munroe et al., 1998), and has also been found to be associated with cognitive anxiety (Strachan & Munroe-Chandler, 2006; Vadocz et al.). In a sample of elite roller skaters, Vadocz et al. found athletes who employed more MG-M imagery demonstrated higher levels of self-confidence than those who used this function of imagery less frequently. Given that this relationship was not evident for any of the other four imagery functions, Vadocz et al. suggested that MG-M imagery, which involves images of being in control or being mentally tough, should be used by athletes who demonstrate lower levels of self-confidence.

In addition to the supported relationship between MG-M imagery and self confidence, an association has also been demonstrated between MG-M imagery and collective efficacy. Munroe-Chandler and Hall (2004) found an increase in the collective

efficacy of a young female soccer team as a result of an MG-M imagery intervention. Similarly, Shearer et al. (2007) identified MG-M imagery as a significant predictor of the variance in collective efficacy among a sample of elite athletes from various interactive sports. These results demonstrate that among elite athletes, those who use more MG-M imagery exhibited greater perceptions of collective efficacy.

MG-M imagery has also been purported to be associated with mental toughness (Hall et al., 1998; Munroe, Giacobbi, Hall, & Weinberg, 2000). An in-depth qualitative study involving elite athletes from various sports describes *where* athletes use imagery, *when* athletes engage in imagery, *why* imagery is being used by athletes, and *what* it is that athletes are imaging (Munroe et al., 2000). Analysis of the athlete interviews revealed four higher order themes related to the MG-M function of imagery; mental toughness, focus, confidence, and positivism. Furthermore, Munroe et al. (2000) found that athletes reported using imagery for the purpose of maintaining mental toughness both prior to and during competition.

Mental toughness is a psychological characteristic that is suggested to contribute substantially to performance excellence (Bull, Shambrooke, James, & Brooks, 2005; Jones, Hanton, & Connaughton, 2007). Despite the importance of this construct in the sport setting, a surprisingly limited amount of research pertaining to it exists in the sport psychology literature. More specifically, questions still remain as to what constitutes mental toughness, who exhibits the qualities of a mentally tough performer, and how this construct emerges in athletes. Although mental toughness is a term commonly employed by athletes, coaches, and sport psychologists alike, the dearth of research has resulted in mental toughness being one of the least understood constructs in applied sport

psychology (Jones, Hanton et al., 2002). Several studies on mental toughness have attempted to bridge the gap between theory and application by developing a comprehensive and operational definition of mental toughness, and to identify key attributes that are associated with being mentally tough. Jones, Hanton et al. (2002) advanced the following definition that states:

> Mental toughness is having the natural or developed psychological edge that enables you to:
>
> - Generally, cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on a performer
> - Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure. (p. 209)

A strength of the above definition is that it proposes mental toughness to be a psychological advantage that can exist naturally or that can be acquired through experience. However, it is limited in the sense that it describes mental toughness in terms of what it allows an athlete to *do* as opposed to defining what mental toughness actually *is*. Further, the definition's focus on outperforming one's opponent implies that only those athletes who surpass the opponent can be considered mentally tough. A more recent definition has been put forth by Gucciardi, Gordon, and Dimmock (2009) in which they state:

> Mental toughness is a collection of experientially developed and inherent sport-specific and sport-general values, attitudes, emotions, and cognitions that influence the way in which an individual approaches, responds to, and appraises

both negatively and positively construed pressures, challenges, and adversities to consistently achieve his or her goals. (p. 67)

Central to this definition are both the outcomes and the processes involved with being mentally tough. Additionally, the construct is described in terms of an individual's progression toward his or her goals, as opposed to superiority over one's opponent. As such, Gucciardi et al.'s (2009) definition, while maintaining that mental toughness is a construct that can be both innate and/or developed through experience, addresses the two noted limitations of the previous definition forwarded by Jones, Hanton et al. (2002).

Within the mental toughness research to date, the majority of studies have been devoted to identifying the characteristics, attributes, or behaviors exhibited by mentally tough athletes (Bull et al., 2005; Gucciardi, Gordon, & Dimmock, 2008; Jones, Hanton et al., 2002; Jones et al., 2007; Middleton, Marsh, Martin, Richards, & Perry, 2004; Thelwell, Weston, & Greenlees, 2005). Indeed, common themes have emerged with respect to the qualities exhibited by a mentally tough performer. Among these general themes are high self-belief (Jones, Hanton et al., 2002; Middleton et al.) and self-efficacy (Thelwell et al.), as well as ignoring distractions, remaining focused, and thriving under pressure (Jones, Hanton et al., 2002; Thelwell et al.). Although recent qualitative studies have contributed substantially to the description and operationalization of mental toughness, several major gaps remain. The majority of these studies have drawn on the knowledge of elite (Fourie & Potgieter, 2001; Jones, Hanton et al, 2002.; Middleton et al.), Olympic (Gould, Dieffenbach, & Moffett, 2002; Jones et al., 2007), and professional (Thelwell et al.) athletes and coaches. Therefore, the abovementioned definitions and attributes said to describe mental toughness may not be generalizeable to other athletic

populations, such as youth, amateur, or recreational athletes. As mental toughness is a quality that can indeed be portrayed by both elite and non-elite athletes alike, research is required to examine mental toughness among wider samples, including athletes of all ages and various skills levels.

Acknowledging the limitations in the mental toughness literature, Connaughton, Hanton, Jones, and Wadey (2008) recently published a review of work on mental toughness to raise awareness of the conceptual and methodological issues in the area, and also to stimulate further research. The authors summarized the difficulty in the literature as "the inappropriate association and misinterpretation of mental toughness with mental skills and positive psychological characteristics without rationale or supporting data" (Connaughton et al., p. 197). They further suggested that a lack of conceptual comprehension has resulted from conclusions being drawn from personal beliefs acquired through consulting with elite athletes, as opposed to through carefully conducted empirical research.

The measurement of mental toughness has also posed a challenging issue, as few inventories have been designed to measure the construct. Additionally, none of these measurement tools has been widely employed nor universally accepted as valid and reliable. Despite this limitation, the tool that has been cited most frequently in recent quantitative investigations is the Mental Toughness 48 Inventory (MT48) developed by Clough, Earle, and Sewell (2002). This inventory was developed based on the authors 4C's model of mental toughness, which is comprised of four dimensions; Control, Commitment, Challenge, and Confidence. Control refers to the belief that individuals can remain influential, as opposed to helpless, in confrontation with stress. Commitment

reflects one's tendency to become involved in the various components of their lives, which results in committed individuals being less likely to give up under pressure situations. Challenge is exhibited by those who feel positive about change, and view change as a normal occurrence in life. Finally, Confidence, which is an important factor in sport performance (Clough et al.), is included in the model to encompass the unique nature of the competitive sport environment.

Clough et al. (2002) have provided initial support for the reliability of the inventory, and several subsequent studies have found additional support for its use (Crust & Clough, 2005; Levy, Polman, Clough, Marchant, & Earle, 2006; Nicholls, Polman, Levy, & Backhouse 2008). However, given the few studies published, the novelty of these studies, and the fact that little detail has been provided on the process of the inventory's development, it has been suggested that further testing and validation of its utility is required (Connaughton et al., 2008; Crust, 2007).

A final limitation within the mental toughness literature is the lack of research investigating the associations mental toughness may have with other important psychological constructs. Specifically, the effect of psychological skills training on the development or improvement of mental toughness has received virtually no empirical attention. This is an area that clearly warrants examination, as an understanding of the role of psychological skills training in developing or maintaining mental toughness will allow for the design of appropriate interventions directed at enhancing this important construct.

Among the popular psychological training techniques used by athletes, mental imagery is a possible strategy for developing or improving mental toughness. Despite the

theoretical association drawn between imagery, particularly the MG-M function, and mental toughness, no quantitative studies to date have examined this specific relationship. Therefore, the purpose of the present study was to investigate the relationship between imagery use and mental toughness in a sample of Varsity athletes. It was hypothesized that imagery use, as measured by the Sport Imagery Questionnaire (SIQ; Hall et al., 1998), would predict mental toughness scores on the MT48 (Clough et al., 2002). Given the relationship between the motivational functions of imagery and confidence (Callow et al., 2001; Vadocz et al., 1997), and more specifically the association between MG-M imagery and mental toughness (Munroe et al., 2000), it was further hypothesized that these functions of imagery (MS, MG-A, and MG-M) would be the strongest predictors of mental toughness.

Methodology

Participants

Participants in the current study were 151 Varsity athletes from a mid-sized Southwestern Ontario University. The sample included both male (n = 101) and female (n = 50) athletes ranging in age from 18 to 27 years (M = 20.70, SD = 1.84). Athletes in the study were actively competing on Varsity sport teams including hockey (n = 36), volleyball (n = 20), basketball (n = 24), football (n = 41), curling (n = 8), and track and field (n = 22).

Measures

Demographic data. Participants were asked to report basic demographic data including age, gender, Varsity sport, and number of years involved in that sport.

Imagery frequency. The Sport Imagery Questionnaire (SIQ; Hall et al., 1998) is a 30 item inventory which assesses athletes' frequency of imagery use. The SIQ (Appendix A) is composed of five subscales that assess both the cognitive and motivational functions of imagery; CS, CG, MS, MG-A, and MG-M. Each item is rated on a 7-point Likert scale anchored at 1 = *rarely use that function of imagery* and 7 = *often use that function of imagery.* Examples of items on the SIQ are: "*When learning a new skill, I imagine performing it perfectly*" (CS); "*I imagine myself successfully following my game/event plan*" (CG); "*I image myself winning a medal*" (MS); "*I imagine the emotions I feel while doing my sport*" (MG-A); and "*I imagine myself being in control in difficult situations*" (MG-M). The SIQ has shown favorable internal consistency for the subscales, with Cronbach's alpha coefficients ranging from .70 to .88, and has demonstrated predictive and content validity (Hall et al., 1998).

Mental toughness. The Mental Toughness 48 Inventory (MT48; Clough et al., 2002) assesses mental toughness and is based on the authors' 4C's model of mental toughness, which includes the dimensions of Control, Commitment, Challenge, and Confidence (Appendix B). The 48-item inventory provides scores on each of the four subscales, as well as an overall score for mental toughness. Items are answered on a 5-point Likert ranging from 1 = *disagree* and 5 = *agree*. A sample item for the Challenge subscale is "*I generally cope well with any problems that occur*". An item from the Control subscale is "*I generally feel that I am in control of what happens in my life*". From the Commitment subscale, a sample item is "*I don't usually give up under pressure*". Finally, an example item from the Confidence subscale is "*I am generally confident in my own abilities*". The MT48 has been shown to be highly reliable, with a

reliability coefficient of 0.9 and internal consistency in the subscales ranging from 0.71 to 0.80 (Clough et al.). For the current study, the MT48 was modified from its original form to include the stem "In sport…" for each item. Also, the questionnaire's general instruction was modified to ask the respondent to consider how they are *in sport*, as opposed to how they are *generally*, when responding to each item.

Procedure

After obtaining approval from the Ethics Review Board at the University of Windsor, head coaches of Varsity athletics teams were contacted (Appendix C). After receiving permission from the coach, athletes were recruited prior to a team practice. First, athletes were briefed by the researcher on the purpose and procedures of the study. Those athletes who agreed to participant were then provided a letter of information (Appendix D), and were asked to complete the SIQ and the MT48. Athletes were also asked to complete a ballot for an opportunity to win a gift certificate to a local eatery. All completed questionnaires were returned immediately to the investigator. To ensure participant anonymity, all personal contact information, which was obtained for the purpose of the gift certificate draw, was submitted separately.

Data Analyses

Tabachnick and Fidell (2001) noted the importance of checking all data to identify and treat problems in the database prior to running an analysis. As such, all data were examined for missing data and outliers. Once complete, the reliability of the SIQ and the MT48 was examined through Cronbach's alpha coefficient tests (Nunnally, 1978). Descriptive analyses were run, including means and standard deviations for age of participants, years of experience, and scores on the subscales of the SIQ and MT48.

Hierarchical multiple regression analyses were used to establish if the functions of imagery, as measured by the SIQ, predicted mental toughness. Based on the theoretical association between the motivational functions of imagery and mental toughness (Munroe et al., 2000), these three functions (MS, MG-M, and MG-A) were blocked and entered first into the regression equation. The two cognitive functions of imagery (CS and CG) were blocked and entered in the second step to determine if these functions contribute to the prediction of mental toughness.

Results

Preliminary Analyses

The data were screened and cleaned for any univariate or multivariate outliers. Missing data comprised less than 1% of the total number of values, which were treated by mean substitution (Tabachnick & Fidell, 2001). Any missing value was replaced with that participant's averaged score on items within that subscale, rounded to the nearest Likert response. Mahalanobis distance was used to detect any multivariate outliers. Examination of residual scatterplots demonstrated normality, linearity, and homoscedasticity, thus the assumptions of relationships between variables required in multiple regression analyses were met (Tabachnick & Fidell)

A summary of the demographic variables as well as the means and standard deviations for each of the five functions of imagery and the four subscales of the MT48 are presented in Table 1. Cronbach alpha coefficients were found to be acceptable on all subscales of the SIQ and MT48. Alpha coefficients ranged from .74-.82 for the SIQ (CS = .81, CG = .74, MS = .81, MG-A = .76, MG-M = .82) and .66-.74 for the MT48

(Control = .66, Commitment = .67, Challenge = .67, Confidence = .74), which were considered acceptable.

One-way analyses of variance (ANOVAs) were computed to examine gender differences in imagery use and mental toughness scores. Differences were observed in the Confidence subscale of the MT48, (F (1, 149) = 4.52, $p < .05$) with males scoring higher than females, as well as in CS (F (1, 149) = 7.76, $p < .05$) and CG (F (1, 150) = 5.71, $p < .05$) imagery, with males reporting more use of each function. However, it is important that these gender differences be interpreted with caution as bias can arise when the number of participants in groups is not the same as the proportion in the general population (Hopkins, 2006). This proved to be the case in the current study as the total sample included an unequal number of males (n = 101) and females (n = 50). As such, it is possible that the gender differences observed were biased towards males. Further, no significant gender differences were observed in any of the variables entered in Step 1 of the regressions, or in three of the four dependent variables. Therefore, gender differences were not further examined and subscale scores were collapsed across gender for the primary analyses.

In order to identify cases of multicollinearity between scores on the SIQ and MT48, Pearson correlations were computed (see Table 2). Each of the imagery subscales showed positive small to moderate correlations with each of the other imagery functions. Also, each of the mental toughness subscales were positively and significantly correlated with one another and these correlations were also small to moderate. With respect to correlations between the two inventories, the MS subscale was correlated only with Confidence, while the MG-A was not significantly correlated with any of the four

subscales. However, positive moderate correlations were observed between MG-M imagery and each of the mental toughness subscales. Both CS and CG imagery also showed small to moderate positive correlations with each mental toughness subscale. The highest correlation observed between any two subscales was .71, thereby assuring an absence of singularity and multicollinearity (Tabachnick & Fidell, 2001)

Primary Analyses

A series of hierarchical multiple regression analyses was conducted to assess the contribution of imagery use to the prediction of mental toughness. Separate regression analyses were conducted for each of the subscales of the MT48, which represented the dependent variables. The five imagery subscales of the SIQ, representing the independent variables, were blocked and entered in two steps. Based on the theoretical associations of the motivational functions of imagery with mental toughness, MS, MG-A, and MG-M were blocked and entered first into the regression equation (Step 1), followed by the cognitive functions of imagery, CS and CG (Step 2). The results of the regression analyses are presented in Table 3.

Control. With Control as the dependent variable, the motivational functions of imagery entered at Step 1 were significant (F (3, 144) = 1.08, $p < .001$) and accounted for 12.9% of the variance. MG-A ($\beta = -.28$, $p < .05$) and MG-M ($\beta = .45$, $p < .001$) were significant individual predictors, with MG-M emerging as the strongest predictor. In this regression, the cognitive functions significantly improved prediction, (F (2, 142) = 5.85, $p < .01$), accounting for an additional 6.6% of the variance in mental toughness scores. The only significant individual predictor emerging in Step 2 was CG imagery ($\beta = .35$, $p < .01$).

Commitment. Similarly, when the dependent variable was Commitment, the motivational functions were significant (F (3,144) = 8.17, $p < .001$) and accounted for 14.5% of the variance. In this first step, MG-M was the only significant individual predictor ($\beta = .45$, $p < .001$). In Step 2, the cognitive functions did not significantly improve prediction, (F (2,142) = 2.71, $p > .05$) with an ΔR^2 of .03. However, the individual contribution of CG imagery ($\beta = .25$, $p < .05$) was significant.

Challenge. With Challenge as the dependent variable, the motivational functions entered at Step 1 were again significant (F (3, 144) = 10.94, $p < .001$), accounting for 18.6% of the variance. Examining the individual contributions, both MG-A ($\beta = -.25$, $p <$. 05) and MG-M ($\beta = .53$, $p <$. 001) beta weights were related to Challenge, with MG-M being the strongest individual predictor. The cognitive functions entered at Step 2 did not significantly improve prediction, (F (2, 142) = 1.80, $p > .05$) with a ΔR^2 of .02.

Confidence. When the dependent variable was Confidence, the motivational functions were significant at Step 1 (F (3, 143) = 11.49, $p < .001$), accounting for 19.4% of the variance. At Step 2, the cognitive functions were also significant (F (2, 141) = 5.92, $p < .01$) and accounted for an additional 6.2% of the variance. Examining the individual contributions, both MG-A ($\beta = -.23$, $p < .05$) and MG-M ($\beta = .52$, $p < .001$), were significant at Step 1, while CG ($\beta = .24$, $p < .05$) and CS ($\beta = .24$, $p < .05$) were significant at Step 2. Once again, the strongest individual predictor was MG-M.

Discussion

The aim of the present study was to investigate the relationship between imagery use and mental toughness in Varsity athletes. Previous research has demonstrated imagery to be an effective strategy to enhance athletic performance (Gregg & Hall, 2006; Hall et al., 1990; Munroe et al., 1998; Munroe-Chandler et al., 2007). The motivational functions of imagery, as outlined by Paivio (1985) and Hall et al. (1998), have further been shown to be associated with competitive anxiety levels (Hale & Whitehouse, 1998), enhanced sport confidence (Callow et al. 2006; Vadocz et al., 1997), self-efficacy (Munroe-Chandler, Hall, & Fishburne, 2008) and collective efficacy (Munroe-Chandler & Hall, 2004; Shearer et al., 2007). Based on the findings from these studies as well as on qualitative imagery research suggesting a link between motivational imagery and mental toughness (Munroe et al., 2000), the present study hypothesized the motivational functions of imagery would significantly predict mental toughness. The results indicated the motivational functions of imagery (i.e., MS, MG-A, MG-M) significantly predicted mental toughness, accounting for more variance in mental toughness scores than did the cognitive functions (i.e., CS, CG). Thus, the primary hypothesis was supported. Specifically, MG-M imagery emerged as the strongest individual predictor for each dimension of the MT48 Inventory (i.e., Control, Commitment, Challenge, Confidence). This function of imagery has been associated with being confident, in control, and mentally tough (Hall et al., 1998), and has also been described as the function of imagery related to dealing with adversity and working through difficult situations (Munroe et al., 2000). Additionally, research has found MG-M imagery to be perceived as the function most effective in gaining or maintaining confidence and staying focused (Nordin &

Cumming, 2008). Considering these previous results, and given that MG-M items on the SIQ clearly reflect the various dimensions of mental toughness (e.g., "*I imagine myself being in control in difficult situations", "I imagine myself appearing self-confident in front of my opponents", "I imagine myself being mentally tough*"), the finding that MG-M was the strongest predictor for each dimension of mental toughness is not surprising.

In addition to MG-M, MG-A imagery also emerged as a significant predictor of Control, Challenge, and Confidence, although this function was inversely related to these mental toughness dimensions. The MG-A imagery function is associated with controlling or regulating arousal and anxiety (Martin, Moritz, & Hall, 1999). Indeed, it has been shown to be employed by athletes as a means of staying calm and relaxed, and for maintaining composure in pre-competition (Munroe et al., 2000). As with MG-M, items on the MG-A subscale of the SIQ relate to elements of mental toughness, particularly the Control dimension, as exemplified by the item which states; "*I imagine myself handling the arousal and excitement associated with my sport"*. Importantly, some research has suggested that having an ability to cope with or control anxiety is a characteristic demonstrated by those who are mentally tough. In the Jones, Hanton et al. (2002) qualitative study with international performers, participants believed competitive anxiety to be an inevitable part of sport, and that mentally tough athletes demonstrate an ability to cope effectively with this type of anxiety. The present study's finding that MG-A imagery negatively predicts mental toughness scores suggests that mentally tough athletes employ less of this function of imagery. This may be a result of mentally tough athletes having developed alternative strategies to effectively control arousal and anxiety. Indeed, many types of physical strategies (e.g., breathing, muscle relaxation) and

cognitive techniques (e.g., meditation, mental cues) are employed by athletes as a means of regulating anxiety and arousal (Williams & Harris, 2006), and mentally tough athletes may be implementing more of these than their less mentally tough counterparts. Alternatively, previous research has demonstrated that athletes predisposed to various levels of anxiety may differ in the degree to which anxiety is perceived as facilitative (Jones, Smith, & Holmes, 2004). As such, mentally tough athletes may interpret anxiety as more facilitative to performance than would less mentally tough athletes, and therefore would not deem it necessary to implement strategies, such as imagery, to regulate this anxiety.

Interestingly, the MS function was not found to be a significant individual predictor for any of the mental toughness subscales. This function of imagery pertains to the achievements and goal-oriented behaviors (e.g., winning an event). Indeed, items on the MS subscale reflect the attainment of goals and achievements, (e.g., *I image myself winning a medal", "I image myself being interviewed as a champion"*). Importantly, MS items do not encompass the mental toughness required of an athlete in order achieve these goal-oriented behaviors, nor do they directly represent any dimension of the 4C's Mental Toughness model (Clough et al., 2002). These overall findings might suggest that for the purpose of improving mental toughness, MG-M and MG-A may be the most effective motivational functions to employ as compared to MS.

The cognitive functions of imagery (i.e., CS and CG) involve images pertaining to the acquisition of skills and the rehearsal of strategies. As predicted, these functions provided only limited additional variance with respect to mental toughness above and beyond that accounted for by the motivational functions. In fact, these functions

accounted for only 6.6% of the variance in Control and 6.2% of the variance in Commitment. Interestingly, CG emerged as a significant individual predictor of Control, Commitment, and Confidence. Although this function, which involves imaging specific skills and strategies of play, does not intuitively bear strong relation to mental toughness, when considering the physical and cognitive strategies involved in the competitive situation as a whole this relationship becomes much more apparent. More specifically, Jones, Hanton et al. (2002) suggested an important attribute of a mentally tough performer is an ability to regain psychological control following unexpected, uncontrollable events. Certainly, athletes will inevitably face unexpected situations and one method of effectively dealing with these events may be to mentally practice, or image, how one will effectively control to the situation when it occurs.

Finally, CS imagery was found to be a significant predictor of Confidence. An explanation for this finding may be that items on the CS subscale imply a degree of cognitive skill or control (e.g., *"I can consistently control the image of a physical skill", "I can mentally make corrections to physical skills"*), which is suggested to be an important attribute of a mentally tough performer (Fourie & Potgieter, 2001; Jones et al., 2007). Further, one element perceived by elite athletes and coaches to be characteristic of mental toughness is a "possession of prerequisite physical and mental requirements" (Fourie & Potgieter, p. 68). Indeed, if an aspect of mental toughness is to demonstrate adequate physical preparedness, then given the use of CS in facilitating physical skill acquisition, it would seem that this imagery function would serve a theoretically sound means by which to acquire this element of mental toughness.

A unique characteristic of mental toughness emerging in the qualitative investigation by Middleton et al. (2004) was "task familiarity" or experience. Athletes and coaches in this study believed that familiarity with their sport, and the adversities that accompany sport, contribute to enhanced mental toughness. Until that point, the role of experience and familiarity had been neglected in mental toughness conceptualizations. Familiarity, as an important factor in mental toughness (Middleton et al., 2004), provides support to the contention that imagery is an effective strategy for enhancing mental toughness. Defined by Vealey and Greenleaf (2006) as "…using all the senses to re-create or create an experience in the mind" (p. 307), imagery serves a highly effective means of increasing familiarity with a sport situation or skill. As such, athletes using imagery to familiarize themselves with a task, event, or adversity, may be better mentally equipped to embrace that situation when it presents itself, as athletes believe specific events and adversities become easier to deal with the second time around (Middleton et al., 2004).

Several limitations of the present study should be addressed. A conceptual limitation of all regression techniques is that a researcher can never infer a *causal* relationship between the predictor (imagery function) and criterion (mental toughness dimension) variables, but instead can ascertain a correlation between the variables of interest. Additionally, the use of self-report questionnaires may allow for potential biases in responses, due to social desirability to appear mentally tough. Further, the present study investigated athletes' use of imagery but did not examine any other types of mental training techniques the participants may have been employing. Therefore, it is possible that other psychological skills training techniques (e.g., goal-setting, self-talk) may alone,

or in concert with imagery, be contributing to athletes' mental toughness scores and thus may account for additional variance.

Certainly, mental toughness is an area that warrants additional research. The present study is the first to demonstrate that imagery use is significantly and positively associated with mental toughness. However, measurements of imagery use and mental toughness were taken only at one point in time. Past research has shown that imagery use changes over the course of a competitive season (Munroe et al., 1998). As such, future studies should implement longitudinal designs to measure the degree to which imagery use and mental toughness scores may change over time. Further, experimental designs using a no-imagery control group should also be conducted. Although gender differences were not evident in the current study, it should be noted that the gender distribution in the sample was unequal (n = 101 males, n = 50 females) and thus, future studies should still consider the possibility of gender differences when examining the imagery and mental toughness relationship. All participants in the present study were current university students competing on a Varsity team, ranging in age from 18-27 years. Therefore, these results may not be generalizeable to other athletic populations. Importantly, as imagery is a popular strategy employed by athletes of all ages (Munroe-Chandler et al., 2007) and competitive levels (Hall, 2001), future research should examine this construct along with mental toughness among broader populations of athletes. Finally, future studies might consider the concurrent use of other types of mental training techniques (e.g., goal setting, self talk) when examining the imagery and mental toughness relationship.

In the Applied Model of Imagery Use, Martin et al. (1999) purported that the type (function) of imagery used by an athlete should match the desired outcome (i.e.,

cognitive, affective, and behavioral effects of the imagery). Of the five functions of imagery identified by Hall et al. (1998), which are included in the applied model, MG-M is the function that is theoretically associated with mental toughness. The present study's findings that MG-M imagery is, indeed, the function that most strongly predicts mental toughness, provides support for Martin et al.'s contention that in order for imagery to be effective, the imagery content must match the intended function. However, recent imagery research has also demonstrated that a particular type of imagery may serve multiple functions (Evans, Jones, & Mullen, 2004; Fish, Hall, & Cumming, 2004; Short et al., 2002), and the present study's finding that both MG-A and CG imagery also predict mental toughness, although to a lesser degree than MG-M, would support this possibility. As such, interventions developed for the purpose of acquiring or enhancing mental toughness, while focusing on MG-M imagery, should also implement these additional functions.

Within the athletic community, mental toughness is regarded as one of the most important psychological factors associated with performance excellence (Bull et al., 2005). The importance of this construct is apparent by the many athletes attributing sport outcomes to mental toughness, as well as by an increasing demand by athletes and coaches for strategies aimed at its development (Clough et al., 2002). Despite this, only recently has the academic community begun to directly examine this important construct. Since pioneering research by Fourie and Potgeiter (2001), which examined perceptions of mental toughness among elite athletes and expert coaches, several groups of researchers have sought to define and operationalize mental toughness in the sport setting (Gucciardi et al., 2008; Jones et al., 2002, 2007; Middleton et al., 2004; Thelwell et al., 2005). Thus,

the extant literature offers various definitions as well as attributes and behaviors described to represent mental toughness. Notwithstanding the progression that has been made in recent years, gaps in the mental toughness literature remain. Certainly, a major drawback is a lack of empirically driven research examining the relationship between mental toughness and psychological skills training techniques. From an applied perspective, understanding the effects of strategies such as goal setting, anxiety control, or imagery on athletes' mental toughness would have significant implications. By determining the effects that psychological skills training could exert on athletes' mental toughness, sport psychology researchers can provide a starting point for athletes, coaches, and consultants to develop specific interventions designed to facilitate the development, maintenance, and enhancement of mental toughness.

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Table 1

Means and Standard Deviations of Demographic Information and SIQ and MT48 Subscales

Variable	Male (n = 101)		Female (n = 50)		Combined Sample (N = 151)	
	M	SD	M	SD	M	SD
Age	20.88	1.83	20.34	1.84	20.70	1.84
Years Played	9.65	4.94	10.59	4.43	9.97	4.78
SIQ						
CS	5.23	.93	4.77	.96	5.08	.96
CG	5.10	.87	4.72	1.00	4.97	.93
MS	4.92	1.25	4.57	1.29	4.80	1.27
MG-A	4.92	1.03	4.61	1.04	4.82	1.04
MG-M	5.58	1.00	5.29	1.00	5.49	1.00
MT48						
Control	3.36	.42	3.35	.47	3.36	.43
Commitment	3.76	.63	3.72	.44	3.75	.57
Challenge	3.72	.50	3.62	.52	3.68	.51
Confidence	3.66	.46	3.49	.47	3.60	.47

Note. SIQ = Sport Imagery Questionnaire; CS = cognitive specific; CG = cognitive general; MS = motivational specific; MG-A = motivational general-arousal; MG-M = motivational general-mastery; MT48 = Mental Toughness 48 Inventory; M = mean, SD = standard deviation. The SIQ is rated on a 7-point Likert scale anchored at 1 = *rarely use*

that function of imagery and 7 = *often use that function of imagery*. The MT48 is rated 5-point Likert ranging from 1 = *disagree* and 5 = *agree*.

Table 2

Bivariate Correlations Between Subscales of the SIQ and MT48

	CS	CG	MS	MG-A	MG-M	Control	Commitment	Challenge	Confidence
CS	-								
CG	.67**	-							
MS	.62**	.56**	-						
MG-A	.63**	.63**	.68**	-					
MG-M	.71**	.65**	.56**	.59**	-				
Control	.17*	.25**	.01	-.06	.25**	-			
Commitment	.24**	.30**	.12	.12	.35**	.53**	-		
Challenge	.27**	.28**	.12	.06	.38**	.55**	.52**	-	
Confidence	.36**	.34**	.16*	.08	.40**	.59**	.52**	.56**	-

Note. CS = cognitive specific; CG = cognitive general; MS = motivational specific; MG-A = motivational general-arousal; MG-M = motivational general-mastery.

* $p < .05$ level . ** $p < .01$.

Table 3

Summary of Hierarchical Regression Analyses for Imagery Functions Predicting Mental Toughness

Model	Variable	B	SE B	β	*t*
Control					
Step 1	MS	-.02	.04	-.05	-.47
	MG-A	-.12	.05	-.28	-2.50*
	MG-M	.19	.04	.45	4.48**
Step 2	MS	-.04	.04	-.12	-1.09
	MG-A	-.17	.05	-.39	-3.45**
	MG-M	.12	.05	.28	2.4*
	CS	.03	.06	.07	.61
	CG	.17	.05	.35	3.09**
Commitment					
Step 1	MS	-.05	.05	-.10	-.93
	MG-A	-.03	.06	-.05	-.44
	MG-M	.25	.06	.45	4.55**
Step 2	MS	-.06	.05	-.14	-1.26
	MG-A	-.07	.06	-.12	-1.05
	MG-M	.20	.07	.35	2.99**
	CS	.00	.07	.01	.05
	CG	.16	.07	.25	2.23*

Challenge					
Step 1	MS	-.01	.04	-.02	-.16
	MG-A	-.12	.05	-.25	-2.28*
	MG-M	.27	.05	.53	5.49**
Step 2	MS	-.03	.04	-.06	-.56
	MG-A	-.16	.06	-.31	-2.76**
	MG-M	.22	.06	.43	3.72**
	CS	.05	.07	.09	.70
	CG	.09	.06	.17	1.52
Confidence					
Step 1	MS	.01	.04	.03	.30
	MG-A	-.11	.05	-.23	-2.12*
	MG-M	.24	.05	.52	5.42**
Step 2	MS	-.02	.04	-.06	-.53
	MG-A	-.16	.05	-.35	-3.11**
	MG-M	.15	.05	.32	2.89**
	CS	.11	.06	.24	1.99*
	CG	.12	.06	.24	2.18*

Note: B = Unstandardized beta (regression) coefficient; SE B = Standard error of B; β = Standardized beta (regression) coefficient; *t* = *t*-statistic; MS = motivational specific; MG-A = motivational general-arousal; MG-M = motivational general-mastery; CS = cognitive specific; CG = cognitive general. $^{*}p < .05$. $^{**}p < .01$.

REVIEW OF LITERATURE

Imagery

Imagery is a well known mental training strategy in the sport setting, and has been shown to be a highly effective performance-enhancing technique among athletes of all ages (Gregg & Hall, 2006; Munroe-Chandler, Hall, Fishburne, & Strachan, 2007), sport types (Munroe, Hall, Simms, & Weinberg, 1998), and competitive levels (Hall, Rodgers, & Barr, 1990). A commonly accepted and comprehensive definition of imagery used in the sport psychology literature is:

> an experience that mimics real experience. We can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smells, tastes, or sounds without actually experiencing the real thing…It differs from dreams in that we are awake and conscious when we form an image. (White & Hardy, 1998, p. 389)

Given imagery is a mental strategy used by athletes of all ages (Munroe-Chandler, Hall, Fishburne, O, & Hall, 2007) and all levels (Hall et al., 1990), it is not surprising that considerable research attention has been devoted to understanding its utility. Evidence for the performance benefits of imagery use has emerged in sport psychology research through case studies, anecdotal evidence, and scientific experimentation (see Morris, Spittle, & Watt, 2005 for a review). Imagery research has effectively portrayed the performance-enhancing effects of imagery use in sport (Beauchamp, Bray, & Albinson, 2002; Caliari, 2008; Garza & Feltz, 1998) and has also revealed associations between imagery use and competitive anxiety levels (Hale & Whitehouse, 1998), enhanced sport confidence (Callow, Roberts, & Fawkes, 2006), self-efficacy (Munroe-Chandler, Hall, &

Fishburne, 2008) and collective efficacy (Munroe-Chandler & Hall, 2004; Shearer, Thomson, Mellalieu, & Shearer, 2007). In addition, qualitative inquiry has provided a wealth of information as to the content of imagery use in both adult (Munroe, Giacobbi, Hall, & Weinberg, 2000) and youth (Munroe-Chandler, Hall, Fishburne, O, et al., 2007) athlete populations. Due to the overwhelming evidence purporting its benefits in the sport domain, imagery remains a popular yet ever so important avenue of research.

Imagery Theories

Although the effectiveness of imagery as a psychological training technique has been thoroughly examined and well documented, a clear explanation for *how* or *why* it is effective has yet to be delineated. Various theories have been put forth which suggest a functional mechanism underlying mental imagery in the sport context, but none have been thoroughly validated or universally accepted.

Psychoneuromuscular Theory

This theory of mental imagery proposed by Jacobson (1930) suggests that identical neural pathways are activated during the vivid imagery of a movement as those that are activated when performing the actual movement. Empirical support has been shown, through studies involving electromyographic recordings, for the notion that vivid, imagined movements produce similar innervation in our muscles as does the actual event, although the activity is far less during imagery as compared to the actual movement (Harris & Robinson, 1986).

Bio-informational Theory

The Bio-informational theory (Lang, 1979) suggests that an image is "a finite information structure which can be reduced to specific propositional units" (p.109). The

Bio-informational theory suggests that mental images consist of two distinct classifications of propositions. Stimulus propositions refer to the content of a scenario being imaged (e.g., the feel of a football in one's hand), whereas response propositions involve the behavioral or emotional response to the situation (e.g., the excitement one feels when hearing a crowd cheer). The theory posits that inclusion of these affective or emotional response propositions while imaging can result in more effective imagery than would images involving stimulus propositions alone (Lang).

Triple Code Theory

Ahsen (1984) proposed a Triple Code theory which is similar to Lang's (1979) Bio-informational Theory, but differing in that it posits images to be composed of three sources of information that are coded by the individual. The first source is the image itself. This is similar to the stimulus propositions included in Lang's model in that in order for images to be effective they should be vivid and realistic, and should closely replicate the object, skill, or scenario as it would occur in real life. The individual's somatic responses are the second source of information, which are comparable to Lang's response propositions, in that they include psychophysiological responses such as increases in heart rate or sweat activity while a skill is being imaged. The third and final source of information proposed in the Triple Code theory is the meaning of the image, which suggests that individual differences in imagery use must be considered. As every image imparts an individual significance to the imager, no two people will have an identical imagery experience, even when the same set of imagery instructions are provided (Weinberg & Gould, 2007). According to the theory, every image will have a

meaning to an individual which is unlike that interpreted by any other person, and therefore no two people will have the same experience.

Each of the abovementioned theories have contributed to an enhanced understanding of imagery use. However, a weakness of both the Bio-informational theory and the Triple Code theory is that each fails to explain how the different sources of information within the theory relate directly to the various functions of imagery. Moreover, these theories leave many questions unanswered and offer little guidance as to how athletes may use imagery beyond simply rehearsing a skill (see Murphy & Jowdy, 1992, for a detailed review). To that end, recent research has proposed applied theories of imagery that offer explicit guidelines for sport psychology practitioners who incorporate imagery techniques in their work with athletes (Holmes & Collins, 2001; Martin, Moritz & Hall, 1999; Paivio, 1985).

Applied Theories of Imagery Use

Analytic Framework of Imagery Use in Sport

Paivio (1985) proposed an analytic framework to explain why athletes use imagery (see Figure 1). Paivio (1985) suggested that mental imagery serves both cognitive and motivational functions, each of which operate at either a specific and general level. The four resulting functions of imagery within Paivio's (1985) framework are cognitive general, cognitive specific, motivational general, and motivational specific. The cognitive general (CG) function of imagery refers for images of game plans, routines, and strategies of play, whereas the cognitive specific (CS) function involves imaging the execution of specific skills. Motivational specific (MS) imagery refers to images relating to specific goals, and the processes required to achieve these goals, while

the motivational general (MG) function pertains to images of affect, and emotional or physiological arousal. Hall, Mack, Paivio, and Hausenblas (1998) assessed the motivational and cognitive functions of imagery in a three-part study designed for the purpose of developing the Sport Imagery Questionnaire (SIQ). Preliminary analysis of responses to the SIQ indicated that items on the questionnaire which were intended to measure MG imagery were, in actual fact, representing one of two more specific constructs. Therefore, two MG scales were retained, one measuring motivational general-mastery (MG-M) imagery, and the other motivational general-arousal (MG-A) imagery. The MG-A function involves imagery associated with arousal and stress, and is utilized by athletes to increase or control arousal levels, or for "psyching-up". The last function, MG-M represents images associated with being in control, mentally tough, and confident.

Applied Model of Imagery Use

Martin et al. (1999) developed an Applied Model of Imagery Use in sport with the intention of reducing the number of imagery-related variables studied in sport contexts to the fewest meaningful factors possible (see Figure 2). The model, which adopts aspects of both the Bio-informational and Triple Code theories, includes four key constructs; the sport situation, the type of imagery used, imagery ability, and the outcomes associated with imagery use.

Sport situation. The applied model indicates that athletes use mental imagery in training periods, prior to, and during competition, as well as during rehabilitation from injury. The function and content of an athletes' imagery will vary depending on the type of sport situation. Hall (2001) initially purported the cognitive functions of imagery would be employed most frequently early in a training program, as the focus at that point

is on acquisition of specific sport skills. As skills are developed and training progresses, however, athletes would begin to make greater use of imagery for its motivational purposes (Martin et al., 1999). It is important to note that, even after skills have been acquired, athletes still employ a substantial amount of imagery for cognitive purposes (Munroe et al., 1998). The applied model also suggests that athletes will use imagery during preparation for competition, for purposes such as maintaining confidence and controlling arousal. The final sport situation in which athletes will use imagery is during the injury rehabilitation and prevention process. Indeed, athletes have been shown to employ cognitive imagery, and to a lesser degree, motivational imagery, to serve a variety of functions during rehabilitation from imagery (Evans, Hare, & Mullen, 2006).

Functions of imagery. The model implies that the type, or function, of imagery used by the athlete will determine the cognitive, affective, and behavioral effects of the imagery, and proposes that athletes use different types of imagery to achieve different outcomes. The applied model includes the five functions of imagery identified by Hall et al. (1998), and further suggests that these types are functionally orthogonal, and also that it is possible for one function to be used in the absence of all others, or for more than one function to be employed at a time. Martin et al. (1999) suggest that in order for imagery to be effective, the imagery content must match the intended function. While research has supported this finding (Feltz & Riessinger, 1990; Munroe-Chandler et al., 2008), others have found that one imagery type may serve multiple functions (Evans, Jones, & Mullen, 2004; Fish, Hall, & Cumming, 2004; Short et al., 2002.). The contention that imagery content may serve more than one function has been demonstrated by Short et al. in a study examining the interaction between imagery function and direction on self-efficacy

and performance. Imagery research suggests that CG imagery is the function that would contribute most substantially to improved performance, yet males in this study demonstrated improved performance with CS imagery only, while females showed performance enhancements only from MG-M imagery. Therefore, it is plausible that an imagery intervention intended to serve a cognitive function may, to some individuals, serve also a motivational function. Short et al. suggest that a method of testing for this possibility is to ask participants to identify the function which they believed the imagery content to serve. Overall, findings such as these by Short et al. support the idea that a given image can serve one or multiple functions, and this is where the meaning of the image to the individual may become relevant. To control for the relative ambiguity between the terms imagery type and imagery function in these cases, Murphy, Nordin and Cumming (2006) suggest that *imagery type* be used to represent the actual content of an image (e.g. seeing oneself practicing a skill, feeling oneself winning a race), whereas *imagery function* should refer to the reason for, or purpose of, using an image (e.g. to improve a skill, to gain confidence).

Considerable research to date has shown an association between CS imagery and the performance of motor skills (for a review see Morris et al., 2005). In line with this, Martin et al. (1999) suggest that CS imagery may be the most effective of all imagery functions in promoting the acquisition and performance of individual motor skills. This contention has been supported in quantitative studies administering imagery interventions. Brouziyne and Molinaro (2005) examined the effects of CS imagery on golf performance for the approach shot. Twenty-three beginner golfers were equally divided into one of three groups; imagery combined with physical practice, physical

practice alone, and a control group which engaged in neither physical nor mental practice of the skill. As predicted, those in the imagery group showed the greatest improvement in approach shot performance. In a similar study using figure skaters, Garza and Feltz (1998) demonstrated individuals engaging in the mental practice of specific skills to significantly improve performance ratings and self-efficacy scores compared to a control group.

In a qualitative examination of imagery use among high-level slalom canoeists and artistic gymnasts, White and Hardy (1998) found the athletes to use imagery in a variety of different environments for both cognitive and motivational purposes. The CS function was reportedly used most often by the gymnasts to rehearse skills and moves during training and competition, and used amongst canoeists to rehearse difficult moves. The systematic practice of CS imagery has been shown to supplement the physical practice of a motor skill (Brouziyne & Molinaro, 2005; Hall, 2001). This view was supported by Blair, Hall, and Leyshon (1993) in an experimental design involving elite and non-elite soccer players. Participants were randomly assigned to either an imagery group, which received six weeks of imagery practice on a soccer task, or a control group which received no imagery training. Results indicated the imagery group showed significant improvements on the task as compared to the control group. These studies provide support for the effectiveness of CS imagery as a supplement to physical practice. In addition to the notable influence that CS imagery can impact on performance, it has also been linked to increased facilitative interpretations of anxiety in a sample of elite ballet dancers (Fish et al., 2004). Therefore, CS imagery may also operate as an effective strategy to reduce pre-competition anxiety in athletes, further supporting previous

findings (Evans et al., 2004; Short et al., 2002) that a given type of imagery may serve multiple functions.

In addition to using imagery to rehearse specific skills, athletes also employ imagery to mentally practice entire game plans, routines, and strategies (Martin et al., 1999). Although case study reports have demonstrated the performance benefits of CG imagery in various sports (Martin et al.), few experimental studies have explored this function of imagery. In the aforementioned study by White and Hardy (1998), it was found that slalom canoeists used this function of imagery to formulate and rehearse potential movement plans through the course. More recently, Munroe-Chandler, Hall, Fishburne, and Shannon (2005) sought to determine the effectiveness of a CG imagery intervention on the execution of three soccer strategies among young female players. Although performance improvements could not be determined from the study, it was evident that the athletes' use of CG imagery, along with CS and MG-A imagery increased significantly over the course of the seven-week intervention.

The MS function pertains to images of specific achievements and goal-oriented behaviors (e.g., winning an event, standing on a podium). A study by Martin and Hall (1995) with beginner golfers demonstrated support for the effectiveness of MS imagery as a means of modifying cognitions relating to goals and motivation. Golfers in the six-session imagery condition spent more time practicing a golf-putting task, set higher goals for themselves, and adhered more closely to their training program than participants in the no-imagery control group. Later, in a study investigating the influence of type of sport and time of season on athletes' use of imagery, Munroe et al. (1998) found that athletes in a variety of team and individual sports demonstrated a significant increase of MS

imagery use during the competitive season. Munroe et al. (1998) suggest that as playoffs and championships approach, MS imagery use is increased perhaps due to an increase in the importance placed on outcome goals.

In the Applied Model of Imagery Use (Martin et al., 1999), MG-A imagery is suggested to be the function most effective in regulating arousal and competitive anxiety. Indeed, Munroe et al. (1998) have demonstrated that athletes employ MG-A imagery for several purposes, including to get psyched up or motivated during practice, as a means of staying calm and relaxed, and for maintaining composure in pre-competition. Several subsequent studies have demonstrated an association between MG-A imagery and cognitive anxiety (Strachan & Munroe-Chandler, 2006; Vadocz, Hall, & Moritz, 1997). In a study of 57 female roller skaters, Vadocz et al. showed that those athletes who used more MG-A imagery exhibited higher levels of cognitive anxiety. In line with this, Strachan and Munroe-Chandler found MG-A imagery to be a significant predictor of cognitive anxiety in young female baton-twirlers. MG-A imagery has also been shown to be related to increased physiological responses to stress. Hecker and Kaczor (1998) found a significant increase in heart rates of female softball players in response to an MG-A imagery script which focused on training or batting in a critical game. Other studies have shown MG-A imagery to be an effective strategy in controlling arousal and anxiety. Jones, Mace, Bray, McRae, and Stockbridge (2002) administered a guided imagery intervention to novice climbers, with an imagery script comprising both MG-M and MG-A imagery. The results indicated that those receiving the combined MG-M and MG-A imagery script reported significantly lower stress levels before, during, and after a wall-climbing task, as compared to the control group.

As described by Hall et al. (1998), MG-M imagery is the function associated with being confident, in control, and mentally tough. This function of imagery has found to be the most effective in enhancing self-confidence (Callow, Hardy, & Hall, 2001; Vadocz et al., 1997), self-efficacy (Beauchamp et al., 2002) and collective efficacy (Munroe-Chandler & Hall, 2004; Shearer et al., 2007). In agreement with the Applied Model of Imagery Use, Nordin and Cumming (2008) found, in a sample of 155 athletes from 32 sports, that MG-M was perceived as the function most effective in gaining or maintaining confidence, or for staying focused. Furthermore, MG-M imagery has been the most frequently used imagery function among various populations of athletes (Arvinen-Barrow, Weigand, Thomas, Hemmings, & Walley, 2007; Munroe et al., 1998). Munroe et al. (1998) investigated the time of season and type of sport on athletes' use of imagery by administering the SIQ to male and female athletes from 10 sports, both at the beginning and end of a regular season. Results indicated that at both time points, athletes used the MG-A and MG-M functions of imagery more frequently than the other functions. These findings suggest that the value of implementing MG-M imagery for the purpose of enhancing confidence should be stressed across the course of a competitive season. More recently, Arvinen-Barrow et al. examined imagery use among elite and novice athletes competing in open and closed sports. A univariate analysis of responses to the SIQ revealed that athletes of both competitive levels, regardless of skill type, used MG-M imagery more than any of the other functions, supporting the contention that athletes generally employ imagery for maintaining or improving confidence, mental toughness, and positive attitudes prior to competition.

Several studies have examined the association between MG-M imagery and athletes' self-confidence. In an imagery intervention with experienced junior badminton players, Callow et al. (2001) demonstrated increases in sport confidence among three of the four participants, suggesting that MG-M may have stabilizing and facilitative effects on athletes' sport confidence. Additionally, Vadocz et al. (1997) demonstrated that junior roller skaters using more MG-M imagery, who more often imaged themselves being mentally tough and in control, demonstrated higher levels of self-confidence.

A similar relationship has emerged between MG-M imagery and collective efficacy. It has been found that among elite athletes from interactive team sports, those who use more MG-M imagery have greater perceptions of collective efficacy than those who use less (Shearer et al., 2007). In addition, Munroe-Chandler and Hall (2004) have demonstrated increases in the collective efficacy in the majority of players on a junior female soccer team following an MG-M imagery intervention.

While past research has established a link between MG-M imagery and self-confidence, self-efficacy, and collective efficacy, researchers (Hall et al., 1998; Munroe et al., 2000) have also found MG-M imagery to be composed of mental toughness. In their qualitative examination, Munroe et al. (2000) found MG-M imagery to entail working through difficult situations and dealing with adversity and to be used most during pre-competition and competition. Despite mental toughness being rated by intercollegiate coaches as the most important psychological technique in determining success (Gould, Hodge, Peterson, & Petlichkoff, 1987), very little is known about this construct or its possible relationship to MG-M imagery.

Imagery ability. Another component of the Applied Model of Imagery Use is imagery ability, which is defined by Morris (1997) as "an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (as cited in Morris et al., 2005, p. 60). Paivio (1986) suggested that virtually everyone has the ability to form an image, although not to the same degree. Further, Martin et al. (1999) proposed imagery ability to be a potential moderator that could impact the relationship between the function of imagery and its intended outcome. A moderator has been defined as a variable "that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (Baron & Kenny, 1986, p.1174). Considering the relationship between imagery ability, and the acquisition, retention, and reacquisition of movements, Goss, Hall, Buckolz, and Fishburne (1986) found that scoring high in both visual and kinesthetic imagery may facilitate the acquisition, but possibly not the short-term retention, of movements. Similarly, in a study examining the effectiveness of visual mental practice on the learning of a physical skill, Isaac (1992) demonstrated that athletes scoring higher in imagery ability showed greater performance improvements than athletes lower in imagery ability. This significant difference was observed among both novice and experienced athletes.

A more recent study by Robin, Dominique, Toussaint, Blandin, Guillot, and Le Her (2007) investigated the influence of imagery ability on the effectiveness of an imagery intervention. Based on their imagery ability scores, skilled tennis players were placed in one of three groups; relatively good imagers, poor imagers, or a control group. Participants physically and mentally practiced a service return shot toward a target over

15 sessions. Results demonstrated not only that imagery had a positive effect on performance improvement, but that improvement was greater among good imagers than in those poorer in imagery ability. These findings provide support for Martin et al.'s (1999) contention that imagery ability acts as a moderating variable in the imagery and performance relationship.

Outcomes associated with imagery use. The final component of the Applied Model of Imagery Use describes three major outcomes of imagery use. The first is for the learning and improvement of skills and strategies. Considerable research has been directed at this outcome of imagery, particularly studying the effectiveness of cognitive types of imagery on skill and strategy acquisition or improvement (Blair et al., 1993; Brouziyne & Molinaro, 2005), with overall results generally supporting the position that imagery use can produce positive changes in performance (Morris et al., 2005). The second outcome is the modification of cognitions, which is dependent on an athlete's subjective interpretation of the imagery. For instance, images that are interpreted to be positive in nature can exert a positive effect on such cognitions as motivation or anxiety, whereas negative changes in these cognitions may be observed in response to images that are negative in nature (Martin et al., 1999). Finally, imagery is used for the purpose of regulating arousal and competitive anxiety. According to Lang's (1979) Bio-informational theory, mental images have the potential ability to elicit physiological changes. Therefore, athletes may employ imagery for the purpose of controlling or increasing physiological activation.

PETTLEP Model of Imagery

Drawing on neuroscience research, Holmes and Collins (2001) developed a PETTLEP model of mental imagery, which emphasizes specific elements of movements in order to increase the functional equivalence between imagery and physical movement. The acronym PETTLEP represents seven components that should be included in an imagery intervention in order for it to be maximally effective. The *Physical* component refers to the physical positioning one takes while imagining. When mentally performing a movement, athletes should simulate as closely as possible the physical characteristics of the action they are imaging (e.g., wearing the correct clothing, imaging while in the proper position for that movement). The *Environmental* component pertains to the physical environment in which the athlete images the movement or action. The environment should be as similar as possible to the actual environment they are envisioning (e.g., a curler could image while standing in the ice shed of the curling rink). The *Task* component relates to the specific task an athlete is imaging. Imagery of the task should be as close as possible in form, feelings, and action to the actual completion of the task. *Timing* refers to the pace at which one images a movement pattern. Holmes and Collins suggest that in order the access the same motor representation of a movement, the temporal characteristics of movement imagery and the physical execution should be the same. The *Learning* element of the PETTLEP model refers to changing the content of the image as skill acquisition advances (e.g., if a newly acquired element of a golfer's swing becomes more natural and automatic with practice, imaging of the swing should reflect this change). *Emotion* is an important component of athletic experiences, therefore imaging of a skill should reflect the emotional significance associated with it (e.g., if a

skier consistently feels very calm just before the start of a race, mental imagery of the preparatory phase of a big race should encompass this). Finally, the *Perspective* element refers to whether persons are imaging themselves as others would see them, from an external perspective, or whether they view the situation as they would see it through their own eyes, from an internal perspective.

Convincing support for the efficacy of the PETTLEP model has been shown in recent imagery interventions. In two studies administering imagery training to Varsity hockey players and junior gymnasts, Smith, Wright, Allsopp and Westhead (2007) demonstrated greater performance improvements in athletes using PETTLEP-based imagery as compared to traditional imagery treatments, which involved no PETTLEP components, specifically when multiple components of the model were included. Further, through these studies Smith et al. demonstrate the applicability of PETTLEP imagery to athletes of varying ages, sports, and level of experience. Outside of the sport domain, the use of a PETTLEP-based imagery in the acquisition of nursing skills has shown preliminary performance enhancing effects (Wright, Hogard, Ellis, Smith, & Kelly, 2008). Also of interest is the contribution of the individual components of the PETTLEP model to effective imagery interventions. To this end, O and Munroe-Chandler (2008) investigated the timing component of the model in a study manipulating image speed. Although no differences were observed in performance improvements across treatment groups imaging at different speeds, a physical practice group, and a control condition, the intervention involved only a single imagery session, and the authors suggest further studies testing this timing component, such as implementing longer interventions, are required.

Measurement

Considerable attention in imagery research has been devoted to establishing sound and reliable assessment tools (for a review, see Morris et al., 2005). Various inventories have been developed to measure both imagery use and imagery ability.

Imagery Use

Sport Imagery Questionnaire (SIQ). The SIQ (Hall et al., 1998) is a 30-item inventory measuring the frequency at which athletes use imagery. It contains six items for each of the five functions of imagery. Items are rated on a 7-point Likert scale ranging from 1= *rarely use that function of imagery* and 7 = *often use that function of imagery.* The SIQ has been shown to have acceptable internal consistency for the subscales, with alpha coefficients ranging from 0.7 to .88 and has demonstrated adequate factorial validity (Hall et al., 1998). A modified version of the SIQ has been developed for use with children (SIQ-C; Hall, Munroe-Chandler, Fishburne, & Hall, in press). The 21-item SIQ-C contains items for each of the five functions of imagery. Favorable internal consistencies have been shown for most of the items, and reasonable structural validity has been demonstrated.

Imagery Ability

Movement Imagery Questionnaire-Revised (*MIQ-R).* The MIQ-R (Hall & Martin, 1997) consists of eight simple motor movements, and asks participants to either "see" (visual imagery) or "feel" (kinesthetic imagery) themselves making the movements and to rate the ease or difficulty with which they do so. Responses are on a 7-point rating scale ranging from 1 = *very hard to see/feel* to 7 = *very easy to see/feel.* The MIQ-R has

favorable psychometric properties and acceptable internal consistencies (Hall & Martin; Vadocz et al., 1997).

*Vividness of Movement Imagery Questionnaire-2 (*VMIQ-2). The VMIQ-2 (Roberts, Callow, Hardy, Markland, & Bringer, 2008) is a 24-item inventory which asks participants to image themselves performing a movement using external, internal, and kinesthetic imagery and to rate the vividness of the image on a 5-point Likert scale anchored at 1 = *perfectly clear and vivid as normal vision* and 5 = *no image at all, you only know that you are thinking of the skill.* Three studies conducted by Roberts et al. have shown the VMIQ-2 to display factorial, concurrent, and construct validity.

Mental Toughness

Mental toughness is considered by athletes and coaches to be one of the most important psychological characteristics in achieving athletic excellence (Bull, Shambrook, James, & Brooks, 2005; Jones, Hanton, & Connaughton, 2007). This is apparent by the many references made to mental toughness in the sport psychology literature (see Crust, 2007 for a review) as well as by the frequency with which it is described by athletes as an imperative characteristic to high performance in sport (Jones, Hanton, & Cannaughton, 2002, 2007). In fact, mental toughness has been found to be one of the mental skills cited most frequently as significantly contributing to performance enhancement among a sample of Olympic champions (Gould, Dieffenbach, & Moffett, 2002). Despite this claim, a surprisingly limited amount of research attention has been devoted to understanding this construct, which may contribute to mental toughness being one of the least understood terms in applied sport psychology (Jones, Hanton et al., 2002).

Several early studies have sought to develop a comprehensive definition of mental toughness, which, drawing little from established psychological theory, lacked conceptual clarity (Jones, Hanton et al., 2002). Further, each definition failed to portray the multidimensional nature of the construct (Middleton, Marsh, Martin, Richards, & Perry, 2004b). A term found in the health-psychology literature, which Clough, Earle, and Sewell (2002) propose to be related to the concept of mental toughness, is *hardiness*. Simply put, it refers to a personality trait that acts as a buffer between life's stressful events and an individual's reaction to them (Clough et al.). Kobasa (1979) has proposed that three characteristics are associated with a hardy personality; Control, Commitment, and Challenge. *Control* refers to a tendency to feel that one is influential in stressful situations, as opposed to being powerless in the face of external forces. *Commitment* reflects the tendency to remain involved, as opposed to alienating oneself, in the various components of their lives. According to this concept of hardiness, those committed to their social context and environment should feel an involvement with others that buffers the impact of stress or great pressure. C*hallenge* is exhibited by individuals who feel positive about change, and subscribe to the belief that change is normal in life. Those who view change as a challenge should, by this concept, remain healthier than those who view change as a threat (Kobasa).

The concept of hardiness has been investigated in various contexts (see Maddi, 2004 for a review). Specific attention has been paid to military populations, with recent studies examining the associations of hardiness with, transformational leadership (Eid, Johnsen, Bartone, & Nissestad, 2007) and completion of military training (Bartone, Roland, Picano, & Williams, 2008) and symptoms of dissociation (Eid & Morgan, 2006).

It was demonstrated by Eid and Morgan that hardiness is negatively related to peritraumatic dissociation, suggesting that hardiness may exert a "buffering effect" on life stress. However, Clough et al. (2002) have suggested that a major drawback to the application of hardiness in the sport setting is that it fails to encompass the unique nature of the competitive sport environment, and its associated mental and physical demands. Clough et al. therefore embodied a fourth dimension, *Confidence*, and proposed that this dimension, in combination with the three C's of hardiness, represented the 4C's model of mental toughness. Although this model carries intuitive appeal, Clough et al. have been criticized for failing to explain why mental toughness constitutes a sport-specific form of hardiness (Crust, 2007). Further, the process by which the 4C's model was developed lacked scientific rigor, and little information is provided on participants, procedures, or analyses involved.

Several recent studies have attempted to formulate an operational definition of mental toughness in sport. Drawing on the experiences of elite athletes, high-level coaches and sport psychologists, various definitions have been generated. Fourie and Potgieter (2001), in an attempt to identify components of mental toughness, sought the opinions of 160 elite athletes and 131 expert coaches from a wide variety of sports. Analysis of written statements made by the athletes and coaches yielded 12 components of mental toughness: motivation level, coping skills, confidence maintenance, cognitive skill, discipline and goal-directedness, competitiveness, possession of prerequisite physical and mental requirements, team unity, preparation skills, psychological hardiness, religious convictions, and ethics. Because of the lack of conceptual clarity existing on the

mental toughness construct at the time, Fourie and Potgieter acknowledged that the themes emerging in their analysis could not be conclusively supported or rejected.

In a three-stage procedure, Jones, Hanton et al. (2002) sought to define mental toughness and to identify key attributes that are characteristic of a mentally tough performer. The study began with a focus group discussion involving three international athletes. From this, a consensus was reached among the participants on a definition of mental toughness, and necessary attributes of an ideal mentally tough performer were identified. In the second stage, individual interviews were conducted with seven additional athletes, during which each athlete was asked to generate his/her own definition of mental toughness, to comment on those definitions generated by other participants, and to offer their opinion on each of the suggested attributes. The final stage involved a review of all proposed definitions, and a collective decision among the authors on a definition that encompassed all of the key factors and elements emerging in stages one and two. Finally, all participants were asked to rate the extent to which they agreed on the chosen definition, and to rank the final attributes in terms of their relative importance to a mentally tough athlete. Emerging was the following definition of mental toughness:

> Mental toughness is having the natural or developed psychological edge that enables you to:
>
> - Generally, cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on a performer
> - Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure. (p.209)

Twelve attributes were identified by Jones, Hanton et al. (2002), which the participants believed to be an important part of being mentally tough. These attributes, ranked in order of importance, were: 1) having an unshakable self belief in your ability to achieve your competition goals; 2) bouncing back from performance set-backs as a result of increased determination to succeed; 3) having an unshakable self-belief that you possess unique qualities and abilities that make you better than your opponents; 4) having an insatiable desire and internalized motives to succeed; 5) remaining fully focused on the task at hand in the face of competition-specific distractions; 6) regaining psychological control following unexpected, uncontrollable events; 7) pushing back the boundaries of physical and emotional pain while still maintaining technique and effort under distress in training and competition; 8) accepting that competition anxiety is inevitable and knowing that you can cope with it; 9) not being adversely affected by others' good and bad performances; 10) thriving on the pressure of competition; 11) remaining fully-focused in the face of personal life distractions; and 12) switching a sport focus on and off as required.

A strength of these findings by Jones, Hanton et al. (2002) is the identification of multiple components of mental toughness, which supports the contention that mental toughness is a multifaceted construct. Also, the definition proposes mental toughness to be a psychological advantage that can be either innate or acquired through experience, suggesting it can be both a natural and/or developed phenomenon. The study, however, drew little from any theoretical frameworks, and the resulting definition described mental toughness in terms of what it allows one to *do*, as opposed to defining what mental toughness actually *is*. These limitations lead Middleton et al. (2004b) to conclude that

mental toughness had yet to be adequately defined and conceptualized. Middleton et al. (2004b) therefore sought to address the gap in previous literature by implementing a qualitative investigation which was guided by sound theory. A sample of 33 participants was selected, which comprised primarily elite athletes and included non-athletes, each with extensive experience in elite level sport through positions as coaches, psychologists, sport scientists, or management. Data were collected through semi-structured interviews ranging from 45 to 90 minute duration, during which each participant's experience of mental toughness was examined. Applying various components of categorization to the transcribed interviews, Middleton et al. (2004b) concluded that mental toughness pertains to the notion of overcoming adversity, and reported the types of adversity that were mentioned by the athletes. The authors further described 12 characteristics of mental toughness that emerged through the analyses. These characteristics included self-efficacy, mental self-concept, potential, task-specific attention, perseverance, task familiarity, personal bests, task value, goal commitment, positivity, stress minimization, and positive comparisons. It is important to note that several of these factors directly paralleled previous research findings (Fourie & Potgieter, 2001; Jones, Hanton et al., 2002) namely; self-efficacy or self-belief, task focus or attention control, motivation, mental self-concept, and coping skills. Finally, Middleton et al. (2004b) offer a preliminary definition of mental toughness as "an unshakeable perseverance and conviction towards some goal despite pressure or adversity" (Mental Toughness Definition Section, ¶ 2). The strength of this proposed definition is that it describes not only what mental toughness *is*, but considers the factors contributing to being mentally tough as well as the actions of a mentally tough performer.

Acknowledging the possibility that variations in the previously proposed definitions and attributes could apply to mentally tough athletes of different sports, Thelwell, Weston, and Greenlees (2005) sought to conceptualize mental toughness within a population of professional soccer players, and to identify the essential attributes for mental toughness within that sport. The first of two studies involved semi-structured interviews with the players, which were transcribed verbatim and analyzed by the researchers. After analysis and interpretation of the transcribed interviews, the following soccer-specific definition of mental toughness emerged:

> Mental toughness is having the natural or developed psychological edge that enables you to:
>
> - Always cope better than your opponents with the many demands (competition, training, lifestyle) that soccer places on the performer.
> - Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure. (p.328)

An important difference between the above mentioned definition and that put forth by Jones, Hanton et al. (2002) is that these soccer players believed that in order to be mentally tough you should *always* cope better than your opponents with the demands of the game rather than *generally* cope better. Ten attributes of mental toughness emerged from the interviews which were agreed upon by the research team. These were labeled as: a) having total self-belief at all times that you will achieve success; b) having the ability to react to situations positively; c) having the ability to hang on and be calm under pressure; d) having the ability to ignore distractions and remain focused; d) wanting the ball/wanting to be involved at all times; f) knowing what it takes to grind yourself out of

pressure; g) controlling emotions throughout performance; h) having a presence that affects opponents; i) having everything outside the game in control; and j) enjoying the pressure associated with performance.

The second study conducted by Thelwell et al. (2005) sought to confirm their own definition that emerged in study one, as well as to identify the importance of the ten aforementioned attributes within a wider population of soccer players. Forty-three male professional soccer players were asked to state the degree to which they agreed with the definition and to rank the ten attributes in order of perceived importance. The definition developed in the first study received strong support among this wider soccer population. Overall, Thelwell et al. demonstrated a general consensus with the Jones, Hanton et al. (2002) definition and attributes as it applies to professional soccer players.

More recently, Jones et al. (2007) examined their original definition in a population of eight super elite athletes, three coaches, and four sports psychologists, all of whom had achieved outstanding athletic success. The three-stage procedure began with focus group discussion, individual interviewing, and follow-up interviewing. Overall, the definition of mental toughness proposed by Jones, Hanton et al. (2002) was supported. Emerging from the responses were 30 attributes that participants believed to be important to a mental toughness framework, as compared to the 12 that emerged in the original study in 2002. These 30 attributes were classified under four broad dimensions; attitude/mindset, training, competition, and post-competition.

Finally, Gucciardi, Gordon, and Dimmock (2008) employed personal construct psychology as a theoretical framework in an attempt to describe mental toughness in the context of Australian football. Interviews were conducted with 11 football coaches who

had considerable playing and coaching experience at the elite level. From analysis of the transcribed interviews, the following definition emerged:

> Mental toughness in Australian football is a collection of values, attitudes, behaviors and emotions that enable you to persevere and overcome any obstacle, adversity, or pressure experienced, but also to maintain concentration and motivation when things are going well to consistently achieve your goals. (p.278)

This definition differs from those proposed before it in that it acknowledges the importance of mental toughness in positive situations as opposed to only in situations with negative effects. Further, by including several different human characteristics, this definition portrays the multidimensional nature of mental toughness.

The abovementioned qualitative studies have contributed substantially to the description and operationalization of mental toughness, as well as to the understanding of its application in sport. However, several major gaps in the area remain. With the possible exception of Clough et al. (2002), who provided minimal information regarding participants, these studies investigating the nature of mental toughness have all drawn on the knowledge of athletes at the elite (Fourie & Potgieter, 2001; Jones, Hanton et al., 2002), professional (Thelwell et al., 2005), and Olympic (Gould et al., 2002; Jones et al., 2007) level, alone or in combination with expert coaches (Fourie & Potgieter; Jones et al., 2007) or experienced sport psychologists (Jones et al., 2007; Middleton et al., 2004b). This is an important limitation to note, as the abovementioned definitions and attributes may not be generalizeable to other athletic populations. Indeed, mental toughness is a quality exhibited not only by those who have reached such an elite level, but will inevitably also be found among their less-elite counterparts, in youth populations, or

among recreational level participants. The focus on this topic must now be directed toward empirically driven research that will test the application of these findings among wider populations. Certainly, these definitions and attributes must be validated among athletes of all ages, competing at all levels, and across all sport types. Further, the relationships between mental toughness and other important constructs that are relevant to athletic success and enjoyment must be investigated. For instance, the association of mental toughness with such individual factors as self-efficacy or anxiety, and group factors as cohesion or leadership, should be examined. Importantly, the effectiveness of known mental training strategies, such as imagery and goal setting, on the development and maintenance of mental toughness must be considered. Finally, quantitative studies are required to further test the reliability and validity of the mental toughness inventories developed thus far, so as to provide thorough and accurate methods of measurement.

Measurement of Mental Toughness

Within the sporting context, mental toughness has been measured through observation as well as through self report questionnaires.

Observation

One of the only studies using an observational measure of mental toughness in sport was conducted by Davis and Zaichowsky (1998) with elite hockey players. The purpose of their study was to investigate the relationship between mental toughness and explanatory style. Measurement of mental toughness was by subjective assessment by four on-ice behaviors that were agreed by the raters to reflect mental toughness. *Adversity response* represented responding to challenge, failure, and set back with increased work and competitiveness. *Over-achievement* pertained to exceeding usual performance when

playing under stress. *Effort* involved playing with consistency and effort at the level of the athletes' ability. Finally, *enthusiasm* was represented by the player appearing enthusiastic and generating enthusiasm among teammates. Skill was subjectively assessed by the raters based on demonstrated ability. Mental toughness scores were calculated by summing the athlete's mental toughness ratings and dividing it by the overall skill rating, with a median split being used to distinguish between those who scored high and low on mental toughness. Unexpectedly, those athletes who demonstrated apparent mental toughness based on the rating criteria tended to use a pessimistic explanatory style characterized by internal, stable, and global explanations for negative events. Despite this interesting finding, this study is not without criticism. In fact, Crust (2007) suggested that the findings of this research are questionable due to the subjectivity of mental toughness ratings, a lack of justification for the five behavioral measures used, and an apparent lack of scientific rigor.

Self Report

Psychological Performance Inventory (PPI). An early utilized measure of mental toughness in sport was Loehr's (1986) PPI, a 42-item self-report questionnaire that is scored on a 5-point Likert scale, with six items measuring each of seven following subscales; self-confidence, negative energy, attention control, visualization and imagery control, motivation, positive energy, and attitude control. Despite its use in the sport psychology literature (Golby & Sheard, 2004, 2006), only recently have researchers begun to evaluate the psychometric properties of PPI (Golby, Sheard, & vanWersch, 2007; Middleton, Marsh, Martin, Richards, Savis et al., 2004). In a study evaluating the factor structure, reliability and construct validity of responses to the PPI, Middleton,

Marsh, Martin, Richards, Savis et al. (2004) administered the inventory to 263 athletes at a specialized sports high school. Confirmatory factor analysis resulted in a poor model fit to the data as well as an improper solution. Exploratory factor analysis was then implemented, which yielded a 5-factor alternative model of better fit. The factors of the alternate model, however, were less strongly correlated with key correlates of mental toughness than were the factors of the original PPI. Therefore, Middleton, Marsh, Martin, Richards, Savis et al.(2004) concluded that neither the PPI nor the alternate model adequately measured mental toughness.

Golby et al. (2007) assessed the construct validity of the PPI in a study using 408 athletes drawn from eight sports. Principal component analysis provided minimal support for the factor structure of the PPI, and further exploratory analysis resulted in a model consisting of four factors of mental toughness; determination, self-belief, positive cognition, and visualization. Golby et al. demonstrated this inventory to possess satisfactory psychometric properties, yet suggest that further studies evaluating its stability are warranted.

Mental Toughness Inventory (MTI). The MTI is a 67-item multidimensional inventory developed by Middleton et al. (2004a) to assess mental toughness. It consists of one global mental toughness factor in addition to 12 factors characteristics of mental toughness; self-efficacy, potential, mental self-concept, task familiarity, value, personal bests, goal commitment, perseverance, task focus, positivity, stress minimization, and positive comparisons. The MTI contains five items for each of the 12 factors, and seven items for the global mental toughness factor. Middleton, Marsh, Martin, Richards and Perry (2005) later sought to refine the length of the MTI and to assess its psychometric

properties across a variety of skill levels (i.e., sub-elite to elite athletes). A sample of 438 sub-elite athletes, aging from 12 to 18 years, and 292 elite athletes, aged 11 to 38 years, completed the original MTI. Confirmatory factor analyses resulted in a 36-item MTI with three items per each of the 12 factors. Further, multigroup CFA revealed the MTI factor structure to be invariant across sub-elite and elite athletes. Middleton et al. (2005) showed the revised MTI to maintain strong psychometric properties, with reliabilities of subscales ranging from .82 to .91. A limitation to the development of the revised MTI is that all data collected were cross-sectional, and therefore validation was drawn from responses given at a single point in time, and no performance data were used to distinguish between the sub-elite and elite populations. As the MTI has yet to be used extensively as a measure of mental toughness, further testing of the instrument's validity and reliability is required (Crust, 2007).

Mental Toughness 48 Inventory (MT48). Clough et al. (2002) proposed a four component model which they referred to as the 4C's model of mental toughness. The model included the original components of Control, Commitment, and Challenge from Kobasa's (1979) model of hardiness, with the addition of the fourth dimension, confidence. From this model, the authors developed the MT48, which provides scores on each of the four subscales, as well as an overall score for mental toughness. Items on the inventory are answered on a 5-point Likert scale anchored at 1 = *disagree* and 5 = *agree*. Sample items measuring each of the four components are; "*I don't usually give up under pressure*" (Commitment); "*I am generally confident in my own abilities*" (Confidence); "*I generally feel that I am in control of what happens in my life*" (Control), and "*I generally cope well with any problems that occur*" (Challenge).

Clough et al. (2002) have demonstrated the MT48 to be highly reliable, with a reliability coefficient of 0.90, and internal consistency in the subscales ranging from 0.71 to 0.80. Two studies have been conducted to establish evidence for the criterion validity of this instrument. In the first, fitness testing of participants was assessed by VO_2 Max, after which participants were asked to cycle at various degrees of workload (i.e., 30 per cent, 50 percent, and 70 percent). With higher workloads, there was a tendency for the less mentally tough to perceive the physical demands as higher. The second study required participants to complete a number of motor tasks, after which they were given either positive or negative feedback. The participants then completed a cognitive exercise as a measure of performance. The mentally tough individuals performed better on the cognitive exercise than did the less mentally tough, further supporting the MT48 as a valid measure of mental toughness. Although these studies by Clough et al. show support for the construct and criterion validity of the MT48, the authors failed to adequately describe the statistical procedures used in its development, therefore further testing of the inventory's reliability and validity is warranted. A shorter unidimensional inventory, the MT18 (Clough et al.), was developed at the same time as the MT48, for the purpose of making it more accessible and useable for sports people. The MT18 provides an overall score for mental toughness but no scores on the individual subscales. With a correlation of $r = 0.87$, the two questionnaires appear to be strongly related.

Applied Research on Mental Toughness

Mental Toughness and Performance

Several studies have demonstrated a positive relationship between mental toughness and performance. Thomas, Schlinker, and Over (1996) investigated the

psychological skills associated with prowess at ten-pin bowling. A group of bowlers, identified as either skilled or less-skilled based on recent performance in competition, were evaluated on psychological skills associated with bowling. The instrumentation used was the Ten-Pin Bowling Performance survey, which was developed specifically for the study. The survey included 95-items rated on a 5-point Likert ranging from '*strongly disagree*' to '*strongly agree*', and was designed to obtain information on the psychological and psychomotor skills of respondents. Eleven of these items on the survey were purported to measure mental toughness. The skilled bowlers reported significantly higher mental toughness, more planning and evaluation, greater confidence in equipment and technique, fewer attributions to luck, and more competitiveness, as compared to the less-skilled bowlers. A weakness of the study, with regard to establishing a relationship between mental toughness and performance, is that no information is provided on how the items on the survey were determined to be valid measures of mental toughness. Additionally, in studies evaluating the reliability of the MT48, Clough et al. (2002) showed greater performance on a cognitive planning task among more mentally tough subjects, while Crust and Clough (2005) showed a significant and positive relationship between mental toughness and performance on a weight bearing endurance task.

Mental Toughness and Injury Rehabilitation

In a sample of 70 athletes undergoing rehabilitation for tendonitis related injuries, Levy, Polman, Clough, Marchant, and Earle (2006) examined the relationship between sport injury beliefs, pain, and adherence to injury rehabilitation. Findings showed that patients who were more mentally tough, as measured by the MT18, perceived their injury to be less severe and were also less susceptible to further injury than the less mentally

tough. Further, the more mentally tough individuals were better able to cope with pain during rehabilitation. No association was emergent between mental toughness and coping appraisals. Despite the seemingly positive benefits of being mentally tough with respect to athletic injury, Levy et al. point out that mental toughness may exert negative influences on adherence to rehabilitation or recovery outcomes, perhaps because mentally tough individuals may interpret their injury as less severe, thereby underestimating the important of the rehabilitation treatment.

Mental Toughness and Other Psychological Characteristics

In a qualitative investigation of Olympic champions, Gould et al. (2002) found high reported levels of mental toughness, coping effectiveness, and optimism. Recently, Nicholls, Polman, Levy, and Backhouse (2008) examined the relationships between mental toughness and coping and optimism quantitatively. Overall, mental toughness was significantly correlated with optimism, as well as with 8 of 10 coping subscales. The authors suggest, based on these relationships, that interventions designed to improve mental toughness should include coping and optimism training.

Personal Construct Psychology Model of Mental Toughness

Only very recently have strong efforts been put forth by researchers in the area of mental toughness to establish a suitable theoretical framework for this construct. Gucciardi, Gordon and Dimmock (2009) proposed the application of personal construct psychology (PCP) in conceptualizing mental toughness in the sport setting. A contemporary interpretation of PCP's fundamental postulate is that "A person's processes, which include experiences, cognitions, affect, and behaviors, are determined by his or her efforts to make sense out of and anticipate his or her world of events,

people, and themselves" (Gucciardi et al., 2009, p. 62). Applied to a mental toughness context, the theory emphasizes the role of various mental toughness characteristics, as well as the individual's approach, appraisal and responses to a situation or event. While PCP has remained relatively ignored in the sport and exercise psychology literature, the recent application of it to describing mental toughness marks the first systematic application of established psychology theory in explaining this important construct.

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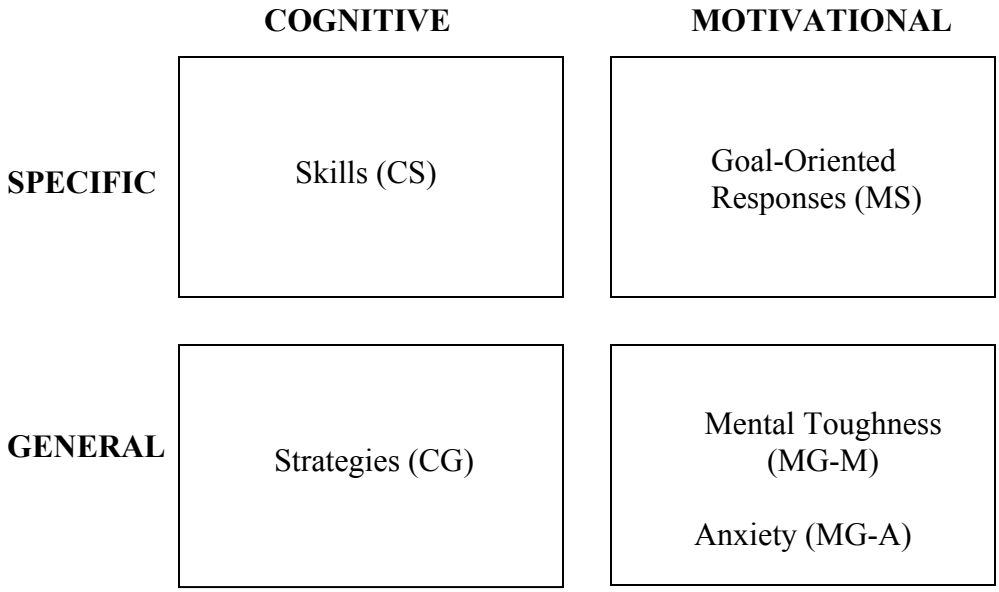
Figure Captions

Figure 1. Analytic Framework of Imagery Effects

Figure 2. Applied Model of Imagery Use in Sport

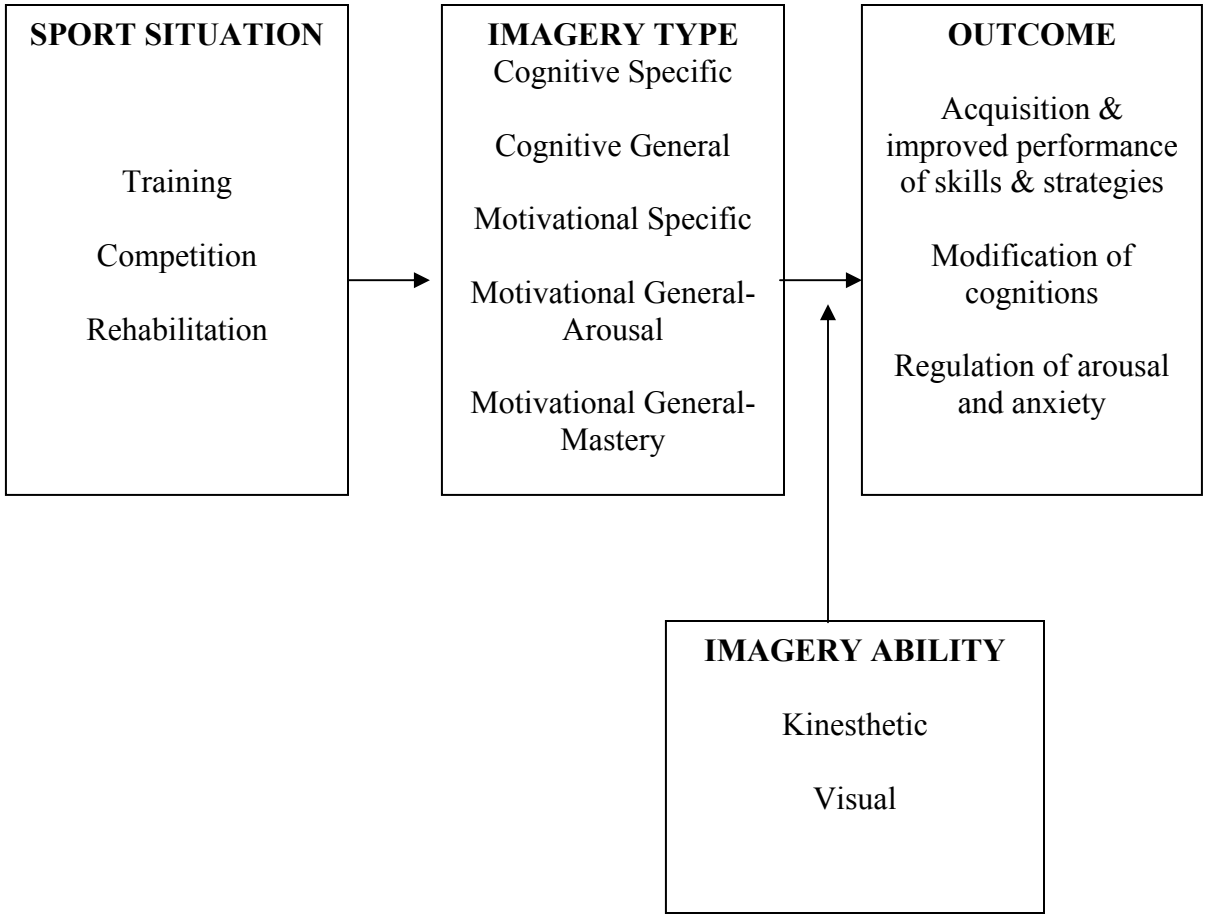
Figure 1



Adapted from:

Hall, C. R., Mack, D. E., Paivio, A., & Hausenblas, H. A. (1998). Imagery use by athletes: Development of the Sport Imagery Questionnaire. *International Journal of Sport Psychology, 29,* 73-89.

Figure 2



Adapted from:

Martin, K. A., Moritz, S. E., & Hall, C. R. (1999). Imagery use in sport: A literature review and applied model. *The Sport Psychologist, 13*, 245-268.

Appendix A

Sport Imagery Questionnaire (SIQ)

(Hall, Mack, Paivio, & Hausenblas, 1998)

Please fill in the blank or circle the appropriate answer:

Sex: M/F **Age:___** **Sport:_____**

Number of Years in Sport:____

Athletes use mental imagery extensively in their training and conjunction with competition. Imagery serves two functions. The motivational function of imagery can represent emotion-arousing situations (i.e., anxiety) as well as specific goals (i.e. scoring a goal) and goal-orientated behaviors (i.e., confidence). The cognitive function entails the mental rehearsal of skills (i.e. body positioning) and strategies of play (i.e., offensive play). This questionnaire was designed to assess the extent to which you are incorporating imagery into your sport. Any statement depicting a function of imagery you rarely use should be given a low rating. In contrast, any statement describing a function of imagery you use frequently should be given a high rating. Your ratings will be made on a seven-point scale, where 1=rarely or never engage in that kind of imagery and 7=often engage in that kind of imagery. Read each statement below and fill in the blank with the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are practicing or competing in your sport. Don't be concerned about using the same numbers repeatedly if you feel they represent your true feelings. Remember that there are no right or wrong answers, so please answer as accurately as possible.

	Rarely or never engage in that kind of imagery.						**Often engage in that kind of imagery**
1. I make up new plans/strategies in my head.	1	2	3	4	5	6	7
2. I image the atmosphere of winning a championship (e.g., the excitement that follows winning a championship).	1	2	3	4	5	6	7
3. I image giving 100%.	1	2	3	4	5	6	7
4. I can consistently control the image of a physical skill.	1	2	3	4	5	6	7
5. I imagine the emotions I feel while doing my sport.	1	2	3	4	5	6	7
6. I imagine my skills improving.	1	2	3	4	5	6	7

	Rarely or never engage in that kind of imagery.						**Often engage in that kind of imagery**
7. I imagine alternative strategies in case my event/game plan fails.	1	2	3	4	5	6	7
8. I imagine myself handling the arousal and excitement associated with my sport.	1	2	3	4	5	6	7
9. I imagine myself appearing self-confident in front of my opponents.	1	2	3	4	5	6	7
10. I imagine other athletes congratulating me on a good performance.	1	2	3	4	5	6	7
11. I imagine each section of an event/game (e.g., offense vs. defense, fast vs. slow).	1	2	3	4	5	6	7
12. I imagine myself being in control in difficult situations.	1	2	3	4	5	6	7
13. I can easily change the image of a skill.	1	2	3	4	5	6	7
14. I image others applauding my performance.	1	2	3	4	5	6	7
15. When imaging a particular skill, I consistently perform it perfectly in my mind.	1	2	3	4	5	6	7
16. I image myself winning a medal.	1	2	3	4	5	6	7
17. I image the stress and anxiety associated with my sport.	1	2	3	4	5	6	7
18. I image myself continuing with my game/event plan, even when performing poorly.	1	2	3	4	5	6	7
19. When I image myself performing, I feel myself getting psyched up.	1	2	3	4	5	6	7
20. I can mentally make corrections to physical skills.	1	2	3	4	5	6	7
21. I imagine entire plays/programs/sections just the way I want them to happen in an event/game.	1	2	3	4	5	6	7
22. Before attempting a particular skill, I imagine myself performing	1	2	3	4	5	6	7

	Rarely or never engage in that kind of imagery.						**Often engage in that kind of imagery**
it perfectly.							
23. I imagine myself being mentally tough.	1	2	3	4	5	6	7
24. When I image myself participating in sport, I feel anxious.	1	2	3	4	5	6	7
25. I imagine the excitement associated with performing.	1	2	3	4	5	6	7
26. I image myself being interviewed as a champion.	1	2	3	4	5	6	7
27. I image myself being focused during a challenging situation.	1	2	3	4	5	6	7
28. When learning a new skill, I imagine performing it perfectly.	1	2	3	4	5	6	7
29. I imagine myself successfully following my game/event plan.	1	2	3	4	5	6	7
30. I image myself working successfully through tough situations (e.g., a player short, sore ankle, etc.)	1	2	3	4	5	6	7

APPENDIX B

Mental Toughness 48 Inventory (MT48)

(Clough, Earle, & Sewell. 2002)

Please indicate your response to the following items by circling one of the numbers, which have the following meaning;

1 = strongly disagree; **2** = disagree; **3** = neither agree nor disagree; **4** = agree; **5** = strongly agree

Please answer these items carefully, **thinking about how you are <u>in sport</u>**. Answer the questions honestly, and do not spend too much time on any one item.

In sport…

	←DISAGREE				AGREE→
1) I usually find something to motivate me	1	2	3	4	5
2) I generally feel in control	1	2	3	4	5
3) I generally feel that I am a worthwhile person	1	2	3	4	5
4) Challenges usually bring out the best in me	1	2	3	4	5
5) When working with other people I am usually quite influential	1	2	3	4	5
6) Unexpected changes to my schedule generally throw me	1	2	3	4	5
7) I don't usually give up under pressure	1	2	3	4	5
8) I am generally confident in my own abilities	1	2	3	4	5
9) I usually find myself just going through the motions	1	2	3	4	5
10) At times I expect things to go wrong	1	2	3	4	5
11) "I just don't know where to begin" is a feeling I usually have when presented with several things to do at once	1	2	3	4	5
12) I generally feel that I am in control of what happens in my life	1	2	3	4	5
13) However bad things are, I usually feel they will work out positively in the end	1	2	3	4	5
14) I often wish my life was more predictable	1	2	3	4	5

15) Whenever I try to plan something, unforeseen factors usually seem to wreck it	1	2	3	4	5
16) I generally look on the bright side of life	1	2	3	4	5
17) I usually speak my mind when I have something to say	1	2	3	4	5
18) At times I feel completely useless	1	2	3	4	5
19) I can generally be relied upon to complete the tasks I am given	1	2	3	4	5
20) I usually take charge of a situation when I feel it is appropriate	1	2	3	4	5

21) I generally find it hard to relax	1	2	3	4	5
22) I am easily distracted from tasks that I am involved with	1	2	3	4	5
23) I generally cope well with any problems that occur	1	2	3	4	5
24) I do not usually criticise myself even when things go wrong	1	2	3	4	5
25) I generally try to give 100%	1	2	3	4	5
26) When I am upset or annoyed I usually let others know	1	2	3	4	5
27) I tend to worry about things well before they actually happen	1	2	3	4	5
28) I often feel intimidated in social gatherings	1	2	3	4	5
29) When faced with difficulties I usually give up	1	2	3	4	5
30) I am generally able to react quickly when something unexpected happens	1	2	3	4	5
31) Even when under considerable pressure I usually remain calm	1	2	3	4	5
32) If something can go wrong, it usually will	1	2	3	4	5
33) Things just usually happen to me	1	2	3	4	5
34) I generally hide my emotion from others	1	2	3	4	5

35) I usually find it difficult to make a mental effort when I am tired	1	2	3	4	5
36) When I make mistakes I usually let it worry me for days after	1	2	3	4	5
37) When I am feeling tired I find it difficult to get going	1	2	3	4	5
38) I am comfortable telling people what to do	1	2	3	4	5
39) I can normally sustain high levels of mental effort for long periods	1	2	3	4	5
40) I usually look forward to changes in my routine	1	2	3	4	5

41) I feel that what I do tends to make no difference	1	2	3	4	5
42) I usually find it hard to summon enthusiasm for the tasks I have to do	1	2	3	4	5
43) If I feel somebody is wrong, I am not afraid to argue with them	1	2	3	4	5
44) I usually enjoy a challenge	1	2	3	4	5
45) I can usually control my nervousness	1	2	3	4	5
46) In discussions, I tend to back-down even when I feel strongly about something	1	2	3	4	5
47) When I face setbacks I am often unable to persist with my goal	1	2	3	4	5
48) I can usually adapt myself to challenges that come my way	1	2	3	4	5

APPENDIX C

Recruitment Letter to Coaches

To (insert name of head coach)

My name is Paige Mattie, and I am a graduate student in the faculty of Kinesiology under the advisement of Dr. Krista Chandler. I am currently conducting my Masters thesis, which will investigate the relationship between imagery use and mental toughness among Varsity athletes.

Having obtained approval from Associate Athletic Director Mike Havey, I am writing to request your permission to recruit members of your Varsity team to participate in my study. Athletes who choose to participate will be asked to complete a short questionnaire measuring imagery use, and another assessing mental toughness. Questionnaires will be delivered to the athletes before a team practice which the athletes will be asked to complete at that time.

I greatly appreciate your consideration of this request. Should you have any questions at all regarding my thesis project, please do not hesitate to contact myself or Dr. Chandler.

Sincerely,

Paige Mattie
mattie@uwindsor.ca
519.253.3000, ext. 4273

Dr. Krista Chandler
chandler@uwindsor.ca
519.253.3000, ext. 2446

APPENDIX D

LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH

Examining the relationship between imagery use and mental toughness.

You are asked to participate in a research study conducted graduate student Paige Mattie and Dr. Krista Chandler from the department of Kinesiology at the University of Windsor. The results of this study will contribute to the fulfilment of Paige's Masters thesis.
If you have any questions or concerns about the research, please feel to Paige Mattie at 519-253-3000 ext. 4237 or Dr. Chandler at 519-253-3000 ext. 2446

PURPOSE OF THE STUDY

To examine the relationship between imagery use and mental toughness.

PROCEDURES

If you volunteer to participate in this study, you will be asked to complete two questionnaires. The total time required for participation is approximately 15 minutes.

POTENTIAL RISKS AND DISCOMFORTS

There are no known risks, discomforts, or inconveniences, physical or psychological associated with this research.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The information from this study may be used in subsequent studies. The researchers may gain valuable insight into how the use of imagery in sport can enhance mental toughness in sport.

PAYMENT FOR PARTICIPATION

If you participate in the study, you will be eligible to win one of 2 gift certificates of $50 value to the Riverside Keg.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The information obtained from the study will not be used for any purpose other than the present research and the communication of the results. Responses to the questionnaires will be kept secure and destroyed five years after the publication of the results.

PARTICIPATION AND WITHDRAWAL

Participation in this study is voluntary. You may refuse to answer any questions and still remain in the study. By submitting this questionnaire once it has been completed, you are consenting to participate in the present study.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE SUBJECTS

The results of this study will be posted on the University of Windsor's Research Ethics Board website by June, 2009 (http://www.uwindsor.ca/reb). If you have any additional concerns or questions, you can email or call the investigators at the address or number above. Please keep this letter of information.

SUBSEQUENT USE OF DATA

This data may not be used in subsequent studies.

RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. If you have questions regarding your rights as a research subject, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____

Signature of Investigator Date

Revised February 2008

VITA AUCTORIS

NAME:	Paige Mattie
PLACE OF BIRTH:	Antigonish, Nova Scotia, Canada
YEAR OF BIRTH:	1985
EDUCATION	University of Windsor, Windsor, Ontario 2007-2009, Master of Human Kinetics McGill University, Montreal, Quebec 2003-2007, Bachelor of Science Dr. John Hugh Gillis Regional High School, Antigonish, Nova Scotia 1999-2003
PRESENTATIONS	"Imagery Use and Mental Toughness in Varsity Athletes". Presented at Kinesiology Research Day, University of Windsor, Windsor, Ontario, March, 2009. "A Proposed Investigation of Imagery Use and Mental Toughness in Varsity Athletes". Presented at the Eastern Canadian Sport & Exercise Psychology Symposium, York University, Toronto, Ontario, March, 2009. "Measuring Physiological Changes Using an Imagery Intervention". Presented at the Canadian Society for Psychomotor Learning & Sport Psychology, Canmore, Alberta, November, 2008. "Measuring Physiological Changes Using an Imagery Intervention". Presented at Kinesiology Research Day, University of Windsor, Windsor, Ontario, April, 2008. "Measuring Physiological Changes Using an Imagery Intervention". Presented at the Eastern Canadian Sport & Exercise Psychology Symposium, Laurentian University, Sudbury, Ontario, March, 2008.

SCHOLARLY EXPERIENCES:	Canadian Society for Psychomotor Learning and Sport Psychology, Organizing Committee Faculty of Human Kinetics University of Windsor September – November, 2007
	Human Kinetics Representative Graduate Student Society University of Windsor September, 2007- August, 2008
CONFERENCES	Eastern Canadian Sport and Exercise Psychology Symposium (ECSEPS), Toronto, Ontario, 2009
	Canadian Society for Psychomotor Learning and Sport Psychology (SCAPPS), Canmore, Alberta, 2008
	North American Society for the Psychology of Sport and Physical Activity (NASPSA), Niagara Falls, Ontario, 2008
	Eastern Canadian Sport and Exercise Psychology Symposium (ECSEPS), Sudbury, Ontario, 2008
	Canadian Society for Psychomotor Learning and Sport Psychology (SCAPPS), Windsor, Ontario, 2008
	Eastern Canadian Sport and Exercise Psychology Symposium (ECSEPS), Ottawa, Ontario, 2006